



# **The Effect of Healthcare Expenditure on the Health Outcomes in Sub-Saharan African Countries**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

Health is a major component for a fulfilled life that everyone in the world desires to acquire. Governments are expected to play a vital role in providing quality health service to their people. Even though an increased health care expenditure is mostly considered as a primary contributor for an improved health outcome, empirical studies however indicate controversial results. The primary objective of this paper is to examine the effect of health expenditure on the selected health outcomes (Life Expectancy, Infant Mortality, Under-Five Mortality and Crude death) in Sub Saharan Africa. The linear dynamic generalized method of moments instrumental variable (GMM-IV) was used on a panel of 39 Sub-Saharan African Countries for the years 1995-2014. Results of this study showed that health expenditure significantly improves life expectancy and lowers infant mortality, under-five mortality & crude death in Sub Saharan Africa. The separate effects of Public and private health expenditures have also shown a significant positive relationship on life expectancy and negative on infant mortality, under-five mortality & crude death. The one period lag of health expenditure was estimated and the regression results indicated statistically significant relationship with health outcomes. In addition to health expenditure, other determinants like Gross Domestic Product (GDP) per capita, urbanization, immunization and basic drinking water brought improvement on life expectancy, infant mortality, under-five mortality & crude death. In contrast, HIV prevalence and unemployment are factors that reduce life expectancy and increase infant mortality,

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under-five mortality & crude death. This study indicated that health expenditure is an important element in attaining improved health outcome in Sub-Saharan African Countries. Therefore, increasing the amount of health expenditure allocated to the health sector yields a better health status. More on, revising policies to improve GDP per capita, immunization, urbanization and basic drinking water service, and strategies intended to reduce HIV prevalence and unemployment assure a better health outcome.

*Keywords: Health expenditure; health outcomes; GMM-IV; Sub-Saharan Africa.*

## 1. INTRODUCTION

Health is highly recognized as a key element of human capital that provides more time for working and improving utility [1]. Human capital investment is one of the major factors in assuring economic growth and sustainable development [2] and this can be realized through increased healthcare expenditure both at individual and national levels. Making more efforts on health improvement is widely considered as the main concern of any nation and this can be realized when enough health care expenditure is allocated [3]. Health expenditure comprises the delivery of health services (preventive and curative), family planning activities, nutrition activities, and emergency health aid [4].

Health expenditure per capita in Sub-Saharan African countries for the year 2000 was \$ 101.7 and later rising to reach \$ 198.7 in 2015. However and this has been reported insufficient as the health care load in the region outweighs healthcare expenditure allocations [5]. Lack of considerable attention on the role of adequate health care expenditure is one of the reasons for inadequate health resource allocation in Sub-Saharan Africa. Consequently, in 22 of the 45 Sub-Saharan African countries, health expenditure is below the minimum level of US\$ 44 per capita in 2009 and is mostly funded from aid and mortgages [6].

In recent years, Sub-Saharan African countries have continued to register the lowest health care expenditure rates as compared to other regions. For instance, health expenditure per capita in North America, European Countries, Latin American and Caribbean regions and Sub-Saharan African was about \$ 9,031, \$ 3,183, \$ 63 and \$ 84 in 2016 respectively [7]. These statistics indicate that Sub-Saharan African countries need to improve investment on health to catch up with other regions of the world.

In most countries, there are normally two sources of funds in the health sector. Health expenditures

are mainly from public and private sources. Public sources represent expenditures allocated for the health sector by governmental agencies including external donor funds whereas private sources are households who spend directly (out-of-pocket) during the time of acquiring health services. Besides, health insurance and some other non-governmental organizations aimed at offering healthcare services are also taken as part of the private source.

Governmental agencies in each country normally cover the biggest share of public health expenditure. For instance, in 2001, the Africa Union states approved the Abuja declaration aiming at improving public health spending. However, only one country in the region attained a target which was about 15% of the annual budget [8]. On the other hand, in Sub-Saharan Africa, the private health care expenditure accounts for the largest rate of total expenditure on health, with a slight change in 2010 to 55% from 61% in 1995 [9]. As part of the private sources, most citizens were required to meet much of the healthcare costs and this was a major burden on households who spent from their pocket at the time of acquiring health care services, often exceeding their capacity to pay which further lead to increased poverty levels in most households [10]. Over the years there was however increased expenditure in both categories in Sub-Saharan Africa. for instance, Public and private health expenditure per capita in Sub-Saharan Africa increase from about \$32 and \$62 in 2000 to \$69 and \$102 in 2014 respectively [7].

Health care expenditure is the key determinant on human capital investment. An increase in health care expenditures possibly increase coverage quality health services and improve the availability of basic medicines, thereby strengthen human capital, which is a potential source of improved labor productivity, better life and general wellbeing [11]. Numerous empirical studies have previously investigated the association between health expenditure and

health outcome using various proxies such as life expectancy, infant mortality, under-five mortality, and crude death. For example, [12,13, 14,15] provided evidence that an increase in health care expenditure secured a better health outcome.

Until the end of the 20<sup>th</sup> century, Sub-Saharan Africa was identified for high infant mortality and low life expectancy but from the beginning of the 21<sup>st</sup> century onwards infant mortality had declined from about 500 to 150 per 1,000 live births and the average life expectancy at birth improved from 30 to 50 years [16]. However, the role of health expenditure in attaining improved health outcome has not received much attention especially in Sub-Saharan Africa. This gap necessitated this study so as to investigate the relationship between health expenditure and four main health outcomes (Life expectancy, Infant mortality, Under-five mortality and Crude death) in Sub-Saharan Africa. More on, it examined the separate effects of public and private health expenditure on health outcomes. The problem of endogeneity was solved using linear dynamic generalized method of moment using instrumental variables as a method of estimation. The rest of this paper is organized as follows: Section two presents critical reviews of empirical literatures; section three describes empirical model and estimation techniques. The empirical results and discussion are described in section four, followed by Conclusion, Recommendation and Future Avenue.

## **2. LITERATURE REVIEW**

### **2.1 Theoretical Review**

Health is widely considered as the essential element in measuring the living condition of the people. Healthy individuals are always effective in accomplishing their tasks. In so doing, they can generate appropriate income which further allows them to lead a better status of living. Most of the literature revealed that the Grossman health theory is considered as one of the best theoretical foundations in health economics. On the basis of [1] theory, health is taken as a capital good that is not subject to an immediate depreciation. Health capital is an investment in the stock of individual's health for better well-being. Demand for Healthcare is one of the basic inputs to make investments in health capital. [1] also indicated that the health capital may raise, drop, or remain constant over time depending on various economic, social and environmental

factors such as education, age, income status, illness, and injury. Studies show that health could not be passively acquired from markets. Instead, it needs serious attention in linking time and investment on health through utilizing healthcare services. As per [1], healthcare is taken as one of the inputs in the health capital sequence that yields a better outcome on physical and mental health. In addition, he specified that economic, social and environmental determinants play a vital role as an input to bring a better health outcome. This study takes healthcare expenditure as an input and life expectancy & mortality as an outcome. This could be still similar to [1] logic in the sense that an increase in healthcare expenditure significantly affects the health care through allocating enough medical and human resources. Improved mental and physical health conditions stated as an outcome in Grossman's health theory possibly brings a better life expectancy and lower mortality. In a similar concept to that of Grossman, Wagstaff described healthcare as one of the major inputs in reaching health outcomes like low mortality and higher life expectancy [17]. Furthermore, he also noted that an improved health care service results in a longer life expectancy & lower mortality and this could be attained and is determined by the accessibility of health resources. Based on the theoretical thoughts of Grossman and Wagstaff, this study uses economic, social and environmental factors as inputs and life expectancy, infant mortality, under-five mortality and crude death as outputs.

### **2.2 Empirical Studies**

In the history of health economics, only a few Studies depict the relationship between health care expenditure and its outcome. Currently, this issue is getting attention by a number of scholars and literature in this aspect most commonly considered health expenditure as an independent variable and major health outcome proxies such as life expectancy, infant mortality, under-five mortality and crude death as a dependent variable. In addition, a number of socio-economic variables like GDP, urbanization, unemployment and HIV prevalence have been used as control variables. Available studies on the association between health expenditure and health outcomes revealed mixed results. Some of the studies proved no relationship between health care expenditures and its outcome. For instance, for the years 1995 - 2013, the effect of public health expenditure on health outcomes was studied by Popoola [18] in Tanzania. A full

Bayesian time series approach was used and results showed that government health expenditure had no impact on health outcomes like an infant and under-five mortality. In addition, an empirical investigation was carried out [19] in Nigeria to examine the association among life expectancy, public health spending and economic growth for the period 1997-2008. A vector autoregressive (VAR) model was used and the results of the study disclosed that there is no bidirectional relationship between life expectancy and public health expenditure.

Very few research works found insignificant relationships between health care spending and health outcome. For example, a study conducted by Grossman [1] explored an insignificant relationship between public health spending and infant & under-5 mortality. In addition, Burnside and Dollar [20] also revealed an insignificant relationship between health care spending and health outcomes mainly on infant mortality. Furthermore, using cross-sectional data for 50 countries, Sanjeev et al. [21] examined the relationship between public health expenditure and health outcome (infant and children) and found insignificant relationship. Finally, the role of health care expenditure in predicting health outcome (infant mortality) in 177 developed, developing and underdeveloped countries was examined by Kim and Moody [22]. The findings of the study revealed that health resources (health expenditures) have an insignificant effect on infant mortality rate. They suggest that the effect of healthcare resources on the health status of the people is low as compared to the contribution of other socioeconomic factors.

Studies reviewed below witness the relationship between health care spending and health outcomes.

A study done by Emanuele et al. [13] considered 133 low and middle- income countries for the year 1995, 2000, 2005 and 2006. Having used fixed effect panel data regression, they examined the relationship between country health spending and health outcome where infant and child mortality has been taken as proxies for the health outcome. The obtained result showed the significant effect of health care spending on reducing infant and under-five child mortality rates with an elasticity of 0.13 to 0.33 and 0.15 to 0.38 respectively.

To investigate the association between the dynamic of the inputs and the outputs of a health

care system, Cochrane et al. [15] carried out a study on 175 countries in the world for the period 1995-2010. Employing Panel data fixed effect method, a significant association between health expenditure and life expectancy has been discovered.

Based on the data collected from 18 developed countries, World Bank [16] investigated the relationship between public health expenditure and mortality rate over the period 1969 to 1971. The results indicated that higher public expenditure is related to a lower mortality rate.

Some of the scholars have also done a few studies on OECD countries to determine the effect of health care expenditure on the health outcome. Mark and Jodi [23] collected data from 20 OECD countries for the years 1960-1992 and conducted research applying health production models. They investigated the effect of public financing of health expenditures, insurance coverage and other factors on health outcome. The findings of the study showed that an increase in health expenditure resulted in a significant negative effect on the mortality rate. Accordingly, a 1% increase in public health expenditure decreases mortality rate by 0.13.

Research works focusing on the Middle East and North Africa region was conducted by Fevzi et al. [24] and they examined the impact of healthcare expenditure on a selected health outcome for 19 countries from 1990-2010. Pooled and Fixed effect panel data regression was employed and the results indicated that an increase in healthcare spending significantly affected the health outcomes by reducing infant mortality rate, under-five mortality and maternal mortality in the regions. Specific findings in public healthcare spending revealed that a percentage increase in per capita government expenditures dropped the infant mortality rate by 0.9%, the under-five mortality by 1.8%, and maternal mortality by 0.3% and a percentage increase in the private health care expenditure resulted in a reduction of the infant mortality rate by 0.9%, the under-five mortality rate by 0.3%, and maternal mortality rate by 0.09%.

A study focusing on 47 African countries was carried out by John and Andrew [25] for the period 1999-2004. Fixed effect panel data regression was used to investigate the effect of health expenditure on health outcomes (infant and under-five mortality). The results indicated that health expenditures are certainly important

contributors with a significant effect on infant and under-five mortality. However, independent findings in Sub-Sahara and North Africa countries showed variation in health outcomes with the former indicating a positive and significant association but this is not true in the case of North Africa. Results indicated that a 10% increase in total health expenditure reduced under-five and infant mortality by 21 and 22% respectively. However, a 10% increase in public health expenditure brought a reduction by 25 and 21% in under-five and infant mortality rates respectively.

In Sub-Saharan Africa, the relationship between health expenditure and its outcome is an emerging concept and only limited literature are available.

Based on the data collected from 45 Sub-Saharan African countries during the years 1995-2011, Jacob and Akanni [26] examined the relationship between health care spending and child health outcomes (infant mortality, under-five mortality and neonatal mortality). A negative and significant relationship has been obtained using Fixed and Random effect panel data regression models with elasticities of -0.11, -0.15 and -0.08 for infant mortality, under-five mortality and neonatal mortality respectively. Moreover, the effects of public health expenditure on health outcomes were investigated by Lawanson [27] over the period 2003-2007 across 45 Sub-Saharan African Countries. 2SLS and fixed effects estimates were used and results indicated that public health expenditure has a positive effect on life expectancy but negative regarding mortality rate.

The other study conducted in Sub-Saharan Africa by Carl and Romain [28] examined determinants affecting child mortality over the period 2000-2011. Panel data fixed, random effect and the instrumental variable method was used and the results disclosed a significant relationship between public health spending and under-5 child mortality rate. In addition, John and Shirin [29] studied the Effectiveness of Health Expenditure on the performance of the healthcare system in Sub-Saharan Africa for the period 1995-2011. The General method of moment technique was used and results showed a greater and immediate effect of health expenditure on immunization, malaria, AIDS and nutrition but a lower impact has been recorded for health outcomes like life expectancy and infant mortality. They further highlighted that the

effectiveness of public health expenditure in achieving its primary objective could be strengthened with an improvement in health care service delivery and better participation of female education program.

Besides, 44 countries in Sub-Sharan Africa has been considered By Jacob et al. [30] to examine the effect of health care expenditure on the health outcome over the period 1995-2010. While using fixed and random effects panel data regression models, results indicated that health care expenditure significantly increased life expectancy at birth and also significantly reduced death & infant mortality rate. More on, both public and private health care spending showed a strong and positive association related to health status although the public one had a relatively higher impact. Accordingly, a percentage increase in total, public and private health expenditures leads to an increase in life expectancy by about 0.7, 1 and 0.5 years respectively. A percentage increase in total, public and private health expenditure dropped infant mortality rate by about 3, 4 and 2 infants per 1000 live birth respectively. A percentage increase total, public and private health expenditures reduced the crude death rate by about 0.6, 0.8 and 0.4 per 1000 people.

Based on the data collected from 46 Sub-Saharan African countries during the years 2000-2015, [20] examined the effects of public health spending, HIV prevalence, child immunization, access to basic drinking water, and sanitation on health outcomes (life expectancy, infant mortality and under-five mortality). The fixed effect, random effect, and OLS estimation methods were employed and results depicted that public health expenditure, children immunization and access to basic drinking water do have a negative and significant relationship with infant and under-five mortality rate, but positively associated with HIV prevalence. On the other hand, public health expenditure, children immunization and access to basic drinking water showed a positive and strong association with life expectancy but a negative association with HIV prevalence. Specifically, a percentage increase in health expenditure per capita decreases under-five mortality and maternal mortality by about 0.5 and 0.35% respectively. He also emphasized that improving public health expenditure, provision of basic drinking water and sanitation, expanding immunization and decreasing HIV prevalence rate are important

contributors in achieving sustainable development goal in Sub-Saharan Africa.

There are also studies conducted at a national level aimed at exploring the relationship between health expenditure and health outcomes. In Nigeria, the effect of public health expenditure on health outcomes (life expectancy and infant mortality) was investigated by [3] for the years 1981-2014. Using the error correlation method as a specification technique, an increase in public health expenditure brought an improved life expectancy and reduced infant mortality. Besides, other variables such as urbanization and HIV prevalence have a significant effect on health outcomes. Specific results showed that a percentage increase in public health care spending resulted in a 0.03% improvement in life expectancy. On the other hand, an increase in public health spending decreases infant mortality rate by about 0.35% per 1000 live birth.

In Ghana, Micheal and Ramu [31] examined the effect of public health spending on health status for the years 1990-2012. They used Ordinary Least Squares and Newey-West regression techniques and results indicated that public health expenditure resulted in significant negative effect on infant mortality. More precisely, a percentage increase in public spending decreases infant mortality rate by about 0.106% per 1000 live birth.

A study done by Rhe [32] examined the effect of health expenditure on life expectancy at birth and infant mortality rate over the years 1985-2010 in Korea. Using time serious data, the obtained result showed a significant and positive effect of health care spending on the two proxies of health status with an elasticity of 0.01 to 0.02. Control variables like a number of physicians and hospital beds have also a strong contribution to the health status with an elasticity of 0.04 to 0.13. He came to the conclusion that health expenditure is likely to be effective in the long run but some of the control variables are more effective in the short run.

Using the error correlation method, Akinkngbe and Mohanoe [33] explored the relationship between public health expenditure and health status in Lesotho. The findings revealed that public health expenditure has a significant effect on life expectancy, infant and under-five mortality. Besides, other control variables like availability of physicians and immunization are also determinants for the health status.

## 2.3 Summary of Empirical Studies and Research Gaps

Literature reviewed above showed mixed results depending on different factors such as geographical location, time and method of analysis. Some studies like [13,14,15] have shown the significant impact of healthcare spending on health outcomes and others such as [34,35] found no relationship between health expenditure and health outcome. The empirical findings indicated that the exact relationship between health expenditure and health outcomes is ambiguous. This indecisive debate opened a way to conduct further study in this area. In addition, majority of the literatures have inadequacy to examine the independent effects of public and private health spending on health outcome and they considered only limited health outcome indicators. Therefore, this study examined the distinct effect of public and private healthcare expenditure on various health outcomes measured by Life expectancy, infant mortality, under-five mortality and Crude death. More on, only a few of the studies emphasized endogenous issues that resulted from an incidence of measurement errors, omitted variables, and reverse causality. Hence, this study considered the problem of endogeneity by means of linear dynamic generalized method of moment's instrumental variable (LDPD GMM-IV) as a method of estimation.

## 3. METHODOLOGY

### 3.1 Population of the Study and Data Sources

In this study purposive sampling technique was used with 39 Sub-Saharan Africa countries out of 45 being considered for the study with the period spanning from 1995 to 2014. In the sampling, countries for the selected years are chosen based on the availability of relevant data. Annual panel data was used for the period 1995-2014 and are sourced from the World Bank, world development Indicators and World Health Organization.

### 3.2 Theoretical Framework

For this study, the health production function for examining the relationship between health expenditure and health outcomes is on the basis of [36] who followed Grossman [1]. The association is expressed as follows.

$$H = (x) \tag{1}$$

Where  $H$  denotes the health output and  $x$  is a vector that stands for separate inputs to the health production function  $F$ .

Rearranging Equation (1) and substituting the value of  $x$  by different variables such as economic, social and environmental factors results in the specification as presented in equation (2) below;

$$H = F(Y, S, V) \tag{2}$$

Where  $H$  is health outcomes and  $Y, S$  &  $V$  are vectors representing economic variables, social variables and environmental variables respectively.

Equation (2) can further be re-written in its scalar form as below;

$$H = f(y_1, y_2, \dots, y_n, s_1, s_2, \dots, s_m, v_1, v_2, \dots, v_l) \tag{3}$$

Where,  $H$  represents health outcome,  $(y_1, y_2, \dots, y_n) = Y$ ;  $(s_1, s_2, \dots, s_m) = S$ ;  $(v_1, v_2, \dots, v_l) = V$  and  $n, m$  and  $l$  are different variables under each sub-groups respectively.

Equation 3 is transformed on the basis of a Cobb-Douglas production function. The health production function associates health outcomes with three major factors treated as an input of the health production system, equation (3) can be expressed as follows;

$$H = \Omega y_i^{\alpha_i} s_j^{\beta_j} v_k^{\gamma_k} \tag{4}$$

Where  $\alpha_i$  and  $\gamma_k$  represent elasticities and  $\Omega$  is a constant.

Applying logarithmic transformation of equation (4) provides equation (5) as follows;

$$\ln H = \ln \Omega + \alpha_i (\ln y_i) + \beta_j (\ln s_j) + \gamma_k (\ln v_k) \tag{5}$$

Where  $i = 1, 2, 3$ ;  $j = 1, 2$  and  $k = 1, 2$  and  $\Omega$  represents the initial health stock of the region. Variables in place of economic factors ( $y_i$ ) comprise Health Expenditure per capita ( $HE$ ), GDP per capita ( $GDP$ ) and Unemployment rate ( $UE$ ); variables representing social factors ( $s_j$ ) include Immunization rate ( $IMM$ ) and HIV prevalence rate ( $HIVP$ ) and variables representing environmental factors ( $v_k$ ) consist of access to Basic Drinking Water ( $BDW$ ) and Urbanization rate ( $UR$ ). These variables are

selected based on previous studies and the availability of data.

### 3.3 Empirical Model

For the purpose of investigating the impact of health expenditure on health outcomes represented as life expectancy, infant mortality, under-five mortality and crude death, model (1) contains health expenditure and a set of control variables. This is the standard model to examine the association between health expenditure and health outcomes. In general form, an econometric model is written as follows.

$$\ln H_{it} = \alpha_i + \alpha_1 \ln HE_{it} + \ln Z_{it} \Psi + \mu_{it} \tag{6}$$

Where  $\ln H_{it}$  is the natural logarithm of health outcomes (life expectancy, infant mortality, under-five mortality and crude death) in country  $i$  at year  $t$ ,  $\ln HE_{it}$  is the natural logarithm of health expenditure and  $Z_{it}$  are control variables which comprises: natural logarithm of GDP per capita, urbanization, unemployment, immunization, HIV prevalence and access to basic drinking water. The coefficient  $\alpha_1$  is an estimate of health expenditure and is expected to be positive for life expectancy and negative for infant mortality, under-five mortality and crude death.  $\Psi$  is the coefficient of the vector of control variables.  $\mu_{it}$  is error terms which include country and time-specific effects.

To simplify the equation using a common denominator,  $\beta_i$  is substituted in the coefficients and written as follows.

$$\ln H_{it} = \alpha_i + \beta_1 \ln HE_{it} + \beta_2 \ln GDP_{it} + \beta_3 \ln UR_{it} + \beta_4 \ln UE_{it} + \beta_5 \ln IMM_{it} + \beta_6 \ln HIVP_{it} + \beta_7 \ln BDW_{it} + \varepsilon_{it} \tag{7}$$

Where,  $H$  = Health outcomes (Life expectancy, Infant Mortality, under-five mortality, and Crude) in a country  $i$  at a time  $t$ ;  $HE$  = Total health expenditure per capita;  $GDP$  = Gross domestic product Per Capita;  $UR$  = Urbanization as a percentage of the total population;  $UE$  = Unemployment as a percentage labor force;  $IMM$  = Child immunization as a percentage of children who received vaccination;  $HIVP$  = Human immune virus prevalence as a percentage of people infected with HIV;  $BDW$  = Basic drinking water as a percentage of people having access to drinking water  $\alpha_i$  Time invariant and captures country-specific effects that were not included in the model  $\varepsilon_{it}$  The error

terms that are assumed to be normally distributed.

As a proxy for health outcomes; Life expectancy, Infant mortality, under-five mortality and Crude death rate can be specified in equation (8), (9), (10) and (11) respectively.

$$\ln LE_{it} = \alpha_i + \beta_1 \ln HE_{it} + \beta_2 \ln GDP_{it} + \beta_3 UR_{it} + \beta_4 UE_{it} + \beta_5 IMM_{it} + \beta_6 HVP_{it} + \beta_7 BDW_{it} + \varepsilon_{it} \quad (8)$$

*LE* represents a life expectancy

$$\ln IMR_{it} = \alpha_i + \beta_1 \ln HE_{it} + \beta_2 \ln GDP_{it} + \beta_3 UR_{it} + \beta_4 UE_{it} + \beta_5 IMM_{it} + \beta_6 HVP_{it} + \beta_7 BDW_{it} + \varepsilon_{it} \quad (9)$$

*IMR* stands for infant mortality rate

$$\ln UFM_{it} = \alpha_i + \beta_1 \ln HE_{it} + \beta_2 \ln GDP_{it} + \beta_3 UR_{it} + \beta_4 UE_{it} + \beta_5 IMM_{it} + \beta_6 HVP_{it} + \beta_7 BDW_{it} + \varepsilon_{it} \quad (10)$$

*IMR* stands for under-five mortality rate

$$\ln CDR_{it} = \alpha_i + \beta_1 \ln HE_{it} + \beta_2 \ln GDP_{it} + \beta_3 UR_{it} + \beta_4 UE_{it} + \beta_5 IMM_{it} + \beta_6 HVP_{it} + \beta_7 BDW_{it} + \varepsilon_{it} \quad (11)$$

*CDR* denotes crude death rate

As total health expenditure is a sum of the public and the private health expenditure, to investigate the separate effect of public and private health expenditure on the four health outcomes (Life Expectancy, Infant Mortality, under-five mortality, and Crude Death) the following models are specified in equation (12), (13), (14) and (15) respectively.

$$\ln LE_{it} = \alpha_i + \beta_1 \ln PUBE_{it} + \beta_2 \ln PVTE_{it} + \beta_3 \ln GDP_{it} + \beta_4 UR_{it} + \beta_5 UE_{it} + \beta_6 IMM_{it} + \beta_7 HVP_{it} + \beta_8 BDW_{it} + \varepsilon_{it} \quad (12)$$

$$\ln IMR_{it} = \alpha_i + \beta_1 \ln PUBE_{it} + \beta_2 \ln PVTE_{it} + \beta_3 \ln GDP_{it} + \beta_4 UR_{it} + \beta_5 UE_{it} + \beta_6 IMM_{it} + \beta_7 HVP_{it} + \beta_8 BDW_{it} + \varepsilon_{it} \quad (13)$$

$$\ln UFM_{it} = \alpha_i + \beta_1 \ln PUBE_{it} + \beta_2 \ln PVTE_{it} + \beta_3 \ln GDP_{it} + \beta_4 UR_{it} + \beta_5 UE_{it} + \beta_6 IMM_{it} + \beta_7 HVP_{it} + \beta_8 BDW_{it} + \varepsilon_{it} \quad (14)$$

$$\ln CDR_{it} = \alpha_i + \beta_1 \ln PUBE_{it} + \beta_2 \ln PVTE_{it} + \beta_3 \ln GDP_{it} + \beta_4 UR_{it} + \beta_5 UE_{it} + \beta_6 IMM_{it} + \beta_7 HVP_{it} + \beta_8 BDW_{it} + \varepsilon_{it} \quad (15)$$

Where *PUBE* and *PVTE* are Public and Private Health expenditures respectively.

### 3.4 Estimation Method

The robustness of the results was confirmed by different estimation methods. The first two estimation methods include fixed and random effect techniques respectively. The two estimation methods can allow controlling for time-invariant changes between individuals and individual specific effects associated with independent variables. Using fixed effect dummy for each country, the pure effect of health expenditure was estimated by considering the influences specific to each country. The time fixed effect results indicated that dummies for every year are zero, this confirms that health expenditures do have a direct effect on life expectancy, infant mortality, under-five mortality and crude death at a particular time. Hausman test was used to decide on the appropriate estimation technique between fixed and random effects. To overcome problems related to heteroskedasticity and autocorrelation the option robust was used. It is vital to provide attention that even if fixed and random estimators seem to be appropriate to the pooled ordinary least square, they cannot address the issue of endogeneity well [37]. The endogeneity of health expenditure has been explained by different authors such as [38,39]. Similarly, the Durbin endogeneity test result for this study indicated that health expenditure is endogenous. Estimation with these conditions could bring inconsistent and biased results. To overcome the challenges, linear dynamic panel model (LDPM) estimators were employed which is a hybrid model derived from the works of Arellano and Bover [40] and Blundell and Bond [41] and allows to run instrumental variables. LDPM is an appropriate method to solve the issue on endogeneity which is not true with the other methods like fixed and random effects. Precisely, the Generalized Method of Moments instrumental variable linear dynamic panel model is applied. For the sake of comparison, this study presents the regression results of LDPM and fixed & random effects panel data models. In the estimation process, diagnostic tests such as Wald, Arellano-Bond autocorrelation and Sargan were used to assure its validity. The significance of each explanatory variable is verified by the wald test. Arellano-Bond autocorrelation is applied to identify serial correlation in the disturbances and it ensures the consistency of the estimates. The validity of the instrument is



checked by Sargan tests of overidentifying restrictions on the essence that residual should be uncorrelated with instruments.

## 4. RESULTS AND DISCUSSION

### 4.1 Descriptive Statistics

From Table 1, the mean of life expectancy at birth (considering the average life expectancy of male and female) was 56 years across 39 countries in Sub-Saharan Africa. On average, infant mortality rate & under-five mortality per 1000 live births and crude death rate per 1000 people was projected as 69,108 and 12 respectively. Total health care spending per capita in Sub-Saharan Africa was nearly US\$190. Of this, averagely, public and private health care expenditures contribute \$106 and \$84 respectively.

Average per capita GDP was nearly \$ 2,206. In Sub-Saharan Africa, about 38% of the total population has been living in urban areas. Of the labor force, almost 10 percent were unemployed. Approximately, 71% of the children at the age of 12-23 months have received a vaccination. The average HIV prevalence rate was nearly 6.9%. However, one country has shown a maximum prevalence rate of 30%. Of the total population, on average, 58% of the people were having access to basic drinking water services. From Table 1, the average per capita GDP has the maximum value. All variables do show a positive range which indicates that the mean is normally distributed.

### 4.2 Health Expenditure and Life Expectancy at Birth

In the fourth column of Table 2, fixed effect, random effect, and dynamic panel data estimates discloses the effects of total health expenditure on life expectancy (Regression results based on equation 8). The seventh column shows the separate effects of public and private health expenditure on life expectancy (Regression results based on equation 12). The results are mainly built on the basis of dynamic linear panel data GMM model estimates. Interesting.

Health expenditure has been noticed to be one of the factors influencing health outcomes in Sub-Saharan Africa. The findings indicated that total health expenditure was found to have a positive and significant coefficient of 0.05 at 1% significant level. An increase in total per capita

health expenditure by 1% would increase life expectancy at birth by about 0.05 % in Sub-Saharan Africa. An increase in healthcare investment is likely to ensure improved healthcare services which leads to a longer life expectancy [42]. This result is consistent with [43,3,44,45,33] who found a positive and significant association between health expenditure and life expectancy. In contrast, [46, 10] found no relationship between health expenditure and life expectancy.

The finding obtained from the public health care expenditure variable provides a piece of substantial evidence that public health care expenditure possibly contributes towards improving a better life expectancy. The findings indicated that public health expenditure was found to have a positive and significant coefficient of a 0.01 at 1% significant level. A percentage increase in public health expenditure per capita would lead to about 0.01% increase in life expectancy at birth. Public health expenditure is found to be an important contributor to life expectancy, this is due to a strong effort headed to attain universal health coverage which comprises building an effective health information system, provision of medicines, expansion of preventive services and making health information campaigns and provision of public health regulatory services. These are essential public health services financed from public sources of health expenditure and plays a significant role in improving the health care services which are a root to achieve a higher life expectancy.

The findings indicated that private health expenditure was found to have a positive and significant coefficient of a 0.03 at 1% significant level. A percentage increase in private health expenditure per capita would lead to about 0.03% increase in life expectancy at birth. It is because in Sub-Saharan Africa private sources of health expenditure has got the main share of the total health expenditure. Governmental agencies in each country are supposed to cover the biggest share of investment on health. However, in Sub-Saharan Africa, public health expenditure is mostly financed from donations and loans [47]. As part of the private sources, this brings more burden on households who spend immediately from their pocket at the time of acquiring health care services. Greater private health expenditure resulted in catastrophic expenditure which leads to poverty [10].

**Table 1. Descriptive statistics for numerous pointers in Sub-Saharan Africa over the period 1995-2014**

<b>Variables</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. dev</b>	<b>Min</b>	<b>Max</b>
Life Expectancy (Total life expectancy at Birth)	780	56	7.1	43.1	74.2
Infant Mortality Rate per 1000 live birth	780	69.1	27.4	11.9	160.1
Under-Five Mortality Rate per 1000 live birth	760	108	48.5	13.6	277.4
Crude Death Rate per 1000 people	780	12	3.3	5.4	21.3
Total Health Expenditure Per Capita (Constant 2011, PPP Int.)	780	190	235.1	5.9	1768.7
Public Health Expenditure Per Capita (Constant 2011, PPP Int.)	780	106	165.7	1	1483
Private Health Expenditure Per Capita (Constant 2011, PPP Int.)	780	84	95.7	1	594.4
GDP per capita (Constant. 2010 , PPP US\$)	780	2,205.6	3,216.3	115.8	20,334
Urbanization (Percentage of Population)	780	37.8	16.6	7.2	87
Unemployment (Percentage of labor force)	780	10	7.6	0.7	39.3
Basic Drinking Water (Percentage of Population)	780	58.3	18.8	15.1	99.9
Immunization (Percentage of children who received vaccination)	780	71.5	20.4	3	99
HIV prevalence ( Percentage of people who are infected)	780	6.9	7.3	0.1	30

Source: World development indicator [58]

**Table 2. Regression results of the effects of health expenditure on life expectancy**

<b>Independent variables</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>
In (Health Expenditure)	0.0551*** (0.00500)	0.0536*** (0.00493)	0.0524*** (0.00998)			
In Health Expenditure (Public)				0.0156*** (0.00350)	0.0176*** (0.00359)	0.0107*** (0.00105)
In Health Expenditure (Private)				0.0388*** (0.00486)	0.0341*** (0.00476)	0.0287*** (0.00106)
In(GDP Per Capita)	0.0442*** (0.00724)	0.0332*** (0.00668)	0.0141*** (0.000876)	0.0450*** (0.00722)	0.0348*** (0.00669)	0.0295*** (0.000953)
Urbanization	0.367*** (0.0756)	0.0149 (0.0526)	0.0289*** (0.00437)	0.372*** (0.0759)	0.0250 (0.0532)	0.118*** (0.00493)
Unemployment	-0.246** (0.0924)	-0.186** (0.0788)	-0.0431** (0.00991)	-0.295** (0.0925)	-0.219** (0.0791)	-0.0188* (0.0109)
Immunization	0.0558*** (0.0126)	0.0761*** (0.0125)	0.187*** (0.00381)	0.0587*** (0.0129)	0.0769*** (0.0128)	0.190*** (0.00466)

Independent variables	FE	RE	DPDE	FE	RE	DPDE
HIV Prevalence Rate	-1.762*** (0.0930)	-1.571*** (0.0824)	-1.236*** (0.0108)	-1.776*** (0.0930)	-1.581*** (0.0828)	-1.536*** (0.0114)
Access to Basic Drinking Water	0.0105 (0.00759)	0.0125* (0.00745)	0.0121* (0.00214)	0.0106 (0.00760)	0.0116 (0.00748)	0.00833* (0.00216)
Constant	4.055*** (0.109)	4.314*** (0.105)	4.323*** (0.0249)	4.050*** (0.110)	4.309*** (0.106)	4.557*** (0.0250)
Number of Observation	732	732	732	732	732	732
F-Test, (p-value)	187.75 (0.000)	-	-	170.21 (0.000)	-	-
R-Squared	0.733	0.721	-	0.733	0.712	-
Wald Test $\chi^2$ , (p-value)	-	1753.51 (0.0000)	55,805.60 (0.0000)	-	1,743.17 (0.000)	64,460.21 (0.0000)
Hausman test $\chi^2$ , (p-value)	62.42 (0.0000)	-	-	64.99 (0.000)	-	-
Sargan Test $\chi^2$ , (p-value)	-	-	36.45 (0.65)	-	-	38.34 (0.32)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)	-	-	AR(2) 4.863 (0.46)	-	-	AR(2) 1.523 (0.13)
Number of Instrumental Variables	-	-	96	-	-	105

Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; DPDE- Dynamic Panel Data Model; 2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses; 3) P denotes the probability value; 4) Regression results based on equation 8 considers total health expenditure; 5) Regression results based on equation 12 comprises public and private health expenditure distinctly

**Table 3. Regression result of the effects of health expenditure on infant mortality**

Independent variables	FE	RE	DPDE	FE	RE	DPDE
In(Health Expenditure)	-0.149*** (0.0128)	-0.137*** (0.0129)	-0.204*** (0.00929)			
In Health Expenditure (Public)				-0.0434*** (0.00908)	-0.0455*** (0.00940)	-0.127*** (0.00648)
In Health Expenditure (Private)				-0.0939*** (0.0124)	-0.0784*** (0.0124)	-0.0214*** (0.00692)
In(GDP Per Capita)	-0.143*** (0.0185)	-0.138*** (0.0176)	-0.103*** (0.00687)	-0.151*** (0.0187)	-0.145*** (0.0177)	-0.110*** (0.00703)
Urbanization	-1.122*** (0.194)	-0.127 (0.143)	-1.362*** (0.0339)	-1.137*** (0.197)	-0.147 (0.145)	-1.338*** (0.0360)
Unemployment	0.163	0.408*	2.453*	0.0333	0.489*	2.522*

Independent variables	FE	RE	DPDE	FE	RE	DPDE
	(0.237)	(0.210)	(0.0560)	(0.240)	(0.212)	(0.0586)
Immunization	-0.141***	-0.219***	-0.273***	-0.154***	-0.227***	-0.314***
	(0.0323)	(0.0325)	(0.0322)	(0.0333)	(0.0336)	(0.0326)
HIV Prevalence Rate	2.050***	2.153***	2.741***	2.101***	2.177***	2.628***
	(0.238)	(0.218)	(0.0573)	(0.241)	(0.220)	(0.0586)
Basic Drinking Water	-0.0681***	-0.0924***	-0.0407***	-0.0681***	-0.0906***	-0.0345***
	(0.0194)	(0.0195)	(0.00986)	(0.0197)	(0.0197)	(0.0103)
Constant	3.363***	3.080***	2.614***	3.444***	3.126***	2.298***
	(0.268)	(0.264)	(0.181)	(0.273)	(0.269)	(0.196)
Number of Observation	736	736	736	736	736	736
F-Test, (p-value)	349.47	-	-	308.44	-	-
	(0.000)			(0.000)		
R-Squared	0.836	0.827	-	0.832	0.823	-
Wald Test $\chi^2$ , (p-value)	-	3295.32	80,983.48	-	3213.39	74,832.23
		(0.0000)	(0.0000)		(0.000)	(0.0000)
Hausman test $\chi^2$ , (p-value)	90.47 (0.0000)	-	-	84.82 (0.000)	-	-
Sargan Test $\chi^2$ , (p-value)	-	-	74.25 (0.73)	-	-	63.56 (0.13)
Arellano-Bond Autocorrelation test (AR) z-value (p-value)	-	-	AR(2) 1.70 (0.89)	-	-	AR(2) 2.23 (0.66)
Number of Instrumental Variables	-	-	91	-	-	84

Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; DPDE- Dynamic Panel Data Model; 2) t-values are for the FE Estimation, and z-values are for the RE and LPDE estimations are shown in the parentheses; 3) Where p=are the probability value; 4) Regression results based on equation 9 considers total health expenditure; 5) Regression results based on equation 13 comprises public and private health expenditure distinctly

**Table 4. Regression results of the effects of health expenditure on under-five mortality**

Independent variables	FE	RE	DPDE	FE	RE	DPDE
In (Health Expenditure)	-0.154***	-0.137***	-0.168***			
	(0.0167)	(0.00526)	(0.0175)			
In Health Expenditure (Public)				-0.0489***	-0.0599***	-0.0512***
				(0.0123)	(0.0130)	(0.00769)
In Health Expenditure (Private)				-0.106***	-0.105***	-0.0335***
				(0.0161)	(0.0169)	(0.00771)
In (GDP Per Capita)	-0.259***	-0.245***	-0.247***	-0.260***	-0.249***	-0.329***

Independent variables	FE	RE	DPDE	FE	RE	DPDE
	(0.0251)	(0.0252)	(0.00412)	(0.0249)	(0.0250)	(0.00729)
Urbanization	-2.877***	-1.746***	-0.598***	-2.937***	-1.786***	-0.548***
	(0.228)	(0.207)	(0.0256)	(0.227)	(0.207)	(0.0410)
Unemployment	0.409	0.631**	0.567**	0.533	0.748**	0.265***
	(0.326)	(0.314)	(0.0527)	(0.324)	(0.314)	(0.0771)
Immunization	-0.224***	-0.333***	-1.210***	-0.221***	-0.329***	-1.516***
	(0.0431)	(0.0445)	(0.0184)	(0.0439)	(0.0457)	(0.0304)
HIV Prevalence Rate	4.590***	4.219***	2.798***	4.619***	4.238***	3.048***
	(0.313)	(0.314)	(0.0571)	(0.312)	(0.314)	(0.0754)
Access to Basic Drinking Water	-0.132***	-0.184***	-0.393***	-0.133***	-0.186***	-0.446***
	(0.0240)	(0.0248)	(0.0123)	(0.0239)	(0.0248)	(0.0157)
Constant	8.076***	7.725***	7.510***	7.978***	7.618***	7.782***
	(0.159)	(0.161)	(0.0202)	(0.162)	(0.164)	(0.0366)
Number of Observation	732	732	732	732	732	732
F-Test, (p-value)	343.82	-	-	302.77	-	-
	(0.000)			(0.000)		
R-Squared	0.776	0.768	-	0.778	0.769	-
Wald Test $\chi^2$ , (p-value)	-	2082.91	54,705.40	-	2076.84	65,426.21
		(0.0000)	(0.0000)		(0.000)	(0.0000)
Hausman test $\chi^2$ , (p-value)	160.04	-	-	171.55	-	-
	(0.0000)			(0.000)		
Sargan Test $\chi^2$ , (p-value)	-	-	43.25	-	-	45.32
			(0.79)			(0.56)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)	-	-	AR(2)	-	-	AR(2)
			5.766			1.427
			(0.46)			(0.13)
Number of Instrumental Variables	-	-	98	-	-	107

Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; DPDE- Dynamic Panel Data Model; 2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses; 3) P denotes the probability value; 4) Regression results based on equation 10 considers total health expenditure; 5) Regression results based on equation 14 comprises public and private health expenditure distinctly

**Table 5. Regression result of the effects of health expenditure on crude death**

<b>Independent variables</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>
In(Health Expenditure)	-0.0852*** (0.0216)	-0.0521*** (0.0175)	-0.117*** (0.0242)			
In Health Expenditure (Public)				-0.0183** (0.0151)	-0.0197** (0.0140)	-0.0644*** (0.0162)
In Health Expenditure (Private)				-0.0726*** (0.0207)	-0.0325** (0.0169)	-0.0321** (0.0174)
In(GDP Per Capita)	-0.172*** (0.0312)	-0.0972*** (0.0197)	-0.0557*** (0.0179)	-0.171*** (0.0310)	-0.0985*** (0.0199)	-0.0593*** (0.0176)
Urbanization	-0.367* (0.326)	-0.404*** (0.114)	-0.522** (0.0882)	-0.390* (0.327)	-0.398*** (0.116)	-0.485** (0.0901)
Unemployment	0.305* (0.399)	0.0736 (0.220)	0.351** (0.146)	0.390* (0.398)	0.0448* (0.222)	0.288** (0.147)
Immunization	-0.201*** (0.0543)	-0.293*** (0.0490)	-0.496*** (0.0837)	-0.209*** (0.0552)	-0.292*** (0.0507)	-0.528*** (0.0818)
HIV Prevalence Rate	4.410*** (0.400)	3.313*** (0.242)	4.101*** (0.149)	4.442*** (0.400)	3.322*** (0.245)	4.014*** (0.147)
Access to Basic Drinking Water	-0.115*** (0.0327)	-0.102*** (0.0293)	-0.254*** (0.0256)	-0.114*** (0.0327)	-0.104*** (0.0294)	-0.256*** (0.0258)
Constant	2.788*** (0.450)	1.279*** (0.362)	0.703*** (0.471)	2.870*** (0.453)	1.309*** (0.366)	0.685*** (0.491)
Number of Observation	732	736	732	732	732	732
F-Test, (p-value)	54.75 (0.000)	-	-	50.19 (0.000)	-	-
R-Squared	0.443	0.419	-	0.446	0.420	-
Wald Test $\chi^2$ , (p-value)	-	623.20 (0.0000)	2,405.15 (0.0000)	-	618.14 (0.000)	2,393.61 (0.0000)
Hausman test $\chi^2$ , (p-value)	23.45 (0.0000)	-	-	76.03 (0.000)	-	-
Sargan Test $\chi^2$ , (p-value)	-	-	42.63 (0.75)	-	-	23.45 (0.41)

<b>Independent variables</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>	<b>FE</b>	<b>RE</b>	<b>DPDE</b>
Arellano-Bond Autocorrelation test (AR) z-value (p=value)	-	-	AR(2) 0.941 (0.81)	-	-	AR(2) 1.026 (0.84)
Number of Instrumental Variables	-	-	95	-	-	112

*Standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1*

*Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; DPDE- Dynamic Panel Data Model; 2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses; 3) Where p=are the probability value; 4) Regression results based on equation 11 considers total health expenditure; 5) Regression results based on equation 15 comprises public and private health expenditure distinctly*

### **4.3 Health Expenditure and Infant Mortality Rate**

In the fourth column of Table 3, fixed effect, random effect and dynamic panel data estimates indicate the effects of total health expenditure on infant mortality (Regression results based on equation 9). The seventh column shows the separate effects of public and private health expenditure on infant mortality (Regression results based on equation 13). Health expenditure has obtained to be one of the factors influencing health outcomes in Sub-Saharan Africa. As presented in model 4 of Table 3, health expenditure brings a substantial effect on infant mortality.

The findings indicated that total health expenditure was found to have a negative and significant coefficient of 0.2 at 1% significant level. An increase in total per capita health expenditure by 1% would decrease Infant Mortality per 1000 live birth by about 0.2% in Sub-Saharan Africa. An increase in health care expenditure is expected to bring improved health care services. Particularly, enough health care investments aiming at improving the quality of maternal and newborn care services would lead to a lower infant mortality rate. This result is in line with [26,48,49,12,15,50] who found negative and significant association between health expenditure and infant mortality. A study work done by [51,22] found insignificant relationship between health expenditure and infant mortality. On the other hand, other authors like [52,53] got a positive association between health expenditure and infant mortality.

The separate public and private effect on infant mortality as presented in the regression results based on equation 13, public health expenditure was found to have a negative and significant coefficient of 0.13 at 1% significant level. A percentage increase in public health expenditure per capita would lead to about 0.13% decrease in infant mortality per 1000 live birth.

The findings indicated that private health expenditure was found to have a negative and significant coefficient of 0.02 at 1% significant level. A percentage increase in private health expenditure per capita would lead to about 0.02% decrease in infant mortality per 1000 live birth. A study conducted in Sub-Saharan Africa by [30] also provided evidence that private health expenditure has a significant association with infant mortality (A percentage increase in private

health expenditure dropped infant mortality rate by 2 infants per 1000 live birth). In contrast, [54] examined a comparison study on the effects of public and private health expenditure on health outcome in Mediterranean Countries. The findings show that private health expenditures did not have any significant association with health outcome.

A strong relationship between health expenditure and infant mortality in Sub-Saharan Africa is due to the ongoing growth in health expenditure. The progressive trend in healthcare expenditure brought a strong effect in improving the health status of the infants in two ways. One is through providing several child vaccination coverages and the rest in delivering health education lessons for better care of infants. The merits listed above contributed much on reducing the number of infants dying.

Public expenditure on health in Sub-Saharan Africa has a strong influence on reducing infant mortality as compared with private health expenditure. Besides its main activity of providing healthcare facilities, the contribution of the public sector plays a vital role in child malnutrition, birth control and other preventive healthcare activities which is not normally addressed by the private one.

### **4.4 Health Expenditure and Under-five Mortality Rate**

In the fourth column of Table 4, fixed effect, random effect, and dynamic panel data estimates show the effects of total health expenditure on under-five mortality (Regression results based on equation 10). The seventh column shows the separate effects of public and private health expenditure on under-five mortality (Regression results based on equation 14).

The findings showed that total health expenditure was found to have a negative and significant coefficient of about 0.14 at 1% significant level. An increase in total per capita health expenditure by 1% would decrease Under-Five Mortality per 1000 live birth by about 0.14% in Sub-Saharan Africa. A steady increase in the health care expenditure over time is expected to bring improved health care services thereby better health outcomes. Particularly, adequate health care investments aiming at improving under-five child deaths that are avoidable and curable through vaccination and adequate nutrition. This result is in line with [55,24,13] who found



negative and significant relationship between health expenditure and under-five mortality.

The distinct public and private effect on under-five mortality as presented in the regression results based on equation 14 showed that public health expenditure was found to have a negative and significant coefficient of 0.05 at 1% significant level. A percentage increase in public health expenditure per capita would lead to about 0.05% decrease in under-five mortality per 1000 live birth. Public health expenditure is found to be an important contributor to under-five mortality. This is due to an increase in public health spending focused on launching child health programs in order to attain progress in reducing under-five mortality in Sub-Saharan Africa. Of the progress made towards achieving lower under-five mortality, spreading coverage of routine immunization, early diagnosis of childhood sickness and better community-based remedy against malaria, pneumonia, and diarrhea, had extensively mentioned.

The findings indicated that private health expenditure was found to have a negative and a significant coefficient of 0.03 at 1% significant level. A percentage increase in private health expenditure per capita would lead to about 0.03% decrease in under-five mortality per 1000 live birth. A study conducted in Sub-Saharan Africa by [56] provided evidence that private health expenditure has significant association with under-five mortality (a percentage increase in public health care expenditure resulted in saving of 6,220 children lives every day in Sub-Saharan Africa).

The results revealed that an increase in health expenditure over time reduced under-five mortality in Sub-Saharan Africa. The progressive trend in healthcare expenditure opens a way to introduce several initiatives against deaths of under-five mortality. Although the progress has varied significantly across Sub-Saharan African countries, governments have made universal immunization programs aimed at providing vaccination to protect children against several diseases such as diphtheria, tuberculosis, tetanus, polio, and measles. In addition, good malnutrition management has been established with the purpose of reducing under-five mortality.

Public expenditure on health in Sub-Saharan Africa has a strong influence in reducing under-five mortality as compared with private health expenditure. Besides its main activity of providing

healthcare services, the contribution of the public sector plays a vital role in child malnutrition, birth control and other preventive healthcare activities which is not implicitly addressed by the private one.

#### **4.5 Health Expenditure and Crude Death Rate**

In the fourth column of Table 4, fixed effect, random effect and dynamic panel data estimates indicate the effects of total health expenditure on crude death (Regression results based on equation 11). The seventh column shows a separate effect of public and private health expenditure on crude death (Regression results based on equation 15).

Health expenditure is found to be one of the factors influencing health outcomes in Sub-Saharan Africa. The findings indicated that total health expenditure was found to have a negative and significant coefficient of 0.1 at 1% significant level. An increase in total per capita health expenditure by 1% would decrease crude death per 1000 people by about 0.1 % in Sub-Saharan Africa. This result is similar with [57,58] who found a negative and significant relationship between health expenditure and crude death. A research done in particular to Sub-Saharan Africa by [30] found a significant relationship between health expenditure and crude death (a percentage increase in health expenditures lowered crude death rate by about 0.6 per 1000 people). The obtained results indicate that there is no relationship between health care expenditure and mortality. Investing more on health is expected to decrease the crude death rate. An increase in health expenditure denotes broader access to essential health care services that contribute to lowering down the death rate.

The effect of public health expenditure on crude death as presented in the regression results based on equation 6 indicated that public health expenditure was found to have a negative and significant coefficient of 0.06 at 1% significant level. A percentage increase in public health expenditure per capita would lead to a 0.06% decline in crude death per 1000 people. Public health expenditure is an important contributor to crude death and an increase in public health spending would enable to provide basic health care services that reduce the death rate.

The effect of private health expenditure on crude death as presented in the regression results

based on equation 15 indicated that private health expenditure was found to have a negative and significant coefficient of 0.03 at 5% significant level. A percentage increase in private health expenditure per capita would lead to a 0.03% decline in crude death per 1000 people. The contribution of Public health expenditure on the reduction of crude death in Sub-Saharan Africa has relatively shown a better effect than private health expenditure. Other than the basic healthcare activities, the public sector contributes a tremendous role in offering health education training which certainly enhances the awareness of the society thereby reaching a better health status. In addition, public sector extensively participates in early preventive activities that safeguard the society from being affected by several diseases.

## 5. CONCLUSION AND RECOMMENDATION

The results showed a positive and significant relationship between total, public and private health expenditures and life expectancy at birth. It also revealed negative and significant association between total, public and private health expenditures and infant, under-five and crude deaths. Therefore, an increase in total, public and private health expenditures plays a remarkable role in improving life expectancy and reducing infant, under-five, and crude deaths in Sub-Saharan Africa. Even though both public and private health expenditures are essential elements in improving health outcomes in Sub-Saharan Africa, public health expenditure had comparatively greater effect. The results clearly suggest that other determinants like GDP per capita, urbanization, immunization, and access to basic drinking water brought enhancement on the health outcomes. On the other hand, HIV prevalence rate and unemployment are also factors that reduce life expectancy and increase infant & under-five and crude deaths.

The association between health care expenditure and health outcomes is a center of attention by policymakers aimed at improving health expenditure. This study provides evidence that health expenditures are an important element in improving health outcomes and contributes new pieces of evidence for the literature on the separate effects of public and private expenditure on the health outcomes. It also provided direction on health policy amendments targeted at increasing the amount of health expenditure thereby resulting in improved health outcomes.

The main policy suggestion that can be drawn from this study is that the governments of Sub-Saharan African countries should enhance the budget allocated to the health sector. This enables the health sector to achieve health-related Millennium Development Goals, strengthen coverage of well-functioning quality health care delivery and availability of essential medicines. However, compared to other regions, the level of resources allocated to the health sector is very low in Sub-Saharan Africa. Governments should provide higher priority to the health sector in their annual budget allocation. Hence, more effort by the policymakers is expected to achieve the Abuja declaration of 2001. The declaration aspires to guide on the allocation of resources by member countries to the health sector of individual countries, it states that member countries should aim at increasing the amount allocated to the health sector to at least 15 percent of their annual national budget. In addition, public healthcare expenditure can be designed on the way to attain better health outcomes by improving child health services, maternal health services, infection disease management, child immunization coverage and HIV prevention and control programs.

An increasing governmental budget alone may not be adequate to achieve quality-based health system in the region. There is a need to diversify domestic funds for health by collecting taxes on harmful products like tobacco and alcohol. This can reduce excess consumption thereby assures better health outcomes, and improve the resources allocated for the health sector. Moreover, special attention should be paid to develop and endorse health care financing strategy focusing on raising or mobilizing funds through introducing social or community-based health insurance. Apart from its role in financing the health sector, social health insurance improves access to quality health services and it protects the society from financial burden as a means of allowing more people to use required services without suffering from out-of-pocket payment which is harmful to households' welfare. World Health Organization [50] provided evidence that in the year 2010 most of Sub-Saharan African Countries experienced the highest burden of diseases and catastrophic health expenditure. Social Health Insurance protects society from catastrophic healthcare spending by mobilizing funds to allow cross-subsidization between the rich and the poor as well as the healthy and the sic [59].

Countries need to adopt policies that will expand the immunization program to all age groups as part of the school legislation. Plus, launching a general public health education program on availability, coverage, and importance of immunization is crucial to meet the wellbeing and productivity of the population. Policies on HIV through legislation, resource allocation on programs geared towards HIV testing and availability of retroviral drugs would bring improvement on the health outcomes. More on, better health outcomes could also be attained through conducting prevention programs to reach out the vulnerable members by educating them about transmission mechanisms, risks and modes of exposure. Government policy focusing on tax reduction legislation aimed at reducing unemployment rates, improved innovation, and growth of entrepreneurship should be designed that enhance employment creating ventures, income sustainability, consumption and investment growth. These initiatives would likely promote a positive impact on health outcomes. Policies on urbanization such as devolution of resource legislation are expected to bring investment that will result in improved access to education, health care, infrastructure, basic drinking water, and housing thereby assuring a significant contribution for a better health outcome.

### **FUTURE AVENUE**

To obtain better results, it will be good if future studies could consider micro-level data on each of Sub-Saharan African Countries. More on, this study used only limited health outcome indicators and thus it will be better if future studies could address the other proxies like neonatal and adult mortality.

### **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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