THE EFFECT OF PUBLIC HEALTH EXPENDITURE ON CHILDHOOD MORTALITY IN SOUTHERN AFRICA (SADC)

By

Chamunorwa Nyamuranga

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

for the degree of

MASTER OF DEVELOPMENT POLICY

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Professor Jaeun SHIN

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Committee in charge:

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ABSTRACT

This study sought to examine the effect of public health expenditure on childhood mortality in Southern Africa region. The empirical approach uses longitudinal data sourced from the World Development Indicators (World Bank) for the period 2000-2013. Infant and under-five mortality rates were used as indicators for childhood mortality. To diminish the possible confounding influence of public health expenditures in the child mortality regressions, we use an instrumental variable approach based on Dynamic Panel estimators or the General Method of Moment (GMM). The study finds that in Southern Africa region, public health expenditure has a strong impact on reducing both infant and under-five mortality rates. Moreover, the study finds that improvements in water sanitation and female literacy all work together to reduce the plausibility of infant and under-five deaths. These findings corroborate previous related empirical evidence for developing countries. Overall, from a policy standpoint, the empirical estimates call for public health policy makers in less-industrialized regions to pay close attention to three very basic measures. These include: improved water sanitation, female literacy along with increased public spending on health as these are all important factors that can help to decrease infant and under-five fatalities in Southern Africa.

Keywords: Public Health Expenditure; Dynamic Panel Estimation; Childhood Mortality; Endogeneity Bias; Southern Africa

Dedicated to my beloved mom and late dad

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Heartfelt gratitude goes to my family for their prayers, love, unwavering support and encouragement. To my loving wife Precious Musevenzo, your love, motivation, compassion and encouragement illuminates my world. Suffice, to sum up by requesting whoever accorded any form of assistance in the accomplishment of this study, to accept my thanks with utmost sincerity.

May God bless you all.

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AIDS	Acquired Immune Deficiency Syndrome
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CPIA	Country Policy and Institutional Assessment
DHS	Demographic and Health Survey
EAG	Empowered Action Group (India)
FE	Fixed Effects
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
GNP	Gross National Product
HIV	Human Immunodeficiency Virus
MDGs	Millennium Development Goals
OLS	Ordinary Least Squares
OOP	Out- of -Pocket
RE	Random Effects
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SSA	Sub-Sahara Africa
UNAIDS	United Nations Program on HIV and AIDS
UNDP	United Nation Development Program
UNECA	United Nations Economic Commission for Africa
UNICEF	United Nations Children's Fund
WHO	World Health Organization

1 INTRODUCTION

1.1 Background of the Study and Overview

The African governments and the international community had identified the reduction of child mortality in Africa as a key priority (Grekou and Perez 2014). Hence, one of the United Nations Millennium Development Goals (MDGs) targeted at decreasing child mortality by over 60% from 1990 to 2015 in developing nations (United Nations 2000). In support of the target of this MDG, the African Union countries promised to channel at least 15% of the national budget to the health sector under the 2001 Abuja Declaration. Moreover, United Nations Sustainable Development Goals (SDGs) launched in the year 2015 indicated its commitment to reducing childhood mortality through SDG 3 target 2[1] .

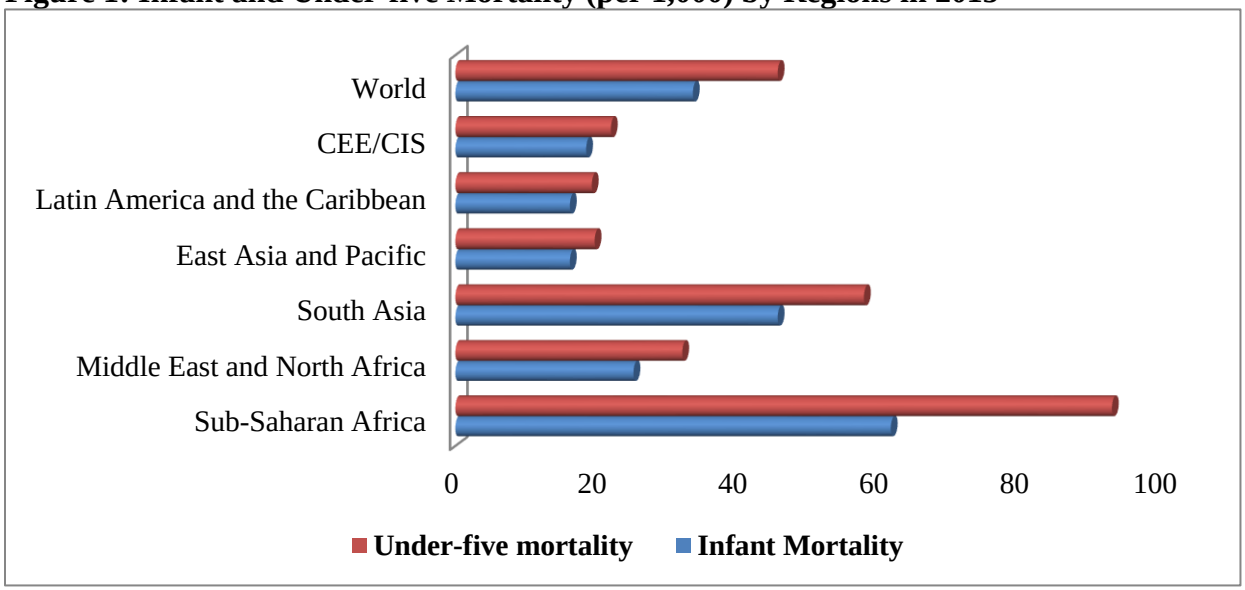
A government which prioritizes children health is likely to enhance country's economic growth in the future since healthy children are more likely to achieve high education outcomes and high labor productivity as adults (Amiri and Gerdtham 2013; Belli 2005; Stenberg et al. 2013). Thus, this possible benefit among others provides stimulus for the provision of adequate health care to children.

Between 1990- 2015, the worldwide under-five mortality rate was reduced by 47 deaths per 1,000 live births. Moreover, in Sub-Saharan Africa (SSA), inclusive of Southern African countries, when compared to the period 1990-1995, the reduction in annual rate of under-five mortality was over five times faster during 2005–2013 (MDGs Report, 2015).

[1] SDG 3 target 2: "Ensure healthy lives and promote well-being for all at all ages. By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births." (Sustainable Development Goals Report, 2016).

Nevertheless, SSA still has the highest infant and under -five mortality rates in comparison to other regions in the world as shown in Figure 1 below.

Figure 1: Infant and Under-five Mortality (per 1,000) by Regions in 2015



Source: UNICEF

Moreover, even greater differences exist in child mortality rates within SSA. West and Central Africa had the highest under-five mortality rate (113.8) compared to Eastern and Southern Africa (SADC)[2] (78.1) in 2015 (UNICEF 2015). The main contributing factor to mortality for children under-five in most Southern Africa countries remains acute lower respiratory infections; other notable causes include prematurity, diarrheal diseases, HIV/AIDS, congenital anomalies, communicable, perinatal and nutritional conditions (Table 1).

[2] SADC: (Southern African Development Community) is a regional organization consisting of 15 member countries namely; Angola, Botswana, Congo (DR), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

Table 1: Causes of death among children 0- 4 years of age in Southern African countries, 2013 (000)

	Acute lower respiratory infections	Prematurity	Communicable, perinatal and nutritional conditions	Diarrheal diseases	Congenital anomalies	Injuries	HIV/AIDS	Other
Angola	31.4	19.8	19.3	26.2	8.8	8.2	2.3	24.3
Botswana	5.8	9.7	4.9	3	4.8	2.8	2.8	6.4
Congo (DR)	16.3	12.6	11.6	10.9	4.5	5.3	1.2	16.5
Lesotho	15.8	13.1	10	9.5	5.5	5.2	9.6	13
Madagascar	9.2	6.6	6.1	5.7	3.8	4.4	0.4	8.4
Malawi	9.3	8.9	8	5.7	4.5	4.5	6.3	10.4
Mauritius	1.8	3.6	1.1	0.4	3.2	0.4	0	3.1
Mozambique	12.4	9.9	7.3	7.7	4.2	4.5	5.1	12.8
Namibia	8.6	7.2	5.3	4.5	3.6	3.6	2.5	6.5
Seychelles	0.7	3	1.9	0.1	3	1.1	0	3
South Africa	7.4	5.3	5.9	4	3.6	3.7	4.5	6.4
Swaziland	12.1	7	7.2	6.9	5.7	4.8	9.8	8.7
Tanzania	8	5.9	6	4.6	4.3	4.1	2.1	7.8
Zambia	12.5	7.3	7	6.8	4.4	4.5	4.8	9.3
Zimbabwe	10.2	10.2	9.2	7.8	5.3	5	6.8	8.1

Source: World Health Organization (WHO)

Southern Africa region[3] a sub-region within Sub-Saharan Africa, experiences the greatest serious Human Immunodeficiency Virus (HIV) epidemics in the world having 5.6 million (17.3 percent) people living with HIV (UNICEF 2015). During the period 2000- 2013 some SADC countries such as Botswana, Lesotho, Swaziland and Zimbabwe had recorded increases in infant and under-five mortality rates, largely due to HIV/AIDS-related deaths (UNECA 2015).

[3] In this paper, we will use the terms Southern Africa and SADC interchangeably.

1.2 Statement of the Problem

Public health spending and its relationship to childhood mortality remain an important area, which needs further study. The decline in under-five mortality rates between the years 2000-2015 overlapped with the increase in public health expenditure in some SSA countries (Odhiambo et al. 2015). In addition, there has been an increase in the amount of donor funding for health programs from US$ 1.4 billion in 2002 to US$ 8.7 billion in 2010 (Wexler et al. 2013). These interventions have resulted in the decline of death from malaria, measles and pertussis, infectious diseases such as cholera and from HIV/AIDS-related illnesses (WHO 2011; UNAIDS 2012).

Furthermore, improved standards of living and greater access to resources due to the growth in the real income per capita have also contributed to the reduction in infant and under-five mortality rates from the years 2000 - 2015 (Anyanwu and Erhijakpor 2007; Yaqub et al. 2012). Enhanced female literacy rates which improve mothers' capacity to consume and access children health care (Anyanwu and Erhijakpor 2007). In addition, an increased rate of women participation in labor force improves their income levels, consequently influencing the household quality of life through good nutrition (Farag, et al. 2013). Efficient resource use in the health sector might occur due to the improved quality of governance, which is due to decreased rates of corruption (Odhiambo et al. 2015; Yaqub et al. 2012; Gupta et al. 2001).

However, despite the improvement in child survival rates, studies indicate that poorer nations, as well as households, has a high concentration of poor health (Wagstaff 2000; Bhalotra 2007, Kumar and Abhishek 2013). As an example, Cutler et al. (2006), notes that in low-income countries under-five mortality accounts for 30% of the total mortality as compared to 1% in rich

countries. In addition, of the entire under-five mortality, 10 million deaths are due to avoidable illnesses, that remain uncommon in high-income countries (Kumar and Abhishek 2013 and Jones et al. 2003). Most people with low-income face challenges of a limited right to use health care services owing to inability to afford it (Preker et al. 2002). Gwatkin (2000) points out that it is people with low-income rather than the wealthy people who usually use public health facilities, therefore, public health expenditure is more crucial to the poor than to the rich (Gupta et al. 2003; Gani 2008). Increasing the health care budget expands the accessibility of health care services while reducing the cost, thereby resulting in the decline of the likelihood of child deaths (Gani 2008).

Increased public health spending is a policy instrument, which is anticipated to contribute substantially in decreasing infant and under-five mortality (Anyanwu and Erhijakpor 2007). The previous studies that assess the spending on health's impact on the reduction of childhood mortality have been inconclusive (Novignon et al. 2012). Studies found that increasing health expenditure would significantly reduce child mortality rates in SSA and other regions (Farag et al. 2013; Muldoon et al. 2011; Farahani, et al. 2010; Gani 2008; Anyanwu and Erhijakpor 2007; Bhalotra 2006; Issa and Ouattara 2005).

Nevertheless, Gupta et al. (1999) and Filmer and Pritchett (1999) found no substantial link between child mortality and health expenditure. Therefore, the question of whether public health expenditure has an impact on infant and under-five mortality is still not settled. Furthermore, existing studies on health expenditure's effect on child mortality rates have not investigated the potential regional heterogeneity across SSA sub-regions.

Given different health systems, regional integration and policies, the effect of spending on health care on child mortality in SSA may vary across sub-regions.

Consequently, this study attempts to fill in the gap in the existing body of research by examining specifically the case of Southern Africa region within SSA, which has the highest incidence of HIV/AIDS in the world and proffers region-specific policy options. To the author's knowledge, this study is among the first that explores the complex connection between public health expenditure and childhood mortality in the context of Southern Africa region within SSA. Furthermore, it is the only study about Southern Africa region, which disaggregates childhood mortality components into infant and under-five mortality to cater for the possibility of measurement errors.

1.3 Research Questions

The subsequent are research questions, which this study will aim to answer:

I. What is the effect of public health expenditure on infant mortality in Southern African countries?

II. What is the effect of public health expenditure on under-five mortality in Southern African countries?

1.4 Objectives of the Study

The broad objective of this study is to investigate whether there is a causal link between public expenditure on health care and childhood mortality measured by infant and under-five mortality rates for Southern Africa region over the period of 2000 - 2013.

This broad objective is divided into two specific objectives:

I. To investigate whether there exists a causal effect between public health care expenditure and infant as well as under-five mortality rates in Southern Africa.

II. To determine the role of economic and non-economic variables that affect infant and under-five child mortality.

1.5 Hypothesis

This study will test the hypothesis that public health care expenditure does affect infant and under-five mortality in Southern African countries.

1.6 Significance of the Study

Public spending on health's effects on childhood mortality is unknown and varies within SSA sub-regions. Such information is critical for understanding the effectiveness of public health expenditure in a specific sub-region within SSA as well as provides region-specific policy recommendations to reduce childhood mortality. It is the same thought that this study concentrates only on Southern Africa region of SSA, which in this paper we assumed the countries in that region have reasonably comparable economic and health characteristics as opposed to studying a broader sample of diverse countries. This study will elucidate the effect of public health care expenditure by examining its relationship with infant and under-five mortality rates in Southern Africa region. In addition, as discussed in previous sections, this region has the highest prevalence of HIV/AIDS in the world, several countries with high child mortality rates and mixed budget percentage towards health sector. As such, it provides an ideal sample for this study.

Furthermore, the study will be vital to the SADC policy makers by helping them to determine appropriate policy interventions to ensure that child health care is improved. Hence, this in future will ultimately safeguard the achievement of SDG 3 goal, target 2 of the United Nations Sustainable Development Goals launched in the year 2015.

1.7 Organization of the Paper

The first chapter has introduced the topic under study and the rest of the paper is organized as follows: chapter two is the literature review subdivided into theoretical literature and empirical literature. Chapter three presents the methodology used in the study. In chapter four and five study concludes with the study's major findings and policy recommendation respectively.

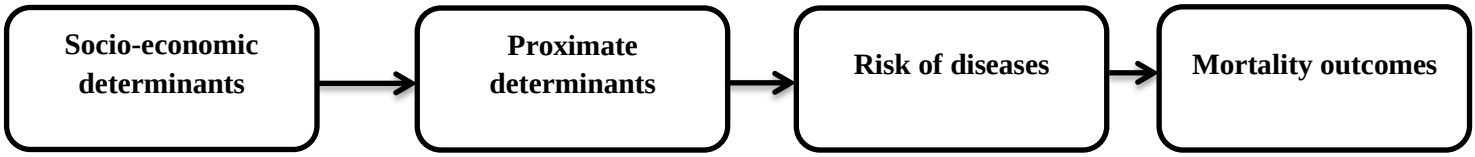
2 LITERATURE REVIEW

2.1 Theoretical Literature Review

Theoretically, connecting health care expenditure to health outcomes have created an enormous debate between health economists and medical scientists leading to different schools of thought.

2.1.1 Mosley-Chen Conceptual Model of Mortality

The model attempts to fill in the gap between medical science approach and social science approach (Mosley and Chen 1984). Moreover, the model recommends combining social and medical science research methods in dealing with infant and child mortality determinants in the least developed nations. The transmission mechanism of the model is shown below.



Source: Mosley and Chen (1984)

Mosley and Chen's argument is that the social economic status affects the proximate determinants as well as the risk of diseases that will promptly affect health and mortality outcomes. The socio-economic factors comprise of the individual, household and community level elements such as income, mother's education level, tradition, norms, nutrition, ecological setting, political economy, health system, physical infrastructure, access to information, sanitation and among others (Mosley and Chen 1984). The proximate determinants include maternal factors, contamination of the environment, deficiency of nutrients and personal illness control. According to their analysis, the model states that health outcomes (infant and child mortality) must not be analyzed as a lone cause, but it is critical to study the interrelationship across the socio-economic factors and identify the direction of causality.

2.1.2 Economic Growth Oriented Theory

Nonetheless, Filmer and Pritchett (1999) produced the economic growth oriented theory, which analyzes the connection between health care spending and health outcome from the economic theme of assessment. They opinion that macroeconomic condition as the major determinant in explaining most infant and child mortality rates differences. According to Filmer and Pritchett, public health care spending has an insignificant effect on health outcomes. However, additional empirical literature linking public spending on health and health outcomes confirmed that public spending on health has an effect on health outcomes. By way of illustration, Hamner et al. (2003) by incorporating the above-mentioned school of thought buttress the significance of public health involvement and rebut the notion that child health outcome is mainly determined by economic growth. Moreover, Rajkurmar and Swaroop (2008) offer an elucidation on the cause of varied evidence established in the relationship among public spending on health care, health sector performance as well as outcome. Rajkurmar and Swaroop argue that it is false to believe that public expenditure on health alone does not have a slight substantial effect, but, it is the quality of government effectiveness that leads to a substantial effect on the ultimate health outcome.

2.1.3 Demand for Health Theory

Finally, Wagstaff (1986) demand for health theory, which considers health care as merely an input of the numerous inputs in the health production function. In that regard, health care is acknowledged as input in the production of the commodity that is low mortality rates in addition to higher lifespan, hence health expenditure is included in the health production function.

Therefore, the government provides availability of healthcare facilities and human resources for individuals to improve their health outcome.

2.2 Empirical Literature Review

Subsequently, recognizing the significance of healthcare expenditure in reducing childhood mortality, several researchers have recently attempted to investigate the linkage between expenditure on public healthcare and health outcomes, particularly since it impacts infant and under-five mortality rates. Whereas some studies found an insignificant effect on public spending on health and childhood mortality, others have proposed that public expenditure on health care has a negative significant effect on infant and under-five mortality. Therefore, because of these mixed results, this study sheds more light using a case of Southern Africa region with high child mortality rate and HIV/AIDS prevalence rates.

2.2.1 Literature Refuting Public Expenditure on Health's Effect on Child Mortality

Musgrove (1996) as well as Kim and Moody (1992) find no evidence of public expenditure on health's effect on child mortality outcomes since the findings were statistically insignificant. Musgrove further asserts that public spending on health merely substitutes out-of-pocket (OOP) health spending and hence it has an insignificant impact on childhood mortality. In a similar vein, Burnside and Dollar (1998) confirm that health spending does not have an effect on infant mortality in low-income countries. This result conforms to that of Filmer and Pritchett (1999) who studied the impact of public expenditure on health as well as non-health elements such as education and culture in determining infant and under-five mortality in ninety-eight low-income nations. Using a multivariate regression, Filmer and Pritchett (1999) point out a very weak effect of government health spending. Filmer and Pritchett's results established a statistically insignificant impact and a change in public spending on health could explain below a seventh of 1% disparity of under-five mortality between nations. They concluded that variables such as

female education achievement, a nation's income per capita and region selection could account for 95 percent of the change in under-five mortality.

The World Bank (1995) stated that public spending on health led to the decline in infant mortality in low-income regions, nonetheless not in higher income regions in the Philippines. Furthermore, the World Bank (2004) analyzed health care spending and infant mortality using Indian states panel data during the period 1980-99. The study concluded that when linear time trend state and fixed effects are incorporated into the model, the impact of health spending on mortality rates is not statistically significant (World Bank 2004). Similarly, Kaushal et al. (2013) conducted their study on public health expenditure and its relation to childhood mortality (measured by infant and under-five mortality) in India; by means of time-series cross-sectional for the period 1985-2009. In addition, OLS, generalized least squares as well as fixed effects econometric models were used. Their findings establish an insignificant result between public spending on health and infant as well as under-five mortality for the Empowered Action Group (EAG) government regions and at the country level. Conversely, significance in the relationship between improved child survival with female literacy and state per capita income was found. They suggest that implementation of other actions accompanied by improved public expenditure on health could lessen India's child mortality rate (Kaushal et al. 2013).

Carrin and Politi (1995) investigated the effect of public spending on health and poverty reduction on health status on a sample of forty low-income countries between 1985 and 1990. They used a methodology, which estimates an equation with health status (measured by infant and under-five mortality and life expectancy,), as the regressand. Each of the variables was regressed on the Gross National Product (GNP) per capita, public spending on health to Gross

National Product (GNP) ratio and absolute poverty rate. Carrin and Politi's empirical results found that public health spending was statistically insignificant.

Gupta et al. (1999) similarly point out that the substantiation of the link between health expenditures and health outcomes is not strong. They noted that non-robustness could be because data on public expenditure on health and mortality is implausible to compare across countries. Moreover, Durlauf et al. (2005) and Temple (1999) proposed that non-robustness could be due to the fact that many of these studies faces the challenges prevalent to cross-country analysis, predominantly, the possibility of a correlation between the variable of concern and unobserved heterogeneity. Gupta et al. (2001) additionally provided proof using a sample of 70 nations to argue that public expenditure on health is essential for the well-being of low-income groups in developing countries as compared to developed countries.

Wagstaff and Cleason (2004) by using the same approach analogous to that of Filmer and Pritchett (1997), show that according to the World Bank's Country Policy and Institutional Assessment (CPIA) index, good strategies and institutions are critical contributing factors for government health spending's effects on health outcomes. Wagstaff and Cleason, highlighted that when the standards of institutions along with policies progresses (as the CPIA index improve), the effect of government spending on health and health outcomes is statistically significant.

Likewise, Rajkumar and Swaroop (2008) used an OLS regression for ninety-one high and low-income countries using annual data for the years 1990, 1997 and 2003 to examine the social results of government's expenditure on health impacts. The authors' findings confirm that countries with low level of corruption and strong governance have a greater negative impact on public health expenditure on child mortality. In addition, Rajkumar and Swaroop, pointed out

that public health care spending per se do not assure improvement of social outcomes, but sound governance factors such as efficient budget design, implementation and monitoring are critical to attaining a higher quality health status. However, their estimates might be biased, as potential endogeneity of health expenditure in the child mortality equation was not controlled.

2.2.2 Literature Supporting Public Expenditure on Health's Effect on Child Mortality

On the contrary, other studies found statistically significant results to substantiate that public health spending leads to decline in childhood mortality rates. Anyanwu and Erhijakpor (2007) illustrated using infant mortality and under-five mortality as responding variable with per capita and government expenditure on health as well as income per capita as independent variables for forty-seven African countries for the period 1999 to 2004. The authors established that total expenditure on health, encompassing the public element, is a significant contributing factor to health outcomes, whereas HIV prevalence, as well as ethnolinguistic fractionalization, are impacting significantly these outcomes. Anyanwu and Erhijakpor further discussed the implications of these results by linking it to the debate of attaining the MDGs targets.

Furthermore, Novignon et al. (2012) found that mutually public as well as private spending on health have a relationship with health outcomes, though public health expenditure effects were confirmed to be robust. They applied fixed and random effects longitudinal data methodology to investigate whether spending on health care substantially affects health outcome by way of decreasing death, infant mortality and improving life expectancy at birth, in forty-four Sub-Saharan African states covering the period 1995 to 2010. A drawback of these results is that potential endogeneity of the health expenditure variables in both infant and under-five mortality regressions were not taken into account. In the same way like Anyanwu and Erhijakpor (2007), they pointed out that in order to achieve the MDGs increasing health care spending, efficacious

public-private cooperation in apportioning spending on health care is necessary (Novignon et al. 2012).

In a study by Gottret and Scieber (2006) which covered eighty-one low income and middle-income countries, they established that 10% rise in government spending on health care has a greater effect in decreasing under-five together with maternal mortality as compared to 10% growth in education, roads and sanitation. Gottret and Scieber concluded that government health spending has a major influence under-five mortality, nonetheless a less significant influence on maternal mortality. Additionally, their study found out that for 10% rise in government health spending the decline in under-five mortality is usually one percent point below the reduction in maternal mortality.

Furthermore, Farahani et al. (2010) show that in India public spending on health resulted in the decline of women, children and elderly death probability. Similarly, Barenberg et al. (2015), applying a longitudinal data set of Indian states for the period 1983 to 1984 and 2011 to 2012, confirmed that public expenditure on health care reduces infant mortality while taking into account important controlling variables such as per capita income, female education, and urbanization. Their findings confirm that a rise in public spending on health by one percent of GDP at state-level is connected with the infant mortality rate declining by approximately eight deaths of infant per one thousand live births. Moreover, Barenberg et al. (2015), found out that female literacy and urbanization decreases the infant mortality rate.

Wang (2002) examined the contributing factors of health outcomes in developing countries at the countrywide level, and rural as well as urban zones individually employing Demographic and Health Survey (DHS) data. Wang found out that public health spending substantially reduces child mortality at the national level. In addition, Issa and Ouattara (2005)

separated expenditure on health into private as well as public and separated 160 nations into 2 clusters depending on income ranking. Their findings establish a strong negative connection between expenditure on health and infant mortality.

Gani (2008), utilizing data from Pacific Island nations over the period 1990-2002, examined per capita public spending on health's impact on infant mortality, controlling variables such as income per person, immunization, urbanization and caloric intake. The author established a statistically negative link between expenditure on health per capita and infant mortality rate. According to Gani (2008), a 10% increment in per capita, health expenditures could cause approximately 6.6% decline in infant mortality, on the average decline of two infant deaths per 1000 for the Pacific Islands. The weakness of this study is that it did not control for potential endogeneity of health expenditure.

Likewise, Farag (2010) studied the effect of health care expenditures on infant mortality using data for Eastern Mediterranean region over the period 1995-2006 using random effects model with year fixed effects that control for year-specific and country unobserved factors. Farag, also included GDP per capita, government effectiveness, as well as gender parity in secondary school education as independent variables. The findings assert that a 1% growth in spending on health care leads to 0.11% decline in infant mortality. However, the fixed effect estimator does not take into account potential endogeneity of health expenditure in infant and under-five mortality equations.

Muldoon et al. (2011) applied mixed effects linear regression study to investigate the link between mortality rates and 13 independent variables, including government and out-of-pocket expenditures on health, using a sample of 136 United Nations member countries for 2008. The authors found that out-of-pocket health expenditure is significantly linked with mortality rates.

Furthermore, health care system, corruption index and access to water and sanitation were other variables confirmed to be central in explaining variability in mortality rates (Muldoon et al. 2011).

In their research of 50 low-income nations, Gupta et al. (1999) established an empirical proof to validate the assertion that more public health expenditure lowered infant as well as child mortality rates. Likewise, Gupta et al. (2001) indicates that public spending on health decreased childhood mortality using a larger sample of seventy developing countries. In another study, Bokhari et al. (2006), using data from 127 nations, confirmed that a rise in per capita public health spending by 10% results to decline in under-five mortality rates by 3.3% on average.

Similarly, another research by Bhalotra (2007) confirmed that there was a considerable effect of public expenditure on health on infant mortality. Additionally, Wagstaff (2002) described a negative relationship among public expenditure on health and under-five mortality while treating public expenditure on health as an exogenous variable.

The above empirical review clearly demonstrates public health spending on childhood mortality has mixed or ambiguous results. These variations may be due to differences in the econometric methodology, data set, time and sample coverage. Most of them included countries in different regions without ensuring relative homogeneity in health outcomes and economic circumstances. In addition, most papers paid no special attention to the direct effect of public health expenditure on both infant and under-five mortality since they focused more on either one of the two and other independent variables.

In this regard, this paper will focus strictly on the link between public expenditure on health care and child mortality, separating the effect on infant mortality from that on under-five mortality taking into account possibility of endogeneity as well as the simultaneity bias.

3 METHODOLOGY OF THE STUDY

3.1 Methodology

Given the nature and characteristics of the problem under investigation in this study, it is incisive to empirically test the hypothesis stated in chapter 1 using the causal inference models with longitudinal data; linear dynamic panel model and static panel data estimators.

Longitudinal/panel data is a distinct case of pooled time-series cross-section in which the same cross-section such as entities (e.g. states, companies, individuals, and countries) is measured over time. In this study, the cross-section includes a sample of all developing, Sub-Saharan Africa and SADC countries, for which yearly observations of a number of variables were collected. There are some benefits and shortcomings of using panel data.[4] Some of the benefits consist of adjusting for individual heterogeneity[5], more informative data, variability, efficiency and degrees of freedom, in addition to less collinearity among the variables; permitting the building and testing of more complex behavioral models; and longitudinal unit root tests that have more power and have standard asymptotic distributions.

Regarding drawbacks, the most severe is the homogeneity assumption, and though formal tests exist that would evaluate its validity, there is a possibility of cross-sectional dependence that would obfuscate the analysis. As such, certain methods and tests need balanced panels and cross-country data consistency. Having acknowledged the advantages and disadvantages of using panel data, this study considers 3 different econometric methods to confirm the robustness of the findings across distinct techniques. Ordinary Least Squares (OLS) with pooled data will be the first estimation technique.

[4] Baltagi (2008: pp 6 – 11) gives a fine overview of the benefits and drawbacks of using longitudinal data.

[5] Unobserved heterogeneity or time-invariant variables that are correlated with independent variables (for example history, institutions and political regimes) might create omitted variable bias in time series regressions.

The weakness of the pooled OLS estimator is that it is probable to produce highly biased coefficients due to ignorance of country-specific effects as well as potential endogeneity of explanatory variables.

The second method consists of applying either Fixed Effects (FE) or Random Effects (RE) estimation methods depending on Hausman specification test. This test assesses the consistency of an estimator when compared to an alternate, less efficient, an estimator that is previously known to be consistent. Hausman specification test assumes that both RE and FE estimators are consistent and evaluates them under the null hypothesis that the RE estimator is more efficient. If the data cannot reject this null hypothesis, the RE method is preferred, and if the data can reject it, the FE method is preferred (Hausman, 1978; Wooldridge, 2012). These two techniques can solve individual as well as time effects and can adjust for heteroscedasticity. Nevertheless, FE and RE seem to be better than pooled OLS; they need certain assumptions to be fulfilled, for instance, strict exogeneity assumption. The shortcomings of RE and FE is that they are centered on country-specific effects and do not consider for stationarity, dynamics and endogeneity.

Public health spending could be potentially endogenous in infant and under-five mortality regressions in the existence of omitted variables, measurement errors and reverse causality. For example, economic adjustments, changes in demographic characteristics and political regime changes or upheavals are potential to be omitted variables correlated with public health spending. Statistical estimation compounded with these challenges may yield inconsistent and biased estimates. In order to handle the potential endogeneity, unobserved heterogeneity and country fixed effects problems, this paper uses the instrumental variable approach based on Dynamic Panel estimators or the Generalized Method of Moments (GMM) first proposed by Arellano and Bond (1991).

The GMM is the key estimation method for this paper. This provides robust estimates. Isaa and Outtara. (2005) as well as Odhiambo et al. (2015) also used this approach. The merit of the linear dynamic panel is the assumption of strict exogeneity and stationarity restrictions and its capability to derive robust results when dynamic instruments are applied. However, this study makes some modifications to these specifications in line with our hypothesis and other circumstances necessitating such changes.

One modification this study makes to the models used by Isaa and Outtara. (2005) as well as Odhiambo et al. (2015) is the inclusion of the interaction term between SADC region countries and public health expenditure to investigate the specific effect of public health expenditure in SADC countries included in the sample of all developing and SSA countries. In addition, due to small sample size of SADC countries (14) which have a high possibility of producing biased estimates as complex econometric methods are used, the study will use two large samples with 93 developing countries and 39 Sub-Saharan Africa countries. Large samples have the advantage of producing unbiased, efficient and consistent estimators. In the two samples Health expenditure, public (% of GDP)*SADC variable is included to examine the precise effect of public expenditure on health in Southern Africa region.

3.2 Model specification

Two models are specified to examine public health spending's effect on child mortality. The first model contains health expenditure and a set of control variables. The baseline model to investigate SADC countries specific public health care spending's effect on child mortality takes the form:

$$Mortality_{it} = \alpha_i + \beta_1 PubH\exp_{it} + \beta_2 PubH\exp_{it} * SADC_{it} + \phi X_{it} + \varepsilon_{it}, i=1\ldots,N \text{ and } t=1\ldots,T\ldots\ldots(1)$$

Where $Mortality_{it}$ is the dependent variable defined by infant and under-five mortality rates, $PubH\exp_{it}$ are public health expenditure, $PubH\exp_{it} * SADC_{it}$ is the interaction of SADC countries and public health expenditure. X_{it} is a vector of socioeconomic control variables believed to influence child mortality. The control variables consist of GDP per capita, improved water source, HIV/AIDS prevalence, female literacy, urbanization, immunization and female fertility. ϕ is a vector of coefficient estimates of the control variables, i= 1,….., N and t = 1,….., T are correspondingly the distinct and temporal magnitudes of the panel, α_i the country fixed effects and ε_{it} is an idiosyncratic error term.

Furthermore, to cater for potential endogeneity of public health expenditure and all explanatory variables, the study introduce the dynamic panel model (GMM) instrumental variable which employs moment conditions whereby lags of the dependent variable and first differences of the exogenous variables are instruments for the first-differenced equation. The simplified equation is as follows:

$$Mortality_{it} = \alpha_i + \gamma_1 Mortality_{it-1} + \gamma_2 PubH\exp_{it} + \phi X_{it} + \varepsilon_{it} \quad \text{.....(2)}$$

Where $Mortality_{it-1}$ is lagged childhood mortality to account for robustness the dynamics of adjustment for childhood mortality. Finally, to investigate public expenditure on health's direct impact on child mortality in SADC countries, we estimate the following equation:

$$Mortality_{it} = \alpha_i + \gamma_1 Mortality_{it-1} + \gamma_2 PubH\exp_{it} + \gamma_3 PubH\exp_{it} * SADC_{it} + \phi X_{it} + \varepsilon_{it} \quad \text{.....(3)}$$

$PubH\exp_{it} * SADC_{it}$ is an interaction term between public health expenditure and SADC which account for public health expenditure's direct efficacy on child mortality in SADC countries.

To cater for the possibility of heteroscedasticity and raise the confidence level of the findings, robust standard errors are applied.

3.3 Definition of Variables

As mentioned earlier, the dependent variable is childhood mortality, which is separated into two equations for infant and under-five mortality. The key explanatory variables are public health expenditure as a percentage of GDP and interaction term between public health expenditure as a percentage of GDP and SADC countries. The control variables are HIV/AIDS prevalence, real GDP per capita, female literacy, total fertility rate, improved water source, urbanization rate and immunization.

Infant mortality rate this is the dependent variable defined as the number of infants that die before living for one year, per one thousand live births in a given year. It averaged 84.8 in the year 2000 and declined to 45.5 in 2013 in the SADC region.

Under-five mortality rate this is also a dependent variable and defined as the probability per one thousand that a newborn will die afore aged 5 years, if subject to age-specific mortality rates of the identified year. In the Southern African region, the under-five mortality averaged 136.1 in 2000 and declined to 66 in 2013 (UNICEF 2015).

Public health expenditure comprises of recurrent and capital spending from the government budget, outside borrowings and grants (comprising donations from NGOs and global aid organizations), as well as social health insurance funds. In this study, it is measured by public health expenditure as a percentage of GDP. In 2013, only two countries in SADC region (Malawi and Swaziland) were compliant with the Abuja pledge. However, in most SADC countries, the public health expenditure had improved during the period 2000-2013.

Public health expenditure*SADC is the interaction term to determine the effect of public health expenditure in Southern African countries.

GDP per capita indicates the income level or proxy for standard of living of a country. A country's capacity to spend on healthcare is influenced to a certain degree by its income level measured by GDP per capita. Previous empirical studies specify that income is the main determining factor of healthcare expenditure. Moreover, the economic theory claims that all else being equal; the amount of government healthcare expenditure should be determined by its income level. Consequently, as the country's income level increases, its healthcare budget rises as well, holding all other factors constant. This will enhance the ability of government and other players to provide additional improved health care and enhancement in access because of higher quality infrastructure.

Female literacy refers to the percentage of females aged fifteen and beyond who can mutually read and write with comprehending a small easy account about their daily life. In literature, it is claimed that female literacy (as well representative of gender equality) is a significant element of infant and children health outcomes, as well as the overall population. In developing nations, women perform a vital duty in sanitation and family health. Female education is negatively associated with fertility rates as well as positively related to infants and children health. Moreover, mothers with higher education level are apparent to be more conscious of their children's nutrition and health, which will influence their children's survival chances. Due to data limitations on female literacy rate, Net enrollment ratio, primary, female (%) from the World Bank Indicators was used as a proxy to measure female literacy.

Urbanization rate is used to capture the ratio of the population living in towns. The justification for the addition of this variable in the model is that most urban areas are linked with higher

possibilities of getting contagious diseases. Moreover, people in urban areas can access healthcare facilities easily and have the lower health private cost for instance transport cost and time to healthcare facilities. Thus, more people in urban areas tend to use healthcare facilities than rural dwellers that could not have access to a proper healthcare facility.

HIV/AIDS prevalence refers to the percentage of people ages 15-49 that are infected with HIV. With five million and six hundred thousand HIV-infected people (17.3%), the Southern African region experiences HIV of the highest severity among other regions of the world. During the period of 2000 to 2013, some SADC countries such as Botswana, Lesotho, Swaziland and Zimbabwe had recorded increases in infant and under-five mortality rates, largely due to HIV/AIDS-related deaths (UNECA 2015).

Improved water source denotes to the percentage of the total population utilizing an improved drinking water source. The improved drinking water source comprises of piped water on dwellings as well as other improved sources of potable water such as public taps, boreholes, protected (wells and springs), and rainwater gathering.

Fertility rate is an indicator of household size and population. It is the average number of children that would be born to a woman throughout her reproductive lifespan assuming she experienced current age-specific fertility rates. High fertility implies more children, hence high health costs for pregnant women as well as children and positive effect on childhood mortality is expected.

Immunization measures the percentage of children aged 12-23 months who were vaccinated before 12 months. A child is considered effectively immunized against measles once received one dose of vaccine.

Table 2: Summary Statistics

VARIABLES	Obs	Mean	Std. Dev	Min	Max
Infant mortality rate (per 1,000 live births)	1,302	46.71	29.54	3.800	143.3
Under-five mortality (per 1,000 live births)	1,302	68.07	50.46	5	235.8
Health expenditure, public (% of GDP)	1,300	2.781	1.458	0.045	11.28
SADC* Health expenditure, public (% of GDP)	1,300	0.500	1.334	0	9.087
GDP per capita, PPP (current international $)	1,291	5,218	4,637	399.9	24,194
Improved water source (% of population with access)	1,300	77.52	16.92	28.90	99.90
Prevalence of HIV, total (% of population ages 15-49)	1,302	3.013	5.720	0.100	29.10
Female literacy, Net enrolment rate, primary, female (%)	849	81.39	17.52	22.10	99.90
Urban population (% of total)	1,302	45.14	19.48	8.246	91.45
Immunization, measles (% of children ages 12-23 months)	1,302	81.44	16.64	16	99
Fertility rate, total (births per woman)	1,302	3.788	1.637	1.085	7.738

3.4 Expected Results

Given the models specified in equations 1-3 above, the variables' expected coefficient results are as follows:

Variable	**Expected Sign**
Health expenditure, public (% of GDP)	Negative
Health expenditure, public (% of GDP)*SADC	Negative
Improved water source (% of population with access)	Negative
Female literacy	Negative
GDP per capita, PPP (current international $)	Negative
Urban population (% of total)	Negative
Prevalence of HIV, total (% of population ages 15-49)	Positive
Fertility rate, total (Births per woman)	Positive
Immunization	Negative

3.5 The Data and Sources

The study utilized balanced longitudinal data set from a sample of 93 all developing nations, inclusive of 39 SSA countries and 14 Southern African countries from years 2000 to 2013, sourced from the World Development Indicators (World Bank). The choice of the sample countries was based on World Bank classification of developing countries and data availability on variables of interest (See Appendix 1).

4 RESULTS AND DISCUSSION

This section will provide a detailed account of the findings obtained from employing pooled OLS, FE/RE and GMM estimators from equations 1-3. Table 3 and 5, show general empirical results from regression established on a sample of 93 developing nations. Table 4 and 6 show results from 39 Sub-Saharan Africa countries and in all regressions there is an interaction variable of Health expenditure, public (% of GDP)*SADC to assess SADC region-specific effect.

Table 3: Results of Infant Mortality- All Developing Countries Sample

VARIABLES	(1) **Pooled OLS with SADC**	(2) **Fixed Effects with SADC**	(3) **GMM without SADC**	(4) **GMM with SADC**
Health expenditure, public (% of GDP)	-1.427***	0.291	-0.198**	-0.0232
	(0.287)	(0.586)	(0.0943)	(0.0477)
Health expenditure, public (% of GDP)*SADC	2.132***	-1.051		-0.542***
	(0.651)	(1.101)		(0.121)
GDP per capita, PPP (current international $)	-0.926***	-0.523**	0.0152	0.0171
	(0.107)	(0.247)	(0.0356)	(0.0335)
Improved water source	-0.150***	-0.829***	-0.0618	-0.0740
	(0.0532)	(0.195)	(0.0472)	(0.0487)
Prevalence of HIV	0.731***	1.654**	0.300**	0.323*
	(0.137)	(0.781)	(0.151)	(0.171)
Female literacy	-0.380***	-0.405***	-0.0381***	-0.0376***
	(0.0429)	(0.0822)	(0.0138)	(0.0139)
Urbanization	-0.0180	-0.464	-0.0653	-0.0540
	(0.0275)	(0.285)	(0.0427)	(0.0392)
Immunization	-0.333***	-0.0994*	-0.00793**	-0.00882**
	(0.0456)	(0.0506)	(0.00348)	(0.00343)
Fertility rate	5.265***	0.613	0.326	0.215
	(0.466)	(2.291)	(0.330)	(0.299)
Infant mortality$_{t-1}$			0.868***	0.869***
			(0.0320)	(0.0342)
Constant	102.0***	167.6***	14.45**	14.98**
	(5.827)	(24.05)	(6.009)	(6.269)
Observations	843	843	617	617
R-squared	0.849	0.769		
Number of country		93	90	90

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*
Fixed effects method is preferred for the estimation of the infant mortality equation based on Hausman test (Prob> Chi^2= 0.000).

In general, the results are consistent with the empirical evidence documented in the literature. Public health expenditure is highly significant at 1% level in the pooled OLS and at 5% level in GMM without SADC. The coefficient of this variable is -0.198 and -1.427 implying that a 1% increase in public health expenditure will reduce infant mortality by 0.198% and 1.43% in developing countries. Public health expenditure and SADC interaction term is significant at 1% level in both pooled OLS and GMM with SADC methods. In the GMM with SADC, it has a coefficient of -0.54 indicating that a 1% increase in public health expenditure will result in 0.54% decline in infant mortality in Southern Africa countries. The variable has a positive sign in pooled OLS indicating the possibility of results inconsistency of the method due to endogeneity and unobserved country-specific heterogeneity that may influence childhood mortality.

In the case of other variables GDP per capita is only significant in two regressions, 1% level in pooled OLS and 5% level in fixed effects. Improved water source is significant in only two regressions at 1% level in both pooled OLS and fixed effects. As expected HIV prevalence is significant in three regressions, at 1% level in pooled OLS, 5% level in both fixed effects and GMM without SADC. The estimated coefficient of this variable ranges between 0.30 and 1.65. Female literacy is significant at 1% level in all four regressions with -0.038 to -0.405 estimated coefficients respectively. Immunization is significant at 1% in pooled OLS and 5% in both GMM without SADC and GMM with SADC. Fertility is only significant at 1% level in pooled OLS with an estimated coefficient of 5.265. The lagged dependent variable is statistically significant across infant mortality in both GMM estimators, suggesting an important past effect on the current infant mortality rate.

Table 4: Results of Infant Mortality- Sub-Saharan Africa Sample

VARIABLES	(1) Pooled OLS with SADC	(2) Random Effects with SADC	(3) GMM without SADC	(4) GMM with SADC
Health expenditure, public (% of GDP)	-1.002	0.196	-0.364**	-0.00929
	(0.824)	(0.820)	(0.152)	(0.110)
Health expenditure, public (% of GDP)*SADC	1.853*	-0.717		-0.626***
	(0.973)	(0.967)		(0.134)
GDP per capita, PPP (current international $)	-2.933***	-0.590	0.134	0.198
	(0.554)	(0.738)	(0.288)	(0.252)
Improved water source	-0.0886	-0.805***	-0.198**	-0.212**
	(0.0735)	(0.255)	(0.0879)	(0.0849)
Prevalence of HIV	1.329***	1.210***	0.288	0.308
	(0.244)	(0.420)	(0.200)	(0.220)
Female literacy	-0.383***	-0.430***	-0.0409**	-0.0425**
	(0.0560)	(0.105)	(0.0167)	(0.0168)
Urbanization	0.317***	-0.209	0.0192	0.0141
	(0.0733)	(0.307)	(0.140)	(0.123)
Immunization	-0.340***	-0.110	-0.00734	-0.0137**
	(0.0569)	(0.0720)	(0.00676)	(0.00693)
Fertility rate	7.409***	5.406	0.562	0.542
	(1.046)	(4.004)	(0.864)	(0.826)
Infant mortality$_{t-1}$			0.831***	0.828***
			(0.0469)	(0.0497)
Constant	75.47***	136.2***	21.34**	22.81***
	(9.244)	(34.61)	(8.591)	(8.463)
Observations	336	336	239	239
R-squared	0.654			
Number of country		39	37	37

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*
Random effects method is preferred for the estimation of the infant mortality equation in SSA based on Hausman test (Prob> Chi^2= 0.103).

Unlike in all developing countries sample, public health expenditure is only significant at the 1% level in GMM without SADC in Sub-Saharan Africa sample. Our hypothesis is confirmed by the statistical results of public health expenditure and SADC interaction variable, which is only significant in dynamic regression with an estimated coefficient of -0.626, implying that a 1% increase in public health expenditure will result in 0.63% reduction in infant mortality in Southern Africa region.

For control variables, GDP per capita is significant at 1% level in only pooled OLS. Improved water source is significant in three regressions, 1% level in random effects and 5% level in both dynamic regressions. HIV prevalence is significant at 1% level in pooled OLS and random effects. Female literacy is significant in all four regressions, highly significant at the 1% level in pooled OLS as well as random effects and 5% in both GMM regressions. Immunization significant at 1% level in pooled OLS and 5% in GMM with SADC. Fertility is only significant at 1% level in pooled OLS.

Table 5: Results of Under-five Mortality- All Developing Countries Sample

VARIABLES	(1) Pooled OLS with SADC	(2) Fixed Effects with SADC	(3) GMM without SADC	(4) GMM with SADC
Health expenditure, public (% of GDP)	-0.635	0.815	-0.352***	-0.166
	(0.394)	(1.032)	(0.123)	(0.117)
Health expenditure, public (% of GDP)*SADC	1.717*	-2.449		-0.566**
	(0.988)	(1.854)		(0.228)
GDP per capita, PPP (current international $)	-0.657***	-0.162	0.109	0.112
	(0.151)	(0.383)	(0.0858)	(0.0845)
Improved water source	-0.168**	-1.582***	-0.0700	-0.0841
	(0.0796)	(0.356)	(0.0928)	(0.0947)
Prevalence of HIV	1.315***	3.680***	0.642**	0.679**
	(0.204)	(1.379)	(0.275)	(0.285)
Female literacy	-0.684***	-0.791***	-0.0986**	-0.0969**
	(0.0726)	(0.144)	(0.0388)	(0.0390)
Urbanization	-0.110***	-1.147**	-0.147	-0.139
	(0.0414)	(0.559)	(0.114)	(0.113)
Immunization	-0.540***	-0.312**	-0.0242	-0.0262*
	(0.0736)	(0.135)	(0.0156)	(0.0155)
Fertility rate	12.62***	-3.197	0.773	0.636
	(0.735)	(4.760)	(0.652)	(0.608)
Under-five mortality$_{t-1}$			0.867***	0.867***
			(0.0317)	(0.0320)
Constant	136.8***	332.2***	24.03**	24.97**
	(9.475)	(55.64)	(10.31)	(10.44)
Observations	843	843	617	617
R-squared	0.882	0.761		
Number of country		93	90	90

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*
Fixed effects method is preferred for the estimation of the under-five mortality equation based on Hausman test (Prob> Chi^2= 0.000).

For all developing countries sample, a rise in public health expenditure by 1% reduces under-five mortality by 0.35% in the GMM without SADC, while a 1% increase in public health expenditure lowers under-five mortality by 0.57% in Southern Africa region using the panel dynamic estimation method with SADC. The lagged dependent variable is statistically significant across under-five mortality in both GMM, suggesting a critical past effect on the present under-five mortality rate.

The estimated coefficients of the control variables also show expected signs and some significance. GDP per capita is significant at the 1% level in only pooled OLS. Improved water source is significant at the 5% level and 1% level in the pooled OLS and fixed effects respectively. Its coefficient is -0.168 and -1.582 implying that 1% increase in access to improved water source lowers under-five mortality by about 0.17% and 1.58% respectively. HIV prevalence is significant across all four estimation regressions. It is significant at 1% level in pooled OLS and fixed effects as well as 5% in both dynamic panel estimation methods. The coefficient of this variable ranges from 0.642 to 3.68, which indicates that a 1% increase in HIV prevalence causes a 0.64% to 3.68% increase in under-five mortality. Female literacy is also significant in all four estimation regressions, is significant at 1% level in pooled OLS and fixed effects as well as at 1% and 5% level in both dynamic methods. The estimated coefficient of this variable has a magnitude of -0.097 to -0.791, which imply that a 1% increase in female literacy causes 0.097% to 0.79% decline in under-five mortality. Urbanization and immunization are significant at 1% level in pooled OLS and at the 5% level in fixed effects. Fertility is significant at the 1% level with an estimated coefficient of 12.62 indicating that an increase of 1 birth per woman causes a rise in under-five mortality by 12.62 deaths.

Table 6: Results of Under-five Mortality- Sub-Saharan Africa Countries Sample

VARIABLES	(1) Pooled OLS with SADC	(2) Fixed Effects with SADC	(3) GMM without SADC	(4) GMM with SADC
Health expenditure, public (% of GDP)	0.421	1.704	-0.575***	-0.160
	(1.404)	(1.660)	(0.184)	(0.234)
Health expenditure, public (% of GDP)*SADC	1.057	-2.377		-0.730**
	(1.561)	(1.967)		(0.295)
GDP per capita, PPP (current international $)	-2.803***	0.441	-0.155	-0.103
	(0.822)	(2.085)	(0.476)	(0.433)
Improved water source	-0.0542	-2.291***	-0.407***	-0.423***
	(0.121)	(0.622)	(0.158)	(0.152)
Prevalence of HIV	2.314***	2.684**	0.492*	0.508*
	(0.357)	(1.135)	(0.264)	(0.281)
Female literacy	-0.767***	-0.781***	-0.0839***	-0.0834***
	(0.0952)	(0.146)	(0.0273)	(0.0277)
Urbanization	0.401***	-1.820*	0.0554	0.0633
	(0.121)	(1.031)	(0.242)	(0.226)
Immunization	-0.644***	-0.411*	-0.00205	-0.0132
	(0.0936)	(0.204)	(0.0208)	(0.0191)
Fertility rate	18.92***	-5.005	-0.651	-0.658
	(1.703)	(10.62)	(1.429)	(1.399)
Under-five mortality$_{t-1}$			0.858***	0.857***
			(0.0324)	(0.0329)
Constant	89.49***	414.4***	44.75**	46.07***
	(15.43)	(96.53)	(17.51)	(17.44)
Observations	336	336	239	239
R-squared	0.743	0.845		
Number of country		39	37	37

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*
Fixed effects method is preferred for the estimation of the under-five mortality equation based on Hausman test (Prob> Chi^2= 0.000).

Public health expenditure is only significant at 1% level in the GMM without SADC with a coefficient of -0.575 implying that a 1% increase in public health expenditure will cause a 0.58% decline in under-five mortality. Indeed, the hypothesis is further confirmed by the statistical results for SADC region in GMM. As expected, the interaction of public health expenditure and SADC is highly significant at the 1% level with a coefficient of -0.73 indicating that a 1% increase in public health expenditure leads to a 0.73% reduction in under-five mortality in SADC

region. This indicates that public health expenditure is more effective in reducing under-five mortality in Southern Africa countries.

In the case of the other variables in the test, GDP per capita is only significant at 1% level in pooled OLS with a coefficient of -2.803. Improved water source is significant at the 1% level in the fixed effects and dynamic panel regressions with coefficients of -2.291 -0.407 and -0.423 respectively. This indicates that a 1% increase in access to an improved water source will reduce under-five mortality by a range of 0.41% to 2.29%. Prevalence of HIV is positively significant only in the pooled OLS and fixed effects regressions at the 1% and 5% with coefficients of 2.314 and 2.684 respectively. Female literacy is negatively significant at the 1% level in four regressions estimated. The coefficient of this variable ranges between -0.083 to -0.781which imply that a 1% increase in female literacy rate by 1% causes a 0.08% to 0.78% reduction in under-five mortality. Immunization and fertility are only significant in the pooled OLS at the 1% level with coefficients of -0.644 and 18.92 correspondingly. This indicates that a 1% increase in immunization and a one-birth increase per woman will reduce under-five by -0.64% as well as increase under-five mortality by 18.92 deaths respectively. Lastly, the lagged dependent variable is statistically significant across under-five mortality in both GMM, suggesting an important a critical past effect on the present under-five mortality rate.

4.1 Possible Mechanisms for Effectiveness of Public Health Expenditure on Reducing Childhood Mortality in Southern Africa Region

Based on the findings above, we can interpret that public health expenditure is more effective in reducing infant and under-five mortality in SADC region as compared to non-SADC regions within SSA. This decline in childhood mortality due to public health expenditure must have been possible partly due to formation of the SADC Health Sector, the adoption of SADC

Health Policy Framework and Protocols as well as SADC HIV/AIDS Strategic Framework and Program by member countries since the year 1998. The basis for the formation of the SADC Health Sector was due to the acknowledgment of the impact that regional cooperation can make in solving health problems of the region. Moreover, the rationale behind this reasoning is that Southern Africa countries in order to implement agreed policies, strategies and interventions SADC has to lobby governments to honor Abuja targets for resource allocation for health, to devote 15% of government expenditure on health. Also, advocate for equitable distribution of resources for different programs at all levels of care, develop monitoring mechanisms for health systems strengthening as well as ensuring that funds are mobilized from all parties, including co-operating partners, to implement regional activities.

It is worth noting that the above initiatives by SADC regional body must have contributed towards alignment of health policies, strategies and interventions to internationally and regionally agreed policy and strategic instruments, thus sending a signal to donors that Southern Africa region is committed to improving access to health interventions for its citizens. Hence, development partners might support with funds, which contributes to public health expenditure specific areas such as scaling up the programs for the prevention of Mother-to-Child transmission of HIV, reproductive health, childhood and adolescent health, communicable and non-communicable diseases among others that have a negative effect on childhood mortality.

5 CONCLUSION

5.1 Summary of the Study

The study met its overall objective of investigating public spending on health's effect on infant and under-five mortality in Southern Africa region while controlling for the effects of GDP per capita, improved water source, the prevalence of HIV, female literacy, urbanization, immunization and fertility rate. We have built on the strengths of the studies like those of Isaa and Outtara by narrowing our analysis to Southern Africa region and we have attempted to overcome the shortcomings of studies that make generalized conclusions for a very broad sample of countries.

In our empirical analysis, we solve the possibility of endogeneity, simultaneity bias and unobserved heterogeneity of public expenditure on health care and child mortality by using an instrumental variable approach based on Dynamic Panel estimators or the General Method of Moment (GMM). Our estimation results find that in Southern Africa region, public health expenditure has a strong impact on reducing both infant as well as under-five mortality rates. We also find that an improved water sanitation and female literacy is linked with lower infant and under-five mortality rates.

5.2 Policy Recommendations

The findings suggest that public health spending, improved water source, female literacy have caused significantly to the reduction in infant and under-five mortalities achieved between 2000 and 2013 in SADC region. The findings have some implications for policymakers.

First, honoring and sustaining the Abuja declaration will be a stride in the right direction. In 2013, only two nations in SADC region (Malawi and Swaziland) were compliant with the Abuja pledge. Although in almost all SADC countries, the public health expenditure had improved during the period 2000-2013, they must increase their allocation to the health sector to attain the Abuja declaration.

For instance, increased public health expenditure will help expand access to as well as utilization of primary health care services, principally for children. This will be one of the key instrument in achieving SDG 3 target 2 in future which states that "by 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live births." (Sustainable Development Goals Report, 2016).

Aside from public health spending, Southern African countries should pay attention to improved water source and female literacy since have been found to reduce infant and under-five mortality. This finding highlights the significance of other non-economic elements to enable the reduction of childhood mortality. Accordingly, other policy implications consist of focusing on improving the basics. In SADC region, these basics are showing real improvement such as the average percentage of people with access to improved water sources went from 49% to 69% from 1990 to 2013, but that is still far below the global figure of 89%. Moreover, policies should gear towards improving female enrolment in schools, at least to the secondary school level, to help raise literacy levels. Increased education might increase a woman's health knowledge or literacy level which in turn influences her to make better and informed lifestyle choices including making health investments for her children (Grossman, 2006).

Highly educated women can process and understand health-related information including communicating well with health providers than their uneducated counterparts which might lower the likelihood of child death.

5.3 Limitations of the Study

This study is not without limitations. First, we could not include some of the key determinants of child mortality such as physicians' density, birth attended by skilled health personnel and nutrition into the statistical models due to the absence of time-series data. Second, we certainly acknowledge the fact that some other changes have since taken place in Southern Africa region that might have influenced our estimates. Nevertheless, we make an effort to control for these changes through the inclusion of country and time fixed effects, our estimates may still show minor biases due to these changes.

Third, the dataset we use is aggregate annual data at the national level. It will be useful to consider household-level data to examine the disaggregated impact of health expenditures on different segments of the population. This is a possible extension for future research in Southern Africa. In other countries such as India, studies have established that health expenditures have larger and lasting effects on the overall well-being of the poor (Gupta et al., 2003). This observation helps public policymakers to draft relevant policies that have bigger and effective impact on the population.

Despite the above concerns, the present study significantly enhances our understanding of the role of public expenditure on health in decreasing childhood mortality in developing countries today.

5.4 Suggested Areas for Further Study

For the purpose of future studies, it is recommended that considerable attempts should be made to disaggregate public health expenditure into the recurrent and capital mix. This is expected to help measure the different responsiveness of the explanatory variables on the disaggregated public healthcare expenditure. Additionally, it will be interesting to analyze the quality of governance effects on the effectiveness of public healthcare expenditure on childhood mortality. Other studies could narrow down our sample even further to one country to produce an even more specific result.

Furthermore, an understanding of the effectiveness of public health expenditures at the country's provincial or regional levels will be of paramount importance in Southern Africa countries. Knowledge of the effectiveness of health expenditures at the regional levels will be very critical for governments to design and implement policies that influence the population and thus improve public health service delivery. The current mortality patterns in countries in Southern Africa and the observed pro-rich inequalities in health might be suggestive of problems with public health service delivery. In light of this point, further research might provide robust analysis at the country's provincial or regional level and inspect impact of public health expenditures at the individual level.

Finally, since many countries in Africa depend on donor finances, it will be interesting for future research to examine how the share of donor funding helps reduce infant and under-five mortality. It might be important to analyze or compare the mortality progress of countries receiving large donor funding to those receiving lower shares of funds. Understanding these links

might provide insights to respective governments regarding management of available health resources and coming up with other means of mobilizing resources domestically.

6 APPENDICES

Appendix 1: List of Developing Countries Included in the Study

1. Afghanistan	36. Ghana*	71. Rwanda*
2. Algeria	37. Guatemala	72. São Tomé and Principe*
3. *Angola**	38. Guinea*	73. Senegal*
4. Argentina	39. Guinea-Bissau*	74. Sierra Leone*
5. Armenia	40. Guyana	75. *South Africa**
6. Azerbaijan	41. Honduras	76. Sri Lanka
7. Bangladesh	42. Iran	77. Sudan
8. Belarus	43. Jamaica	78. Suriname
9. Belize	44. Kazakhstan	79. *Swaziland**
10. Benin*	45. Kenya*	80. Syrian Arab Republic
11. Bolivia	46. Kyrgyz Republic	81. Tajikistan
12. *Botswana**	47. Lao PDR	82. *Tanzania**
13. Burkina Faso*	48. Lebanon	83. Thailand
14. Burundi*	49. *Lesotho**	84. Togo*
15. Cabo Verde*	50. Liberia*	85. Tunisia
16. Cambodia	51. *Madagascar**	86. Uganda*
17. Cameroon*	52. *Malawi**	87. Ukraine
18. Central African Republic*	53. Malaysia 54. Mali*	88. Uzbekistan 89. Venezuela
19. Chad*	*55. Mauritius*	90. Vietnam
20. Colombia	56. Mexico	91. Yemen

21. *Congo, Dem. Republic**	57. Moldova	92. *Zambia**
22. Congo, Republic*	58. Morocco	93. *Zimbabwe**
23. Costa Rica	59. *Mozambique**	
24. Côte d'Ivoire*	60. *Namibia**	
25. Cuba	61. Nepal	
26. Djibouti	62. Nicaragua	
27. Dominican Republic	63. Niger*	
28. Ecuador	64. Nigeria*	
29. Egypt	65. Pakistan	
30. El Salvador	66. Panama	
31. Eritrea*	67. Papua New Guinea	
32. Ethiopia*	68. Paraguay	
33. Fiji	69. Peru	
34. Gambia, The*	70. Philippines	
35. Georgia		

Notes:

1. ***** Sub-Saharan African countries.
2. Southern African Development Community countries (SADC) in italics.

7 REFERENCES

Amiri, A., and Gerdtham, Ulf-G. (2013). Impact of maternal and child health on economics growth: New evidence based Granger Causality and DEA Analysis.

Anyanwu J.C. and Erhijakpor A.E. (2007). Health expenditures and health outcomes in Africa. African Development Bank, Economic Research Working Paper, No 91.

Arellano, M. and Bond S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, *Review of Economic Studies* 58(2): 277-297.

Baltagi, B.H. (2008). Econometric analysis of panel data, 4e. John Wiley and Sons Ltd.

Barenberg A., Basu D. and Soylu C. (2015). The effect of public health expenditure on infant mortality: Evidence from a panel of Indian states, 1983-84 to 2011-12. University of Massachusetts - Amherst Working Paper Series. Paper 199.

Belli, P.C., Bustreo, F. and Preker, A. (2005). Investing in children's health: What are the economic benefits? *Bulletin of the World Health Organization* 83:777-784.

Bhalotra S. (2007). Spending to save? State health expenditure and infant mortality in India. *Health Economics* 16(9): 911–28.

Bokhari, FA.S, Gai, Y. and Gottret, P. (2006). Government health expenditures and health outcomes. *Health Economics* 16(3):257-273.

Burnside, C. and Dollar, D. (1998). Aid, the incentive regime, and poverty reduction, The World Bank, Washington D.C. Macroeconomics and Growth Group.

Carrin G. and Politi C. (1995). Exploring the health impact of economic growth, poverty reduction and public health expenditure. *Tidjschrift voor Economie en Management*, 40:227-246.

Cutler, D., Deaton A. and Lleras-Muney A. (2006). The determinants of mortality. *Journal of Economic Perspectives* 20(3):97-120.

Durlauf, S.P. and Temple J. (2005). Growth econometrics. *Handbook of Economic Growth Volume* 1A*, ed*. Aghion, P. and Durlant S.N., 555-677. North-Holland: Amsterdam.

Farag, M., Nandakumar, A. K., Wallack, S., Hodgkin, D., Gaumer, G. and Erbil, C. (2013). Health expenditures, health outcomes and the role of good governance. *International Journal of Health Care Finance and Economics* 13(1):33-52.

Farag, M. (2010). Health financing and health outcomes in the Eastern Mediterranean region. Brandeis University Working Paper 10(02).

Farahani, M., Subramanian, SV. and Canning, D. (2010). Effects of state-level public spending on health on the mortality probability in India. *Health Economics* 19(11): 1361–1376.

Filmer, D and Pritchett L. (1999). The impact of public spending on health: Does money matter. *Social Science and Medicine* 49(10):1309-23.

Filmer, D. and Pritchett, L. (1997). Child mortality and public spending on health: How much does money matter? World Bank Policy Research Working Paper No.1864. Washington DC.

Gani, A. (2008). Health care financing and health outcomes in Pacific Island countries. *Health Policy and Planning* 24(1):72-81.

Gottret, P. and Schieber, G. (2006). Health financing revisited: A practitioner's guide. The World Bank, Washington, D.C.

Grekou, C. and Perez, R. (2014). Child mortality in sub-Saharan Africa: Why public health spending matters. Université de Paris Ouest Nanterre La Défense, Working Paper 2014-28.

Grossman, M. (2006). Education and nonmarket outcomes. *Handbook of the Economics of Education*, 1, 577-633.

Gupta, S., Verhoeven, M. and Tiongson. E. (2003). Public spending on health care and the poor. *Health Economics* 12(8):685–96.

Gupta, S., Verhoeven, M., and Tiongson, E. (1999). Does higher government spending buy better results in education and health care? IMF Working paper 99/21. Washington D.C.

Gwatkin, D.R. (2000). Health inequalities and the health for the poor: what do we know? What can we do? *Bulletin of the World Health Organization* 78(1):3-18.

Hamner, L., Lensink, R. and White, H. (2003). Infant and child mortality in developing dountries: Analyzing the Data for Robust Determinants. *Journal of Development Studies* 40(1): 101-118.

Hausman, J. A. (1978). "Specification tests in econometrics". *Econometrica* 46 (6): 1251–1271.

Issa, H. and Ouattara, B. (2005). The effects of private and public health expenditure on infant mortality rates: does the level of development matters? University of Wales Swansea.

Jones, G., Steketee, R. Black, R., Bhutta, Z. and Morris, S. (2003). How many child deaths can we prevent this year? *Lancet* 362:65-71.

Kumar, K., Ram, F. and Abhishek, A.S. (2013). Public spending on health and childhood mortality in India.

Kim, K. and Moody, P.M. (1992). More resources, better health? A cross-national perspective. *Social Science and Medicine* 34(8):837–42.

Mosley, W.H and Chen, L.C. (1984). An analytical framework for the study of child survival in developing countries. *Population and Development Review* 10:25-45.

Muldoon K.A., Galway, L.P., Nakajima, M., Kanters, S., Hogg, R.S., Bendavid, E. and Mills, E.J. (2011). Health system determinants of infant, child and maternal mortality: A cross-sectional study of UN member countries. *Globalization and Health* 7:42.

Musgrove, P. (1996). Public and private roles in health. Technical Report 339. World Bank Washington, D.C.

Nolte, J. and Mckee, M. (2004). Does health care save lives? The Nuffield Trust.

Novignon, J., Mussa R. and Chiwaula L. (2012). Health and vulnerability to poverty in Ghana: Evidence from the Ghana Living Standards Survey Round. *Health Economics Review* 6:2-11.

Odhiambo, S.A., Wambugu, A., and Kiriti-Ng'ang'a, T. (2015). Effect of health expenditure on child health in Sub-Saharan Africa: Governance perspective. *Journal of Economics and Sustainable Development* 6(8):43-65.

Organization of African Unity. (2001). Abuja Declaration on HIV/AIDS, Tuberculosis and other related infectious diseases, (OAU/SPS/ ABUJA/3).

Preker, A., Carrin, G., Dror, D., Jakab, M., Hsiao, W. and Arhin-Tenkorang D. (2002). Effectiveness of community health financing in meeting the cost of illness. *Bulletin of the World Health Organization* 80(2):143-150.

Rajkumar, A. S. and Swaroop, V. (2008). Public spending and outcomes: does governance matter? *Journal of Development Economics*, 86: 96-111.

Stenberg, K. (2013). Advancing social and economic development by investing in women's and children's health: A New Global Investment Framework. *The Lancet* 383(9925): 1333-1354.

Temple, J.R.W. (1999). The new growth evidence. *Journal of Economic Literature* 37(1): 112-156.

United Nations. (2016). The Sustainable Development Goals report. Retrieved March 07, 2016 from http://unstats.un.org/sdgs/report/2016

United Nations. (2015). The Millennium Development Goals Report. Retrieved March 07, 2016 from http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/

United Nations. (2012). Global HIV/AIDS Response Progress reports. Joint United Nations Program on HIV/AIDS, Switzerland: Geneva.

United Nations (2000). Millennium Development Goals. Retrieved March 07, 2016 from http://www.un.org/millenniumgoals/

UNICEF. (2015). Monitoring the situation of children and women. Retrieved March 06, 2016 from http://data.unicef.org/child-mortality/under-five

Wagstaff, A. and Cleason, M. (2004). The Millennium Development Goals for health: Rising to the challenge. Washington, D.C. World Bank.

Wagstaff, A. (2002). Intersectoral synergies and the health MDGs: Preliminary cross-country findings, corroboration and policy simulations. Background Paper for the development committee accelerating progress towards the health nutrition and population Millennium Development Goals. Washington DC: World Bank.

Wagstaff, A. (2000). Socioeconomic inequalities in child mortality: Comparisons across nine developing countries. *Bulletin of the World Health Organization* 78(1), 19-29.

Wagstaff, A. (1986). The demand for health: Theory and applications. *Journal of Epidemiology and Community Health* 40:1-11.

Wang, L. (2002). Health outcomes in poor countries and policy options: Empirical findings from Demographic and Health Surveys. World Bank Policy Research Working Paper No. 2831.

Wexler, A., Valentine, A. and Kates. (2013). U.S. Global Health Policy: Donor funding for health in low and middle-income countries 2002-2010. The Henry J. Kaiser Family Foundation; Washington.

Woodridge, J. M. (2012). Introductory econometrics: A Modern Approach, 5e. Mason, OH: South-Western CENGAGE Learning.

World Health Organization. (2011). World Malaria report. World Health Organization, Switzerland; Geneva.

World Bank. (1995). Philippines: Public expenditure management for sustained and equitable growth. World Bank Report No. 14680-PH, Washington.

Yaqub, J.O., Ojapinwa, T.V. and Yussuff, R.O. (2012). Public health expenditure and health outcomes in Nigeria: The impact of governance. *European Scientific Journal* 8(13):190-201.

Young, F. W. (2001). An explanation of the persistent doctor-mortality association. *Journal of Epidemiology and Community Health* 55(2):80-84.