DETERMINANTS OF EARLY CHILDHOOD MORTALIY IN NYANZA REGION, KENYA

ZACHARY O. OCHOLA

X50/64721/2013

RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENTS OF THE AWARD OF MASTER OF ARTS DEGREE IN ECONOMICS, UNIVERSITY OF NAIROBI.

July 2018

DECLARATION

This is my original work and has not been submitted in any University for a degree programme.

Signature …….. **Date**……

Zachary O. Ochola

This Research Project has been submitted for examination with my approval as a University supervisor

Signature …… **Date**……

Dr. Mercy Mugo

DEDICATION

I dedicate this work to my ever supportive family. To my uncle and aunt, Vitalice and Roselyne, you have been a pillar in my life, thank you for your support, love and sincere help, may the good Lord reward you handsomely.

To my grandmother, Bendetta, you have been my light; thank you for the prayers. I pray to God to give you a longer healthy life.

ACKNOWLEDGEMENT

I convey my gratitude to all those who guided me in different ways in writing this research paper. I am indebted to my supervisor Dr. Mugo who made the research a learning process through her valuable inputs. She was patient with me and for that I am grateful.

I wish to also sincerely thank my lecturers at the University of Nairobi, School of Economics, for their intellectual guidance. Special thanks goes to Prof. Kulundu, Dr. Awiti, Dr. Nyandemo and Dr. Ochoro. Not forgetting my classmates, Owango, Benard, Cyrus and Beryl who made learning interesting through group discussions and sharing of ideas. You were indeed a blessing to my school life.

Special recognition goes to my fiancée, Astrid who always encouraged me and for inspiring me all the time whenever I got overwhelmed with school and work assignments. Above all I thank the Almighty God for good health and for always giving me insight of new ideas during the preparation of this research paper.

Contents

List of Tables

List of figures

List of Acronyms

MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
UNICEF	United Nations Children's Fund
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immune Deficiency Syndrome
KDHS	Kenya Demographic Health Survey
WHO	World Health Organization
OLS	Ordinary Least Squares
WFS	World Fertility Survey
HIBS	Household Integrated Budget Survey
NFHS	National Family Health Survey
IV	Instrumental Variable
KNBS	Kenya National Bureau of Statistics
LOGIT	Logistic Regression Model
ROK	Republic of Kenya
2SLS	Two Stage Least Squares
ORS	Oral Rehydration Solution

Abstract

For Kenya to achieve sustainable development goals (SDGs), it must strive to eradicate early childhood mortality. The country has made tremendous progress in combating early childhood mortality in the recent past. However, despite the progress, the country still experiences high early childhood mortality, as per international standards. Regional mortality differentials are still evident across different regions within the country. It is due to this background that the study sought to investigate determinants of early childhood mortality in Nyanza, a region in Kenya which has persistently reported poor early childhood health indicators. Using 2014 KDHS data for Nyanza region, the study employed logistic regression and 2SLS to estimate child health outcome models (neonatal, post-neonatal, infant and under-5).

The findings of this study indicate that maternal health knowledge and sanitation play significant roles in reducing neonatal mortality but the same factors were found to have insignificant effect in determining post-neonatal, infant and under-5 mortality. Mother's education was also found to play a significant role in reducing neonatal deaths as well as in reducing infant and under-5 mortality. Neonatal and under-5 mortality were found to increase with increase in mother's age. Sex of the child (if male) plays a significant role in increasing infant and under-5 mortality while, on the other hand preceding birth interval of >24 significantly reduces infant and under-5 deaths. Household economic status was found to play a significant role in reducing under-5 mortality. No estimated variable in the post-neonatal model was found to be significant in determining post-neonatal mortality in Nyanza region.

Based on the findings, the study recommends increased health education and awareness programmes through mass media. The study also recommends promotion of women education as a way of empowering their households economically as well as eradicating illiteracy on matters related to child health. Finally, there is need for government and stakeholders to initiate programmes that will inform the residents of Nyanza region on need for improved sanitation and hygiene in the households.

CHAPTER 1: INTRODUCTION

1.1. Background and Trends of Under-five Mortality

The future continued economic growth and development of any nation or society depends on survival of its children at early stages of life (under-5) and keeping them healthy all through adulthood. Survival of healthy children is necessary to secure vibrant future, technologically advanced and productive labor force for the economy to replace the aging less productive and exiting labor. Survival of healthy children is therefore key to sustained development and growth of an economy. Identifying and mitigating on factors that might cause early childhood mortality thus is of utmost importance to nations and societies.

Child health has been top of the agenda among global development initiatives. In the year 2000, a global initiative to eradicate extreme poverty in all its forms by 2015 was launched. The progress was to be monitored through the millennium development goals (MDGs). One of the MDG agenda was to lessen child deaths by about 67% between the years 1990 to 2015.

During the MDGs implementation period, the global under-five death rate reduced by 52% from 91 to 43 deaths per 1000 live births in 1990 and 2015 respectively. Consequently, the total annual under-five mortality reduced from 12.7 million to 5.9 million (Hug, Ejdemyr & Beise, 2015).

Sub-Saharan Africa witnessed yearly decline in under-five mortality increase from 1.6% in 1990-2000 to 4.2% in 2000-2015, a progress that was faster than for the world as a whole (Hug et al., 2015). However, despite the notable achievement in ensuring child survival, chances that a child will live to celebrate its fifth birthday in most developing countries in this region are still low.

In Kenya, the trends on child survival have been fluctuating over the years. In the immediate years after obtaining self-governance (1960-1980), Kenya posted a steady annual decline in under-five mortality (Brass, 1993; Hill, 2001; Kabubo, 2012). Rustein (2000) credited the decline to accessibility of clean water, better sanitation, and improvement on nutrition among children as well as steady macro-economic setting that stimulated growth in post-independent Kenya.

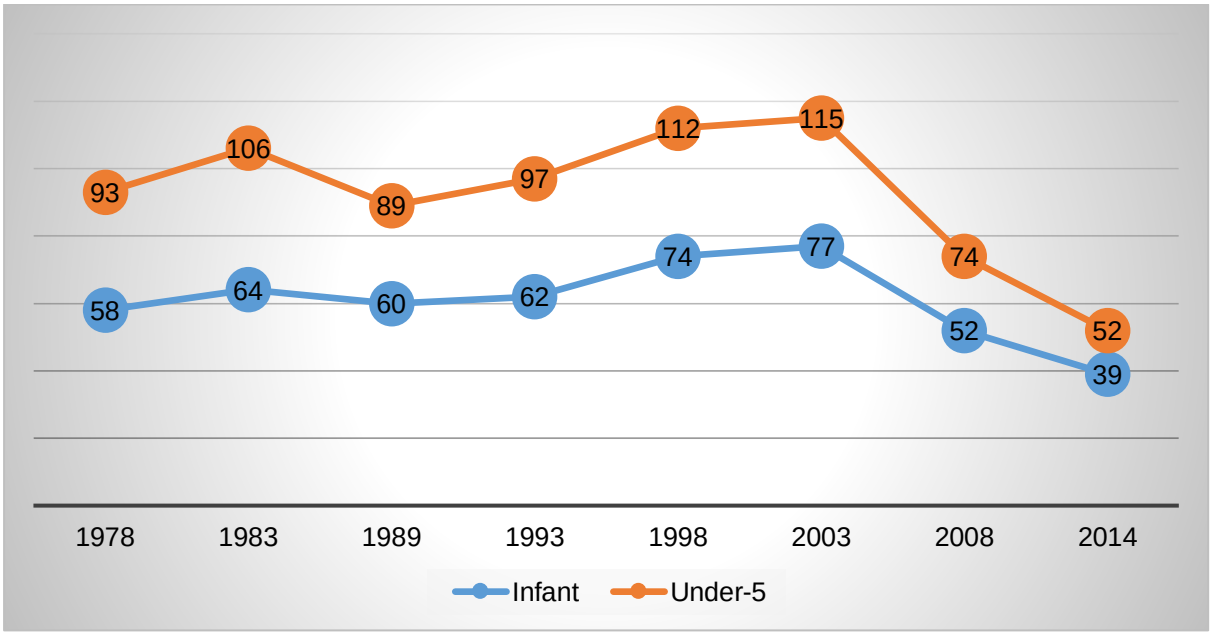
In early 1990s, Kenya witnessed increased under-5 mortality. Ikamari (2004) attributed the increased mortality to high poverty levels, structural adjustment programs which lead to economic hardship, drop in uptake of maternal healthcare, increased child malnutrition, reduction in child immunization coverage, HIV/AIDS endemic and ethnic clashes/civil strife that had hit some regions of the country.

In the recent past during the MDGs programs execution period, a sustained decline in under-five mortality has been observed in Kenya. The under-five mortality has slumped from 115 to 74 deaths per 1000 live births in 2003 and 2008 respectively (KDHS, 2003, 2008) and is currently lowest at 52 deaths per 1000 live births (KDHS, 2014). Kenya has therefore experienced mixed trend in early childhood mortality with steady decline in recent past (Figure 1.1).

The recent decline has been due to increased utilization of parental health care services such as; consumption of postnatal care services for mothers and newborns, improved health care seeking behavior for childhood illnesses as well as increased levels of ownership and use of insecticide-treated mosquito nets coupled with interventions such as new-born care, early and exclusive breastfeeding (KDHS, 2014; MDG Status report, 2013). Despite the progress, the decline was insufficient for Kenya to achieve its MDG 4 country specific target of reducing child death to 22 deaths per 1000 live births.

The MDG agenda has since been replaced by the sustainable development goals (SDGs) agenda which aims to eradicate avoidable deaths of neonates and children below the age of five by year 2030. This is a clear indication that child health continues to be a key area of concern for policy makers.

Figure 1.1: Trends in Infant and Child mortality in Kenya



Source: *KDHS 1978-2014*

Despite the significant progress made in curbing early childhood mortality, it is still high in Kenya, by international standards. This is regardless of various measures Kenya has put in place to combat the childhood deaths, for example Kenya's first health framework; 1994-2010, incorporated numerous intervention measures to improve health of the entire population. As a result of implementation of this framework, health sector observed increased expenditure on health by the government including waiver of maternity services fee in public health centers and dispensaries as well as free TB treatments in public health facilities; Malezi Bora strategy (Republic of Kenya [RoK], 2010) which focuses on child immunization, deworming, treatment of childhood illness, ownership and use of mosquito nets. Other recent interventions put in place to combat childhood mortality include Beyond Zero campaign initiative which aims to eliminate new HIV infections among children and reducing HIV related deaths among women in Kenya.

Substantial variations in child mortality across regions in Kenya is well documented. For instance, a child born in Nyanza region of Kenya is nearly twice as likely to die before its fifth birthday compared to a child born in Central region of Kenya (KDHS, 2014). Regional differentials in early childhood mortality in Kenya calls for adoption of differentiated policies or programs when tackling the problem within different regions.

This will guarantee that the scarce resources are utilized to target factors with high impact on child survival region by region.

Table 1.1: Childhood Mortality Rates in Kenya by Region-2014 (Deaths per 1000 live births)

	Mortality type			
Region	**Neonatal**	**Post neonatal**	**Infant**	**Under-5**
Kenya	22	16	39	52
Nyanza	**19**	**31**	**50**	**82**
Western	19	21	40	64
Rift Valley	20	14	**34**	45
Central	24	14	38	**42**
Eastern	24	**12**	36	45
North Eastern	24	13	37	44
Coast	25	19	44	57
Nairobi	39	16	55	72

Source: *Kenya Demographic and Health Survey (2014)*

Table 1.1 shows that indeed there are significant regional differentials in early childhood mortality across different regions in Kenya. Other than in neonatal mortality where it performs best[1], Nyanza region has the highest rates compared to other regions. This is consistent with the findings of KDHS' of 1993,1998, 2003 and 2008 which all showed Nyanza to be having the highest under-5 mortality rates with 189, 199,206 and 149 deaths per 1000 live births respectively.

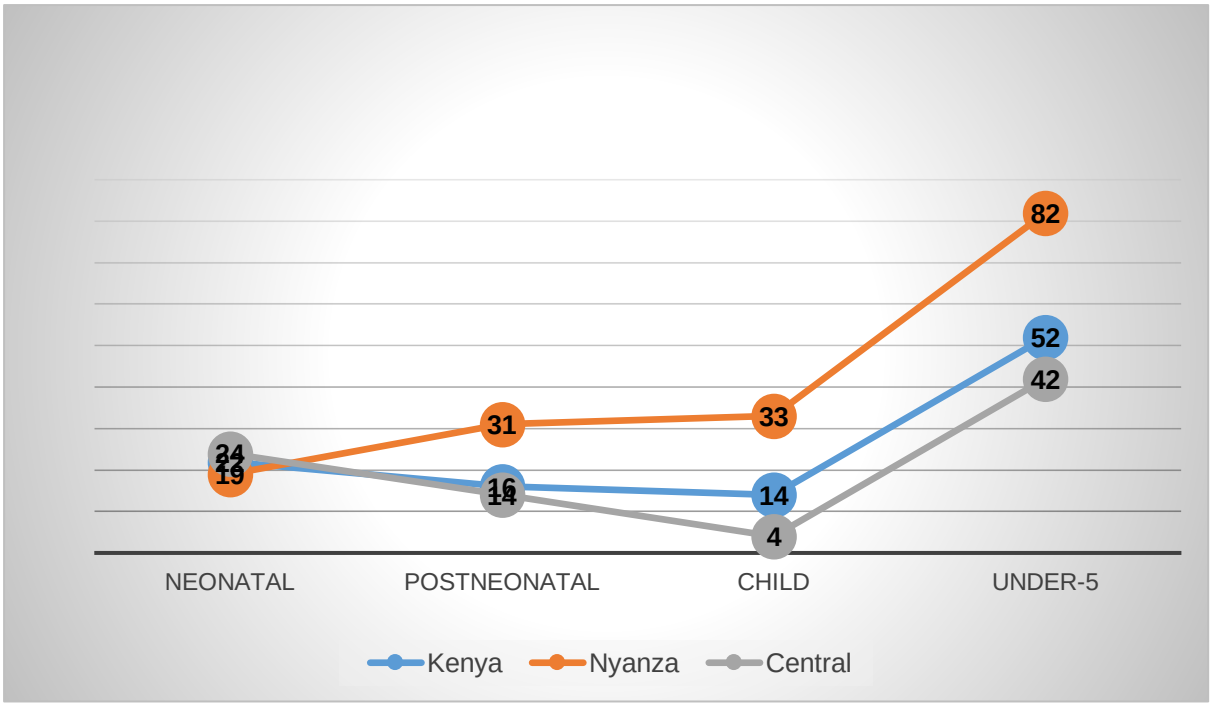
This study therefore seeks to investigate the factors behind persistently high childhood mortality rates observed in Nyanza region of Kenya. Specifically, the study intends to investigate the various factors behind each and every childhood mortality indicator (neonatal, post neonatal, infant and under-5 mortality).

A child's chances of dying are highest during the neonatal period (Buwembo, 2010; World Health Organization [WHO], 2016). It is therefore expected that as children ages, mortality reduces. The trend is exhibited by Central region and also by the overall national mortality trend for Kenya but to the contrary, Nyanza region is

[1] Reduced neonatal deaths are as a result of supervised/hospital deliveries which results to reduced birth injuries and reduced neonate infections, most of neonatal deaths occur at home thus unreported.

exhibiting a different trend (Figure 1.2). While nationally and in other regions the trend declined, it was on the rise for Nyanza region and increased much faster for under-five mortality. This could be hypothesized to be as a result of exposure to external environment or maybe as a result of exposure to late post-neonatal transmission of HIV-1 during breastfeeding. However, the reasons are not clearly understood and documented warranting the proposed study.

Figure 1.2: Mortality Trends as a Child Ages: Kenya, Nyanza and Central Region



Source: *Kenya Demographic and Health Survey (2014)*

Available literature (Elmahdi, 2008; Mutunga, 2004; Pitterle, 2011) has pointed to various factors influencing childhood mortality. For instance, Elmahdi (2008) found that socioeconomic factors such as mother's education, place of residence and employment status of the mother impact on infant mortality. Mutunga (2004) was able to link infant and child mortality to socioeconomic and environmental factors such as access to sanitation, source of water, type of dwelling and sources of energy. Kaldewei and Pitterle (2011) ascertained existence of a relationship between infant mortality and behavioral factors such as breastfeeding, smoking and birth spacing.

Literature therefore reveals several factors associated with childhood mortality. However, due to increased awareness on child health and increased interventions,

childhood mortality predictors are also varying over time. It is therefore important that we continue studying factors influencing early childhood mortality using most recent data to reveal new predictors and to also monitor changing effects of known predictor so as to reduce childhood mortality to the minimum.

We should also monitor childhood mortality trends and predictors across regions in Kenya so as to identify the areas that require more interventions and more resources to combat childhood mortality. This will ensure the country achieves its objective of reducing overall childhood mortality. This paper therefore focuses on determinants of early childhood mortality in Nyanza region of Kenya.

1.2. Early Childhood Mortality and its Measurements

The primary causes of childhood mortality vary as the child ages, from dynamics related to demographics to causes associated with the environment. As the child grows older, it interacts more with the environment. This exposes the child to various infectious diseases that can be contracted through environmental contamination at the same time, the child is also prone to injury and poisoning.

Fikree et al. (as cited in Klaauw and Wang, 2011), for example observed that issues that determine neonatal deaths are different from those that are associated with post-neonatal deaths. Preterm birth, absence of breathing when the child is born, and infections cause most neonate deaths while malaria, pneumonia and diarrhoea are the major causes of most post-neonatal deaths (World Health Organization [WHO], 2016). Mortality among children can therefore be grouped and analyzed by age at death.

1.2.1. Neonatal Mortality

Neonatal deaths are those that occur within the first 28 days after birth (UNICEF, et al., 2007). A child's survival chance is lowest during this period and therefore safe delivery and effectual neonatal care are required to avoid these deaths (WHO, 2016).

1.2.2. Post-neonatal Mortality

These are deaths that occur between ages (1-11) months (UNICEF, et al., 2007). Mortality in this period are mainly as a result of pneumonia, diarrhoea and malaria which can be mitigated through breastfeeding, sleeping under treated mosquito nets, use of oral rehydration solution (ORS) to treat diarrhoea and using safe water and food.

1.2.3. Infant and Child Mortality

Infant mortality is the demise of a live birth before reaching age of precisely one year (UNICEF, et al., 2007). On the other hand, child mortality is the demise of a child between ages 1-4 years. Infant mortality is an important indicator in that mortality tends to reduce at a slower pace at infancy as compared to children between ages 1-4 years (Buwembo, 2010).

1.2.4. Under-5 Mortality

These are deaths that occur from birth to the point when a child reaches the exact age of 5 years (UNICEF, et al., 2007). It is an important indicator in that it's a good measure of overall levels of childhood mortalities in the society. It is also regarded as an indicator of social and economic wellbeing of a nation thus an indicator of degree of poverty in a society (UNICEF, 2006).

1.3. Statement of the Problem

Nyanza region has been grappling with high cases of early childhood mortality since 1990s (KDHS, 2003, 2008, 2014; Omariba, 2005). The researcher finds no evidence from the literature of any attempt to study in isolation and determine the factors behind the poor performance on child health indicators in this region. This study thus intends to study the determinants of early childhood mortality in Nyanza.

Survival chances of a child is lowest in the neonatal period (Buwembo, 2010; WHO, 2016). Therefore, it is expected that a child's chances of dying reduces as it grows past the neonatal period. Interestingly, childhood mortality in Nyanza region exhibits a contrary trend whereby it records low neonatal mortality and high post-neonatal mortality (KDHS, 2014). This could be hypothesized to be as a result of exposure to external environment or maybe as a result of exposure to late post-neonatal transmission of HIV-1 during breastfeeding. This study aims to test these hypotheses by analyzing some selected variables related to the environment as well as estimating maternal knowledge on mother to child HIV transmission,

1.4. Research Questions

1. What are the main determinants of early childhood mortality in Nyanza?
2. What is the impact of maternal health knowledge on early childhood mortality in Nyanza?
3. What are the policy needs for the reduction of early childhood mortality in Nyanza?

1.5. Objectives

1.5.1. Broad Objective

The study aims to determine the causes of early childhood (neonatal, post-neonatal, Infant and under-5) mortality in Nyanza region of Kenya.

1.5.2. Specific Objectives

1. To investigate the impact of socio-economic, demographic and environmental factors on early childhood mortality.
2. To analyze the impact of maternal health knowledge on early childhood mortality.
3. To make policy recommendations geared towards reducing early childhood mortality in Nyanza.

1.6. Justification of the Study

This study is important in that, first, it comes at a time when the implementation period of the MDGs programs have elapsed with statistics showing that the country did not manage to achieve its MDG4 country specific target of reducing child mortality to 22 deaths per 1000 livebirths. This is despite various interventions that were put in place to meet the target. There is need therefore to continue investigating the underlying factors hampering child survival by targeting regions in Kenya which still register high child deaths.

Secondly, this study will help in bridging the knowledge gap on the role of factors such as teenage motherhood and breastfeeding debut on early childhood survival since the literature offers little insight on the role of these factors.

Finally, this study uses the most recent demographic data (KDHS 2014) which may reveal the latest factors behind high mortality rates in Nyanza, which differs markedly from other regions in rates and trends of childhood deaths.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter presents the theoretical framework (Mosley and Chen, 1984) which informs the theoretical basis for this study. It is followed by the empirical literature review of studies on early childhood mortality and finally the methodological considerations and data choices.

2.2. Theoretical Literature Review

Efforts to study determinants of early childhood mortality require specification of a model that includes all the relevant variables that may influence child health and mortality directly or indirectly. A framework establishes causal relationships between various determinants of child health and mortality enabling us to understand how different factors may effect child health and survival in the society. Such an understanding is important in safeguarding child survival.

Health care production is influenced by genetic endowment, lifestyle and amount of medical care consumed given technological-biological production association among others (Santerre & Stephen, 2010). In household health production, choice inputs by households are considered to be informed by health technology (Rosenzweig and Schultz, 1983). Health technology in this case is the human biological interaction through which human behaviour affects health. The household choices are also influenced by prices of commodities and household income. Rosenzweig and Schultz (1983) states that in order to deduce a causal relationship between health and inputs, there is need to control for heterogeneity and thus estimate health technology from models where inputs influencing health are themselves choice variables like mother's education.

The household health production framework was further improved by Mosley and Chen (1984). Their framework is commonly used in studying early childhood mortality in less developed countries. This is because it incorporates both social and medical research approaches to form one comprehensive and systematic analytical model for studying childhood survival. The framework is a flexible model which any researcher can modify to suit any particular research approach; medical or social or combination of both.

According to Mosley-Chen framework, economic, environmental and social factors at personal, household or communal level operate through “proximate determinants” (a set of biological mechanisms) to impact on mortality. For instance, an educated mother will use child health management skills she learnt to reduce risks of her child dying since she is likely to; take a child to clinic for treatment or immunization, exclusively breastfeed the child or put the child to breast early since she understands the nutritional benefits to the child.

The proximate determinants framework presents underlying mechanisms through which economic, environmental and social factors determine disease process and ultimately health outcome (mortality). The framework identifies and groups into five categories the proximate determinants as; maternal fertility factors (parity, birth spacing and age at (first) birth), environmental determinants (source of drinking water, type of toilet facility, insect vector, food and fingers contamination etc.), nutrients deficiency (consumption of micronutrients, calories and proteins), personal illness control (medical treatment as a curative measure and preventive measures; such immunization, sleeping under mosquito net) and injury (accidental or intentional).

The Mosley-Chen (1984) framework was integrated into an economic model of choice by Schultz (1984). The model investigates the partiality that might occur as a result of direct association between health inputs and an individual’s health outcome as it is employed in epidemiological research. The argument behind the model is that initial health endowment of individuals differ and therefore their health inputs are informed by their knowledge of their health endowment. Schultz (1984) model is based on microeconomic model of the household where individuals allocate their resources as a result of value of their time, non-human capital endowments and the relative prices for their inputs and outputs. Value of time an individual works is determined by the market since the market sets the wage rate (Schultz, 1984).

An individual will allocate his/her resources to yield optimal satisfaction for all his choice variables for instance nutrients intake, food purchase, medical care and child care time for a given set of constraints; wages/income, prices and a given production technology. The model provides two sets of equations and issues suggestion on methods of estimating each equation. The first equation is the demand equation which predicts proximate determinants as a function of socio-economic and cultural factors.

It can estimated using OLS for discrete choice variables logit or probit functions can also be used. The second equation is the health production function and it predicts health outcome as a function of proximate determinants. It can be estimated using logit or structural equations methods (Schultz, 1984).

This study thus explores determinants of early childhood mortality using the health production function to predict health outcome (early childhood mortality) as a function of proximate determinants (demographic, social, economic and environmental factors). The choice of exploratory variables was informed by the assumption that proximate determinants influence early childhood survival chances.

2.3. Empirical Literature Review

Various studies (Fotso, 2013; Kabubo-Mariara, 2012; Liu, 2014; Mustafa and Odimegwu, 2008) have investigated factors that influence childhood mortality in Kenya with majority of them using KDHS data. Some of these studies were due to concerns about slow pace of early childhood mortality decline despite numerous measures put in place to combat the early childhood deaths (Fotso, 2013; Kabubo-Mariara, 2012; Liu, 2014). Other studies (Mott, 1979; Muriithi, 2015; Mustafa and Odimegwu, 2008; Omariba, 2007; Ottieno and Kichamu, 1986) were however motivated by the desire to understand the underlying factors behind high early childhood mortality.

This section reviews some of these studies on early childhood mortality with regards to proximate determinants and the corresponding findings.

2.3.1 Socioeconomic Determinants of Early Childhood Mortality

Social, economic and environmental factors influence the probability of childhood survival. Various studies (Ettarh and Kimani, 2012; Mugo, 2012; Mutunga, 2004; Oleche, 2005; Omedi, 2015; Osita et al., 2015) have shown that maternal education, type of residence, toilet facility, source of drinking water, cooking fuel, health expenditure and household economic status impact child health outcome.

A relationship has been established between mother's education and childhood survival. Caldwell (1979) in relation to Nigeria argued that higher education resulted to a decline in infant mortality via factors such as delivery in health facility, and increased prenatal care visits for pregnant women. His argument is that education influences a mother's health seeking behaviours leading to better child health

outcomes. Hobcraft (1993) supported Caldwell argument by stating that educated women are successful in reducing prevalence of childhood diseases such as diarrhoea episodes, cough or fever since they are likely to seek medical attention whenever child shows the symptoms. Furthermore, educated mothers are also likely have their children immunized as well as utilize prenatal and postnatal care factors which eventually ensure child survival. In addition, educated mothers are also likely to get married late and move into parenthood later in life and have fewer offspring. This makes the educated mother's less likely to die at childbirth orphaning their children a condition that has consequences on child survival, fewer children also ensure quality in their development.

Mother's education has also been shown to be associated with hospital deliveries whereby increased hospital deliveries being witnessed alongside increasing level of education of pregnant mothers whereas mothers with no education were found to have increased dangers of experiencing childhood mortality (Brals et al., 2013; Osita et al., 2015). Significant effect of maternal education on childhood survival have also been found in several other studies (Desai and Alva, 1998; Fayehun, 2010; Hobcraft, 1984; Kovstead et al. 2002; Mutunga, 2004).

Mother's education can also be employed as a proxy variable for household wealth or maternal knowledge. Medrano et al. (2008) used education as a measure of maternal health knowledge while Burchi (2009) established that maternal schooling can be used so as to determine nutritional status of children though with decreasing direct marginal contribution after primary education. They concluded by stating that with improved maternal knowledge, a child is guaranteed good health. In addition, mother's education indirectly contributes to a child's good health through better household economic status. On the contrary, maternal education has also been found to have an inverse relationship with child health and household wealth. Hill et al. (2001) with reference to Kenya noticed a negative relationship between maternal literacy and child mortality. They instead argued that HIV epidemic was the more likely cause of deteriorating child health conditions in Kenya and not demographic or socio-economic factors.

Region of residence has also been found to significantly impact on early childhood health outcome. This is evidenced in several studies (Ikamari, 1996; Klaauw and

Wang, 2011; Omariba, 2005; Omedi, 2015) which have found existence of regional disparity in early childhood mortality in Kenya. For instance, Omedi (2015) found that infant mortality was higher in Nyanza region where it was 2.6 times that of Eastern region. Mwangi and Muriithi (2015) also found that infants born in Nyanza, Western and North Eastern regions have higher mortality risks as compared to those born in Central, Coast, Eastern, Nairobi and Rift Valley regions.

In addition, type of area of residence has also been found to significantly determine early childhood health outcome. Mariara et al. (2012) found that children in countryside areas were more in danger of dying than those in urban areas. This was attributed to the fact that children in rural regions are exposed to poverty more than their counterparts in urban dwellings. Similarly, Osita et al. (2015) established that mothers living in rural areas experience high infant mortality rates than those living in urban settlements. The same finding was witnessed by Ettarh and Kimani (2012) who observed high under-5 mortality rate in rural areas as compared to urban areas. It is therefore important to employ differentiated policies when tackling early childhood mortality in different regions and areas. Special focus should be towards improving living conditions in rural areas so as to eradicate early childhood mortality.

Maternal labour force participation has also been found to significantly influence early childhood mortality. For instance, (Elmahdi and Odimegwu, 2008; Ikamari, 1996; Mugo, 2012; Omedi, 2015) with reference to Kenya found a significant positive connection between maternal work status and a healthy child. Mwangi and Muriithi (2015) further determined that infants whose mothers were sales agents had high mortality risk compared to those of mothers who were managers or teachers. This can be argued to be as a result of the likely childhood survival knowledge acquired during the course of work.

However, Uddin et al. (2009) exhibited that maternal occupation had no significant effect on early childhood mortality instead they found that father's occupation was significant in determining early childhood mortality. They observed that high childhood mortality was witnessed among fathers whose occupation was agriculture oriented as compared to those in service sector. The finding was in concurrence with Hobcraft et al. (1984) who found that father's employment status determined the early childhood survival outcome while mother's employment status was insignificant in determining

the same. This indicates that father and mother's occupation complement each other when it comes to determining early childhood mortality.

Economic status and malnutrition have also been proven as key determinants of early childhood mortality. Studies have found significant association between early childhood mortality and household economic status (Alves and Belluzo, 2005; Burchi, 2009; Kabubo-Mariara et al., 2012; Mwangi and Muriithi, 2015; Omolo, 2014). For instance, Mwangi and Muriithi (2015) found that the poor and the very rich experience high early childhood mortality levels. They argued that this could be attributed to the fact that rich mothers have limited time to attend to their new-borns due their busy schedule whereas the poor mothers lack enough resources to afford proper nutrition for the child as well as even afford basic medical care for the child.

Breast milk has been found to be highly nutritious for the new-born. Therefore, breastfeeding is a major determinant of early childhood mortality. For instance, Ettarh and Kimani (2012), Elmahdi and Odimegwu (2008) and Kaldewei and Pitterle (2011) in their studies found that breastfeeding played a significant role in influencing early childhood survival.

Place of delivery has been put forward as a significant determinant of early childhood health. Osita et al. (2015) found that previous caesarean section delivery increased risks of experiencing infant and under-5 mortality as compared to normal delivery. Omolo (2014) on the other hand argues that children born in public health facilities were likely to die than those in delivered in private health facility. This is in contradiction with the finding by Mwangi and Muriithi (2015) which found that infants delivered in private health facilities had reduced mortality risks. This may be due to private health institutions having better infrastructure, have drugs available at all times and have highly motivated and enough health workers.

2.3.2 Proximate Environmental Determinants of Early Childhood Mortality

Environment plays a vital role in determining population health and more specifically early childhood health. This is so since when a child is interacting with the physical/external environment he/she is likely to get in contact with hazardous substances which may result to; injury, ingestion of poisonous or contaminated substances as well as interacting with non-immunized children. These may result to disease or even death.

Several studies have investigated the role of environmental factors on early childhood mortality. Mutunga (2004) and Mosley and Chen (1984) found that environmental factors play a significant role in determining early childhood survival. Alves and Belluzzo (2005) with reference to Brazil determined that early childhood mortality rates are influenced by hygiene at both the environment and household levels. This was backed by the studies by Omolo (2014) and Mwangi and Muriithi (2015) who found that sanitation greatly reduce early childhood mortality.

The household socioeconomic status has been estimated in terms of household source of water for drinking, levels of sanitation, type of cooking energy, levels of schooling and household income/wealth status. Mosley and Chen (1984) argue that socioeconomic factors work through “proximate” determinants (environmental, maternal, injury, individual infection control and nutritional status) to impact on child health. In agreement, several studies have found an existence of a relationship between environmental factors (sources of household drinking water, toilet facility, cooking energy used in by the household) and early childhood mortality (Kembo and Ginneke, 2009; Olufunke, 2010; Wichmann, 2006 and Klaauw and Wang, 2003).

However, Anderson et al (2002) found that the role of environmental factors in determining early childhood health is unimportant as long as mother’s education and other factors were taken into consideration. They conclude by stating that in households with clean drinking water, type of toilet facility had significant impact in determining child survival while in households without clean drinking water, type of sanitation had little impact on child survival.

2.3.3 Proximate, Behavioural and Demographic Factors.

A strong relationship has been found between behavioural and demographic factors and early childhood survival. A significant association has been found between sex of a child and infant mortality, with male children likely to die before reaching their fifth birthday as compared to female children (Claeson et al., 2000; Elmahdi and Odimegwu, 2008; United Nations Secretariat, 1988). Pandey et al (1998) found a U-shaped association between maternal age at birth and early childhood mortality. Therefore, when maternal age at birth increases from teenage to matured age, probability of experiencing child death declines and then probability rises again as the mother transits to old age. This can be attributed to the fact that young mother’s may

lack basic skills on how to take good care of their children due to inexperience. Older mothers on the other side are likely to experience complications during pregnancy or childbirth. Other studies have also documented evidence of a connection between maternal age at birth and early childhood mortality (Brals et al., 2013; Hobcraft, 1993; Ngigi, 2013).

Preceding birth interval, birth order, breastfeeding and birth weight have also been shown to impact on early childhood mortality. Da vanzo et al. (2004) exhibited that preceding birth of interval below twenty-four months is linked highly with greater dangers of neonatal deaths while interval of below 36 months are more allied to higher child mortality risks. This finding was backed by Kaldewei and Pitterle (2011); Elmahdi and Odimegwu (2008); Ettarh and Kimani (2012); who found that breastfeeding and birth spacing played a significant role in determining early childhood mortality. Further, birth order of first born and other orders 4 and above have increased mortality risks (Osita et al., 2015). Elmahdi and Odimegwu (2008) found birth order to be significant in rural areas only.

2.3.4 Maternal Health Seeking Behaviour

It is important for mothers to have knowledge of when to seek preventive or curative health care services for herself or her young child. Kaldewei and Pitterle (2011) states that immunization coverage is connected to low early childhood mortality. Uddin et al (2009) showed that for mother who never attended any antenatal visit, they experienced higher early childhood mortality. However, Omolo (2014) noticed that in absence of socioeconomic factors, place of delivery was not significant in determining child survival.

2.4 Methodological Considerations and Data Choices.

Schultz (1984) designed an economic choice model which explores the biases that may arise from direct association of health inputs to an individual health outcome as it is presumed in epidemiological research. The model is based on an argument that individuals have varying initial health endowment and their health inputs are influenced by their knowledge of health endowment. It was informed by microeconomic model of a family, where individuals apportion the resources they own based on non-human capital endowment, value/ quality of their time and comparative cost of input and output with an aim of maximizing utility for all the choice bundle.

The model provides two sets of equations and their estimation approaches. The first equation is a demand equation which envisions proximate determinants as a function of socioeconomic factors. It can be estimated using Ordinary Least Squares (OLS) but when choice variables are discrete, logit or probit functions can be employed. The second equation is health production equation which predicts health outcome as a function of proximate determinants. This equation can be estimated using logit or structural equation methods (Schultz, 1984). We can therefore use reduced form demand equation for health to study early childhood survival.

Reviewed studies used varying methodologies in studying early childhood survival. For example, some studies (Anderson et al, 2002; Elmahdi and Odimegwu, 2008; Kaldewei and Pitterle, 2011; Medrano et al., 2008) applied logistic model in estimating early childhood mortality due to the binary nature of the independent variable. Other studies have used cox proportional hazard models, probit and survival time analysis models (Da Vanzo, 2004; Kabubo-Mariara et al, 2012; Pandey, 1998). The results were presented in multivariate and regression tables. Secondary data mostly National Fertility Survey, Demographic Health Surveys and census data were the major data source for most of the studies.

For this study, logistic regression and 2SLS regressions are used to estimate the independent effect of each explanatory variable on each of the four indicators of early childhood health indicators; Neonatal mortality, post-neonatal mortality, infant mortality and under-five mortality separately. This is so because factors that determine neonatal mortality differ from those of post-neonatal mortality. In addition, socioeconomic factors have varying impact on childhood mortality across different child age cohorts (Hobcraft, McDonald and Rutstein, 1985; Mutunga, 2004; WHO, 2016). The logit model is used since it's the mostly used model in studying early childhood health outcomes (Anderson et al, 2002; Elmahdi and Odimegwu, 2008; Kaldewei and Pitterle, 2011; Medrano et al., 2008). In addition, due to binary nature of the dependent variable and suspected likelihood of endogeneity in the specified model, logistic regressions and 2SLS regressions will be employed in the study.

The variables selected in this study are based on reviewed literature and most are informed by Mosley and Chen (1984) theoretical framework. However, not all possible

determinants of early childhood survival are considered in the estimated model due to limitations in the data.

2. 5. Overview of the Literature Review

Reviewed literature have categorized determinants of early childhood mortality to socioeconomic, environmental and demographic and behavioral factors. Additionally, maternal health knowledge and health seeking behaviors like antenatal care visits, breastfeeding have also been found to boost health endowment thus significantly reducing early childhood mortality.

This study therefore investigated the role of some socioeconomic, demographic, environmental, behavioral, maternal health knowledge and health seeking behavior on early childhood health outcome (mortality) in Nyanza region of Kenya.

CHAPTER 3: METHODOLOGY

3.1. Introduction

This chapter presents the methodological approach employed to meet the study objectives. In particular, it presents the theoretical framework informing the study, estimation models and estimating techniques, study variables, diagnostic tests, study area and data source and type.

3.2. Theoretical Framework

Both maternal health status and child health outcomes have comprehensively been explored by various country specific studies (Kabubo-Mariara et al., 2008; Mulugeta, 2011 and Oyekale, 2014). These studies employed the modified utility maximization theory introduced by Rosenzweig and Schultz (1983). According to Rosenzweig and Schultz (1983) a reduced form health demand equation can be employed to study child survival. The equations are the health production function and the health input-demand equation. The model was informed by household utility theory where a household chooses a bundle of good from a set of bundles with a goal of maximizing utility.

The utility function of the household is therefore written as;

$$U = u(X, Y, H) \quad \text{...} \quad (1)$$

Whereby:

X represents a good consumed for utility purposes and it has no direct impact on health such as mother's education, place of birth, mother's employment status and birth interval, Y is good consumed to impact on health such as consumption of food for nutritional purposes and taking medication and H is a vector of the health status of n children in the household.

Schultz (1984) states that, health of child is influenced by the proximate environmental/ biological input good (Y) (drinking water, cooking fuel, immunization, sanitation facilities), a child's health input good/service (I) (curative/preventive medical care),(k) is the household health knowledge (breastfeeding debut/, birth spacing.) and (μ) which is child health attribute due to environmental or genetic condition factors which are not determined by the parent.

According to Schultz (1984), child health production function is therefore given as a linear function;

$H = F(Y, I, k, \mu)$ ..... (2)

A household chooses Y with an aim of reducing health outcome (morbidity/mortality). The inputs choices are based on μ, household preferences (PR), household economic status (M) existing market prices and household's physical environment constraints (P).

The household thus maximizes utility (U) given child health production function (H) subject to household budget constraint given as;

$M = P_X + P_Y + P_I$ ..... (3)

Where:

M is the income for the household, P_X is the price of consumption good X, P_Y is the price of health associated good Y, P_I Price of a child health input I.

Prices and household income are set by the market and thus assumed to be exogenous to the household and thus by extension to child health.

The reduced form household health demand equations are therefore given as:

$D_X = D(P_Y, P_I, k, M, \mu)$ 4a

$D_Y = D(P_Y, P_I, k, M, \mu)$ 4b

$D_I = D(P_Y, P_I, k, M, \mu)$ 4c

Substituting demand functions for Y and I (4b and 4c) into health production function (2) we obtain;

$H = F(D_Y(P_Y, P_I, k, M, \mu), D_I(P_Y, P_I, k, M, \mu), k, \mu) = F(P_Y, P_I, M, k, \mu)$.....5

From equation 5, child health is determined by household health knowledge (k), household income (M), a child health endowment (μ) for all children in the household and relative prices P_Y and P_I. Following Kovsted *et al.,* (2003) and since DHS does

not collect data on commodity prices, the study assume that prices are identical for all households and thus the reduced form input demand equation is given as:

$$H = F(Y, I, M, k, \mu) \quad \text{.....6}$$

From equation 6, child health can therefore be explained by direct child health input (I), proximate child health input (Y), household income (M), child's health endowment (μ) and health knowledge of the household (k). In particular, health knowledge is likely to be negatively correlated with a child's (unobserved) genetic health endowment because mothers with "healthy" children need not acquire as much health knowledge as parents with "sickly" children, ceteris paribus.

One major problem the estimation will encounter is on the current market price for goods consumed for health purposes since DHS dataset does not collect information on prices of commodities. The study thus follows Kovsted et al. (2003) where we assume identical commodity prices for all households and estimate child health as a product of direct child health input I, proximate child health input Y, household income M, child's health endowment μ and health knowledge of the household k.

3.3. Estimation Techniques and Model Estimation

3.3.1 Logistic regression

For logit model, the probability of a child dying during the observation period can be given as:

$$\Pr(Y = 1) = P_i \quad \text{.....} \quad (7)$$

While that of a child surviving (not dying) during the observation period is given by:

$$\Pr(Y = 0) = 1 - P_i \quad \text{.....} \quad (8)$$

The model follows a sigmoid distribution function given as:

$$P_1 = \Pr(Y = 1) = \frac{1}{i + e^{-(\beta_1 + \beta_2 X_i)}} \quad \text{.....} \quad (9)$$

Equation 10 can be re-written as:

$$P_1 = \Pr(Y = 1) = \frac{1}{i + e^{-z_i}} \quad \text{.....} \quad (10)$$

Where: $z_i = \beta_1 + \beta_2 X_i$; Equation 11 presents the cumulative logistic distribution function. As $z \to \infty$, e^{-z} approaches 0 and p tends to 1 but not beyond 1. While as $z \to -\infty$, e^{-z} tends to ∞ and p approaches 0 but can't go below 0.

This makes the logistic regression model more popular since the range of the function f (*z*) is always between 0 and 1 irrespective of the value of *z*. The model is therefore by design set up to describe the risk probability which is a number between 0 and 1.

In this study, the probability of a child dying during observation period is given as:

$$p_i = p(Y = 1 \mid X) = \frac{1}{1 + e^{-(\beta_0 + \beta' X)}} \quad \text{.....} \quad (11)$$

Where X is a vector of explanatory variables and β' is a vector of their respective coefficients.

We re-write equation 11 as:

$$p_i = p(Y = 1 \mid X) = \frac{1}{1 + e^{-z_i}} \quad \text{.....} \quad (12)$$

Therefore, the probability of a child not dying during the same period is given as:

$$(1 - p_i) = p(Y = 0 \mid X) = \frac{1}{1 + e^{z}} \quad \text{.....,.....} \quad (13)$$

We obtain the logistic function model by taking the odds ratio which is the logit predictor. It is given as;

$$\frac{p_i}{1 - p_i} = \frac{1 + e^{z_i}}{1 + e^{-z_i}} \quad \text{.....} \quad (14)$$

Getting the natural logarithm of equation 14 above, we obtain the logistic model as indicated below;

$$Li = \ln \frac{p_i}{1 - p_i} = Z_i \quad \text{.....} \quad (15)$$

Where:

$$Z_i = \beta_0 + \beta_1 Ma + \beta_2 Me + \beta_3 Tno + \beta_4 Bdeb + \beta_5 Hs + \beta_6 MCT + \beta_7 HW + \beta_8 Sow + \beta_9 As + \beta_{10} Cf + \beta_{11} Un + \beta_{12} Tor + \beta_{13} Soc + \beta_{14} Bs + \beta_{15} PV + \beta_{16} Pod + \beta_{17} TTI + \beta_{18} Emm + \varepsilon$$

To interpret the findings of the model, the study estimated marginal effects which measures the impact of one independent variable on the dependent variable while holding the other covariates constant.

According to Glewwe (1999) and Wakefield *et al.,* (2010), health knowledge acquired in the process of a mother undertaking day to day activities is potentially endogenous in a child health model. Mothers' treatment of their children's health problems often cause them to acquire additional health knowledge. Following Glewwe (1999) mother's health knowledge is a key mechanism by which mother's education leads to improved health. Methodologically, ignoring the endogeneity of mother's health knowledge may seriously underestimate its role in promoting child health. Endogeneity occurs when the variable to be estimated (maternal health knowledge) is correlated with the error term, thus resulting to biased estimates even when there is sufficiently large number of observations. Other sources include; omitted variables and simultaneous causality (Bascle, 2008). According to Mwabu (2008), its presence compromises validity of the ordinary least squares estimators.

Literature on health outcomes (Kabubo-Mariara et al., 2009b; Oyekale, 2014 and Peters et al., 2014; Schultz and Mwabu, 2002), demonstrates a simultaneous or bi-directional causality between a factor(s) considered to be potentially endogenous and health outcomes.

3.3.2 The Instrumental Variable Approach

In the presence of endogeneity, Ajakaiye and Mwabu (2009) suggests that a tool must be found to change the 'treatment variable' exogenously, without changing other unobserved variables with which it is correlated. Such tools include Instrumental Variable (IV) method, natural experimentation or randomization.

This study employs IV approach since the data used is from a cross-sectional survey. The intention of this approach is to transform endogenous variable into exogenous variable using a valid, relevant and strong instrument (Bascle, 2008; Mugo, 2012). The IV method is a powerful tool in econometrics since it allows consistent parameter estimation in the presence of correlation between independent variables and the error term (Shea, 1997). The mostly used IV estimation technique is a one equation approach using two-stage least squares (2SLS) estimators (Bascle, 2008; Mwabu, 2008). 2SLS instrumental variable estimation is a useful tool in the event that the

instrument is valid and strong, otherwise this effectiveness is lost (Murray, 2006a and 2006b). Stock et al., (2002) warns that getting hold of an exogenous instrument is a hard task.

Various studies including Mwabu (2008) and Mugo (2012) have used different instruments such as labour force participation, education, prices (monetary and time), household income and asset as well as some environmental characteristics. In this study, exposure to mass media is used as the instrumental variable, this is because mass media has been found to be an effective tool in improving child health knowledge (Mashreky *et al.,* 2015). In addition, almost all of the effects on maternal education on childhood health can be explained by her access to information through radio, television and newspapers (Thomas et al., 1990).

According to Choudhury (2015) children born to mothers having any kind of exposure to the mass media are less likely to die during infancy compared with children born to mothers having no mass media exposure. A mother is therefore able to prevent child death using some knowledge acquired in the process of day to day undertakings while interacting with; mass media, as a result of her education, due to previous experiences, in church and in many other avenues (Wakefield et al., 2010; Development Media International, 2016; and Choudhury, 2015). She is likely to use this knowledge to improve the health of her child. This information is normally not known to the researcher (unobserved) and therefore introducing maternal health knowledge to an econometric model is likely to bring about endogeneity bias.

Maternal health knowledge in this study was constructed using a mother's awareness on ways by which HIV is transmitted from a mother to a child. A mother was thus deemed to be knowledgeable if she was found to be aware of all or some ways by which HIV can be transmitted from a mother to child, otherwise she was categorized to have no child health knowledge. Instrument relevance, validity and strength was also determined as discussed in diagnostic tests sub-section below.

3.3.3 Model Specification

This study estimates four independent models, each for the four early childhood health indicators; neonatal, post-neonatal, infant and under-five mortality. The differential analysis is due to evidence from literature which argues that factors that determine neonatal mortality are different from those that determine post-neonatal mortality

(Fikree *et al.,* 2006; WHO, 2016). In addition, socioeconomic factors have varying impact on childhood mortality across different child age cohorts (Mutunga, 2004). All the four models analyzes the effects of same exploratory variables on each of the dependent variable(s) which in this case will be neonatal, post-neonatal, infancy and under-five health outcomes.

The model estimated is specified as:

Y_i = f (Ma, Me, Mws, Bdeb, Bdur, MCHK, HW, Sow, As, Cf, Tod, Oun, Tor, Soc, Bs, Sspc, PV, Pod, TTI, Media)…… (16)

Where:

Y_i is the dependent variable. It is represented by 1 if a child was reported to have died during the observation period (neonatal, post-neonatal, infancy or under-five) depending on the model being estimated and 0 otherwise. Table 3.2 presents the variable notations, definitions and a priori expectations.

3.4. Study Variables

Variables to be studied were informed by Mosley-Chen framework on the factors influencing child survival in developing countries (Mosley-Chen, 1984) and by reduced for input demand equation (6) under the theoretical framework. The choice of variables to be estimated was also influenced by reviewed literature on early childhood mortality. In addition, the nature of available data played a further role on choice of variables to be used in this study.

The explanatory variables chosen comprised of maternal characteristics (mother's age, maternal education and breastfeeding debut), environmental/household characteristics (household economic status, source of the household's water, type of sanitation facility, type of food preparation fuel, use of mosquito nets and type of area of residence), bio-demographic and child endowment characteristics (sex, birth order and birth spacing) and Health care variables (place of delivery, antenatal visits and Tetanus Toxoid Injection) as well as maternal health knowledge measured by mother to child HIV transmission knowledge.

Table 3.1: Considered Variables Definition and a priori Expectations

Variable	Definition and Measurement	A-priori Expectation
Maternal/Behavioural factors		
Mother's age (*Ma*)	Age of mother at birth measured as a continuous variable.	Mixed: It is expected that younger mothers and very old mothers are likely to report high early childhood mortality
Mother's Education (*Me*)	Level of education attained by the mother categorized into four groups namely; No education-(1) Yes (0) No; Primary-(1) Yes (0) No; Secondary-(1) yes (0) No; Higher-(1) Yes (0) No No education is reference group	Mixed: Educated women are expected to have knowledge to improve child health hence reducing mortality. On the contrary educated women are likely to get good job which may make them have little time to care for the child hence increasing mortality
Total Number of children under-5 (*Tno*)	Total number of children a mother has had in the past 8 years (more than 3 is used as reference category) <3 – (1) Yes (0) No 3+ - (1) Yes (0) N0	Positive: Households with more than 2 children under five years is likely to have high child mortality rate
Breastfeeding debut (*Bdeb*)	Categorised into; Immediately after birth (1), Within first hour (2), Hours (3), Days (4)	Negative: It is expected that a child who is put to breast immediately after birth is unlikely to suffer from pneumonia, diarrhoea and breathing problems thus reducing mortality
Maternal Health Knowledge (MHK)	This is proxied by Mother to child HIV transmission awareness that was categorized into; Aware of all ways, Aware of some; Not aware at all	Negative: It is expected that if a mother is aware of how a mother can transmit HIV to child then they are likely to prevent the transmission to the child thus reducing chances of a child dying due to HIV complications
Household/Environmental Characteristics		
Household's wealth (*Hw*)	Categorized into; low, middle and high quintiles	Negative: It is expected that children born to households in high wealth quintiles will have low child mortality risks
Source of drinking water (*Sow*)	Piped water is used as reference category; Piped water into dwelling, public tap, open well, rain water, river and others	Negative: Clean drinking water is expected to lower mortality risks
Access to Sanitation (*As*)	No facility is used as reference. The categories are; No facility, Flush toilet, Ventilated improved toilet and pit latrine	Negative: Availability of clean waste disposal facility is expected to have reduced mortality risks
Cooking fuel (*Cf*)	Electricity is used as reference category; Electricity, LPG, Kerosene, Wood, Coal, Dung and Grass	Negative: Cooking fuel that doesn't pollute air has low mortality risks.

Variable	Definition and Measurement	A-priori Expectation
Household size (Hs)	Categorized into; 1-3 (1), 4-6 (2), 7-9 (3) and 10+ (4)	Positive: Household size is an indicator of overcrowding in the household. An overcrowded household increases the risk of a child contracting respiratory disease like TB thus increasing chances of child mortality.
Type of area of Residence (*Tor*)	Categorized into dummy variables; Rural and Urban	Negative: It's expected that mortality risks are lower in urban than in rural areas due to differentials in development
use of mosquito nets (U*n*)	Grouped into those who own and use nets, doesn't own nets/own but do not use	Negative: Since malaria is one of the leading killer disease, households who use mosquito nets to prevent themselves from contracting malaria are likely to reduce childhood mortality.
Child/demographic characteristics		
Sex of Child (*Soc*)	Categorized into Male and female	Positive: Boys are expected to have high mortality that girls
Birth Spacing (Bs)	Less than 24 months is used as reference variable. <24 months, >24 months	Negative: Birth spacing (24months) is expected to have positive impact on child survival chances
Health Services Variables		
Antenatal Visits (Av)	Antenatal visits during Pregnancy; <4 visits, 4+ visits	Negative: Antenatal visits are expected to reduce mortality
Place of Delivery (*Pod*)	Delivered at home or in the facility	Negative: Delivery in the hospital is likely to reduce risks of child mortality
Tetanus Toxoid injection (*TTI*)	Mother received the immunization or not; a dummy variable; Immunized or otherwise	Negative: Injecting mothers with TT during pregnancy reduces risk of child mortality
Instrument Variable		
Exposure to mass media (*EMM*)	Mother Listens to radio, reads newspaper and watches Television	Negative: Exposure to media enhances maternal health knowledge hence reduces mortality

Source*: Author's compilation*

3.5. Diagnostic Tests

3.5.1. Likelihood Ratio (LR) Test

This test was done in order to determine whether the model to be estimated is correctly specified so as to achieve meaningful result. This test employs p-value whereby if the p-value of the LR test is such that $p<0.05$, then there exists a significant relationship between the dependent variable and the explanatory variable(s) and if $p>0.05$ then no significant relationship exists between the dependent and independent variable.

3.5.2. Endogeneity

The endogeneity test was done to test for existence of endogeneity in the model. Endogeneity occurs if there is a correlation between independent variable and the error term. The explanatory variable and the error term thus become correlated. We thus use the resulting p values of the Durbin-Wu-Hausman test for exogeneity to determine the significance or non-significance of the test. If the p value is greater than 5% then maternal health knowledge is exogenous in the respective childhood mortality model whereas if otherwise then it is endogenous thus adopt the use of 2SLS.

3.5.3Test for Instrument Validity and Strength

According to Verbeek, (2008) an instrument is said to be valid if it satisfies two conditions; instrument relevance (if it is correlated with the independent variable) and instrument exogeneity (if it is uncorrelated with the error term). If a correlation between a regressor and an instrument is weak, it brings about a technical problem in making statistical conclusion (Stock, 2010). However, there are ways of detecting and tackling weak instruments for IV regression inference (Shea, 1997; Stock et al., 2002).

The study conducted three main tests; Durbin (score) and Wu-Hausman tests for endogeneity of maternal child health knowledge and F test for the validity of the chosen instrument (exposure to mass media). Both Durbin (score) and Wu-Hausman tests were conducted first to test whether maternal child health knowledge was endogenous or exogenous in the child health outcome equations. If the null hypothesis (error term is not correlated with the regressor) is rejected, then it implies the regressor is endogenous and hence 2SLS ensues. F-Statistics is used to test the validity of the instrument employed to correct for endogeneity. If we reject the null hypothesis, then the instrument is not valid. On the other hand, if the F-statistics is greater than 10 ($F>10$), then the instrument is strong enough thus 2SLS is appropriate, otherwise

2SLS may be biased (Stock, 2010). The significance of the instrument (exposure to mass media) at first stage indicated its relevance and thus validity. The study never tested for instrument over-identification (Sargan test) since this was a one variable one instrument endogeneity test.

3.6. Description of Study Area

Nyanza is one of the eight regions in Kenya previously[2] referred to as Nyanza Province. It is to the South-West of Kenya and its population is mainly the ethnic Luo and the Bantus speaking sub-tribes such as Kuria, Luhya and Gusii.

Agriculture is the main economic activity of the people in this region. Sugar cane, tea and rice are the main cash crops from this area in addition to subsistence farming mainly focusing on maize and beans farming. Fishing is also a major economic activity in the region.

Nyanza is one of the worst regions in Kenya in terms of child survival as well as widespread poverty (Watkins, 2000). The region is also characterized by high HIV/AIDS and malaria prevalence (Otieno, 1992). This could be attributed to its proximity to Lake Victoria where we have practices such as sex for fish which spreads HIV among fishermen and fish vendors. In addition, other cultural practices such as wife inheritance and non-circumcision of males increase the risk of HIV transmission.

In addition, due to the region's closeness to the lake, some areas within the region are prone to waterborne diseases like diarrhea which is a common cause of early childhood mortality. Further, the lake has been found to have several breeding sites for malaria vectors leading to high malaria prevalence among residents of the lake basin (Minakawa et al, 2012), children under-five are the most vulnerable group affected by malaria (WHO, 2016).

3.7. Data Source and Analysis

This study used the 2014 Kenya Demographic and Health Survey data, collected between May to October 2014. A nationally, regionally and county representative sample of 40,300 households was drawn targeting women of the reproductive age

[2] Following enactment and successive implementation of the Kenya 2010 constitution, new administrative units and boundaries came into use as a result of devolved units.
Nyanza region currently comprises on six devolved units (counties) namely; Siaya, Kisumu, Migori, Homa Bay, Kisii and Nyamira.
This study covers all the counties in the former Nyanza province.

(15-49 years) and men aged between 15-54 years. The sampling of households applied two-stage cluster sampling methodology where at first stage a total of 1,612 clusters were drawn from the master sampling frame after which 25 households were systematically drawn from each of the sampled clusters. Of the sampled households, 36,813 households were found occupied at the time of interview visits out of which 36,430 were successfully interviewed resulting to a 99 percent response rate.

A total of 32,132 women were eligible for the national survey. From the eligible number, only 31,079 women were successfully interviewed.

During data processing, the data was categorized into counties and regions using unique identifiers to make it possible for data users to be able to undertake analysis at the regional level, county levels or any other lower administrative levels. Since the scope of this study was Nyanza region, the data for the region was extracted from the national sample using the unique identifier (variable 024 in the dataset) before any analysis could be done. Upon extraction, the sample had a total of 4, 254 (13.4 percent of the national sample) women from Nyanza, which represented the total sample size of this study. Before any further analysis, new variables were regenerated to make analysis easier in line with the study objectives. For example, birth spacing was categorized to <24 or >24 Months, place of delivery was grouped into; home delivery or hospital delivery.

In order to understand the distribution of the data better, descriptive statistical analysis was undertaken. This is presented through means, proportions, frequencies and standard deviations and regressions were then done using statistical software STATA version 14.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter presents the study findings and discussion of empirical results on the determinants of early childhood (Neonatal, Post-neonatal, Infant and Child) mortality in Nyanza region of Kenya. Presentation and discussion of descriptive statistics, diagnostic test results and empirical findings are presented.

4.2. Sample Description

This section presents descriptive characteristics of women from the Nyanza region sampled during the 2014 KDHS as shown in Table 4.1. The variables under study include; the early childhood mortality (neonatal, post-neonatal, infant and under-5), age, education, number of children under the age of five years, breastfeeding, maternal child health knowledge, socioeconomic status, water sources, access to sanitation, household size, residence, use of mosquito nets, sex of the child, preceding birth interval, antenatal visits, hospital delivery, tetanus toxoid injections and access to mass media (instrument variable).

There were a total of 4,254 women from Nyanza region interviewed during the 2014 Kenya Demographic and Health Survey. A total of 2,085 singleton births were reported to have occurred in this region five years prior to the survey. From these births, a total of 182 children were reported to have died before reaching their fifth birthday, comprising of 55 and 80 neonatal and post-neonatal deaths while 47 deaths occurred post infancy.

The average age of the mothers was 29 years. Majority had primary education (58.7 percent) with 32.6 percent and 7.3 percent having secondary and higher education respectively while 1.4 percent having no education. This shows that about 40 percent of women from the region have access to education and are likely to improve on health of their children. Approximately, 92.8 percent of the respondents reported to have three and above under-5 children in the household in the past 8 years meaning there could be competition for scarce resources among the many children in the household. About 38 percent of new-borns were never breastfed immediately after birth thus missing necessary nutrition immediately after birth.

Table 4.1: Maternal/Behavioral/Demographic Characteristics (n=4254)

Discrete variables			**Percentage**
Alive			91.271
Deaths			8.729
Mortality (n=2085)			
Neonatal			1.871
Post-neonatal			1.535
Infant			3.405
Education			
No education			1.363
Primary education			58.651
Secondary education			32.652
Higher education			7.334
Children 5 and under in household			92.783
Breast feeding (n=950)			
Immediately			61.895
Within the first hour			3.263
Hours			31.474
Days			3.368
Mother to Child HIV Transmission Knowledge			
Not aware at all			2.233
Aware of some			51.105
Aware of all ways			46.591
Continuous Variable	**Mean**	**Std.Dev.**	**Range**
Age (years)	28.643	9.453	15-49

Source: *Author's Calculation, KDHS 2014*

Mother to child HIV transmission (MTC) knowledge was also explored in different categories that is not aware at all; aware of some; and aware of all ways. Results show that 2.2 percent were not aware of any way of MTC HIV transmission, with 51.1 percent of respondents reported to be aware of some ways and 46.6 percent were

aware of all ways of MTC. These findings imply that there is increased awareness creation which may be as a result of introduction of free maternity care in all public hospitals in Kenya as well as increased HIV transmission awareness publicity over the mass media. The increased awareness is likely to reduce mother to child HIV transmission leading to a decrease in early childhood deaths related to HIV/AIDS infections.

On the other hand household economic status was analyzed in three different categories; low, middle and high wealth quintile (Table 4.2). Those who were in the low wealth category were 44.3 percent with those in middle category being 24.3 percent whereas 31.4 percent being higher economic status category. This means that majority of women interviewed were in lower wealth quintile and thus less economically empowered. This implies that they are less likely to afford proper medical care for their children hence high risk of experiencing early childhood mortality. Source of water was examined as one of the element of household/ environmental factor where different sources of drinking water were explored. About 55 percent of households reported to use drinking water from protected sources thus less likely to consume contaminated water which according to literature has impact on health.

Table 4.2: Household and Environmental Characteristics (n=4254)

Discrete Variables	**Percentage**
Socioeconomic Status	
Low	44.288
Middle	24.307
High	31.406
Water sources	
Piped	2.985
Public standpipe	19.840
Protected well/spring	31.829
Unprotected well/spring	15.186
Water surface	27.221
Bottled	0.447
Other water sources	0.353

Discrete Variables	Percentage
Access to Sanitation	
No toilet facility	11.472
Flush toilet	3.949
Ventilated improved toilet	24.800
Pit latrine	56.888
Cooking fuel	
Electricity	0.635
LPG	4.231
Biogas	0.141
Kerosene	1.011
Coal and lignite	0.024
Charcoal	19.911
Wood	71.697
Household size (membership)	
Size 1-3 members	17.701
Size 4-6 members	51.340
Size 7-9 members	26.281
Size 10 plus members	4.678
Residence	
Urban	33.592
Rural	66.408
Use of mosquito nets (n=2516)	
No use of nets	23.251
All children	69.118
Some children	7.631

Source: *Author's Calculation, KDHS 2014*

Majority of households in the Nyanza region (57%) use pit latrine with 11.5% reporting to have no toilet facility. This could be attributed to lack of awareness on the importance of having an access to improved toilet facility. It could also be as a result of low economic status among residents of Nyanza region which doesn't allow them to construct an improved toilet facility. The situation raises concerns on sanitation and hygiene among the households in this region, a factor that have a direct influence on

child health. Similarly, nearly 92% of the respondents reported using either wood or charcoal as the main source of cooking fuel. These types of fuel have adverse effects on environment, air quality and consequently health as suggested in the literature and thus are likely to impact negatively on childhood survival.

Nearly 78 percent of the households have large household sizes ranging between 4-9 members, way above the national average of 3.9 members. This is likely to lead to increased competition for resources among household members. In addition, they are also to suffer from airborne diseases due to congestion in the household. On the other hand, majority of the households (66.4 percent) reside in rural areas which, as literature suggests experience higher childhood deaths as compared to urban areas. Lastly, on use of mosquito nets by children who were below five years was also examined. It was found that approximately, 13.8 percent of the respondents reported that children under-5 never slept under mosquito bed net the previous night. Approximately 40.9 percent revealed that all children slept under mosquito net while only 4.5 percent reported that some children slept under a mosquito net.

On child and health service characteristics, the study found that over half of children (53.2 percent) were male (Table 4.3). Mothers who reported preceding birth spacing of over 24 months were 87.5 percent. The long birth intervals contributes to prolonged breastfeeding and reduces competition among new born thus significantly reducing the probability of under-5 deaths as pointed out in the literature. On access to health services and hospital deliveries, approximately 58.3 percent of residents had at least four antenatal visits to the health facilities which is the minimum recommended number of visits while 71.1 percent of mothers reporting to have delivered in a health facility or having a skilled health professional attend to them during delivery. Hospital delivery reduces child deaths which may occur as a result of birth complications.

Table 4.3: Child Characteristics and Health Services Variables

Variables	Percentage
Sex (n=2085)	
Male	53.218
Female	46.782
Preceding Birth Interval (n=4254)	
More than 24 months	87.518
Less than 24 months	12.482
Antenatal Visits (n=2075)	
At Least 4	58.313
Less than 4 visits	41.687
Place of Delivery (n=2050)	
Hospital	71.122
Non-Hospital	28.878
Tetanus Toxoid Injection (n=4254)	
Immunized	97.720
Not immunized	2.280
Access to Mass Media (n=4254)	
Have Access	87.659
No Access	12.341

Source: *Author's Calculation, KDHS 2014*

Approximately 97.7percent of the interviewed women reported to have received the tetanus toxoid injection during pregnancy with only 2.3 percent failing to get the injection. This indicates that these women were able to reduce neonatal deaths from tetanus related complications. Finally, on access to health information through mass media, about 87.7 percent of the respondents reported to have frequently listened to either radio, or watched television frequently or read newspaper frequently. Health information access was measured through mass media access frequency. In this study it was used intensely as an instrumenting variables as demonstrated in the next sub sections.

4.3 Econometric Estimation of child health outcomes (Early childhood mortality)

4.3.1 Introduction

The first objective of the study was to investigate the impact of socio-economic, demographic and environmental factors on early childhood mortality in Nyanza, Kenya. The second objective is focused at analysing the impact of maternal health knowledge and behavioural factors on early childhood mortality in Nyanza, Kenya.

4.3.2 Endogeneity of Maternal Health Knowledge

Maternal health knowledge is potentially endogenous to child health outcomes as described in the methodology. As a result, the study conducted the endogeneity test to test the hypothesis. The null hypothesis states that the maternal health knowledge is exogenous in each model. Table 4.4 presents the 2SLS results and shows that the Durbin (score) for post neonatal mortality model had a p value greater than 5 percent implying failure to reject the null hypothesis for this particular model. This meant that maternal health knowledge was exogenous in the model and thus no need for use of an instrument. On the other hand, the endogeneity test results for the other childhood (neonatal, infant and under-five) mortality models indicated that maternal health knowledge was endogenous since we rejected the null hypotheses for all the three models. These findings conformed to those of Wu-Hausman confirmatory test of endogeneity, thus use of an instrument to exoginize the endogenous variable (maternal child health knowledge) in the three child health outcome models.

The study thus employed both the logit and 2SLS analysis in the respective and recommended models to examine the net effect of socio-economic, demographic, environmental, maternal health knowledge and behavioural factors on child health outcomes in Nyanza.

4.3.3 Validation of the Frequent Access to Mass Media

Maternal health knowledge, according to confirmatory test was found to be endogenous in three child health models. This therefore required an instrument to correct for the bias that was likely to arise as a result of endogeneity in the models.

The study settled on access to mass media as an instrument to maternal child health knowledge. As shown in Table 4.5, the first stage results of the 2SLS regression indicate that the instrument (exposure to mass media) is valid and thus relevant. This is because the respective p-value were found significant at 5% level of significance

implying that the proposed instrument is relevant to instrument proposed maternal health knowledge in the child health models. However, the same instrument was found to be weak since the F-statistic values were below the threshold of F>10, hence a weak instrument.

Table 4.4: Logit Regression Results: Early Childhood Mortality

Dependent Variable (s)	Logistic regression		Logistic regression		Logistic regression		Logistic regression	
	Neonatal (Model 1)		Post Neonatal (Model 2)		Infant (Model 3)		Under-5 (Model 4)	
	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)
Maternal health knowledge	-.005742	-0.89	0.0023	0.37	-.0025478	-0.43	-.002426	-0.39
Age of the mother	.0010321**	2.01	-0.00002	-0.04	.0007732*	1.69	.000942**	1.96
Education level	-.0179623**	-2.02	-0.00006	-0.01	-.0126103*	-1.74	-.0140523*	-1.83
Number of children under-5 in household	.0092178	0.82	(omitted)	-	.017601	1.42	.0142366	1.23
Wealth (Low)								
Middle	-.0035359	-0.47	-0.0048	-0.80	-.0061642	-0.85	-.0081274	-1.07
High	-.0121142*	-1.78	(not estimable)		-.0178586***	-3.18	-.0205162***	-3.55
Protected Water Source	-.0013452	-0.19	0.007	1.20	.0038559	0.62	.0043977	0.68
Sanitation (No toilet facility)								
Flush toilet	(not estimable)	-	(not estimable)	-	(not estimable)	-	(not estimable)	-
Ventilated improved toilet	.0118624	1.30	-0.0014	-0.12	.0105966	1.12	.0122972	1.17
Pit latrine	.010077	1.62	-0.0103	-1.04	.0031368	0.46	.0001908	0.03
Household Size (Size 1-3 members)								
Size 4-6 members	(not estimable)	-	-0.0003	-0.03	.0125902	1.56	.013726*	1.67
Size 7-9 members	(not estimable)	-	0.0008	0.07	.0059626	0.71	.007292	0.85
Size 10 plus members	(not estimable)	-	(not estimable)	-	.0114067	0.75	.0193666	1.10
Residence	-.0076735	-0.86	0.0049	0.70	-.0024435	-0.33	-.0010003	-0.13
Use of mosquito nets (No use of nets)								
All children	-.0086581	-1.06	-0.0135	-1.59	-.0146411*	-1.84	-.0137205*	-1.69

Dependent Variable (s)	Logistic regression		Logistic regression		Logistic regression		Logistic regression	
	Neonatal (Model 1)		Post Neonatal (Model 2)		Infant (Model 3)		Under-5 (Model 4)	
	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)
Some children	-.0124197	-1.11	(not estimable)		-.0206756**	-2.10	-.0221766**	-2.32
Sex (male=1)	.0056076	0.85	0.0078	1.14	.0074745	1.22	.0083091	1.30
Antenatal visits	-.0022135	-1.13	-0.0017	-0.85	-.0023194	-1.26	-.0022962	-1.20
Preceding Birth Interval (>24 months)	-.0177837**	-2.47	-0.0120	-1.62	-.020037***	-2.94	-.0212433***	-2.99
Tetanus Toxoid injection	-.0115484	-1.03	Omitted		-.0039615	-0.32	-.0014214	-0.11
Mass media	Omitted		-0.0002	-0.02	.0210732*	1.76	.0172059	1.59
	Number of obs = 1,416 LR chi2(18) = 36.94 Prob > chi2 = 0.0053 Log likelihood = -86.59 Pseudo R2 = 0.1758		No. of observations = 1051 LR chi2(15) = 14.41 Prob > chi2 = 0.4944 Log likelihood = -49.29 Pseudo R2 = 0.1275		Number of obs = 1,852 LR chi2(20) = 48.55 Prob > chi2 = 0.0004 Log likelihood = -129.16 Pseudo R2 = 0.1582		Number of obs = 1,852 LR chi2(20) = 52.55 Prob > chi2 = 0.0001 Log likelihood = -139.34 Pseudo R2 = 0.1586	

Source: *Author's Calculation, KDHS 2014*

(***) (**) and (*) Significant at 1% 5% and 10% levels respectively.

Omitted variable: The variances were too low and thus dropped from the model.

Not estimable: The observations were either too few or there were no observations at all.

Table 4.5: 2SLS Regression Results: Early Childhood Mortality

Dependent Variable (s)	Instrumental variable (2SLS) regression		Instrumental variable (2SLS) regression		Instrumental variable (2SLS) regression	
	Neonatal (Model 1)		Infant (Model 3)		Under 5 (Model 4)	
	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)
Maternal health knowledge	-0.2445*	-1.70	-0.2523	-1.57	-0.2306	-1.46
Age of the mother	0.0009*	1.68	0.0010	1.52	0.0012*	1.90
Education level	-0.0222**	-2.03	-0.0226*	-1.84	-0.0220*	-1.82
Number of children under-5 in household	0.0036	0.30	0.0110	0.80	0.0104	0.77
Wealth (Low)						
Middle	0.0103	0.91	0.0082	0.64	0.0044	0.35
High	-0.0116	-1.08	-0.0185	-1.54	-0.0210*	-1.78
Protected Water Source	-0.0179	-1.51	-0.0140	-1.05	-0.0120	-0.92
Sanitation (No toilet facility)						
Flush toilet	0.0287	1.09	0.0247	0.84	0.0213	0.73
Ventilated improved toilet	0.0294*	1.76	0.0284	1.52	0.0279	1.51
Pit latrine	-0.0262	-1.08	-0.0342	-1.26	-0.0338	-1.26
Household Size (Size 1-3 members)						
Size 4-6 members	0.0211	1.43	0.0219	1.32	0.0206	1.26
Size 7-9 members	0.0185	1.04	0.0192	0.97	0.0178	0.91
Size 10 plus members	0.0145	0.69	0.0115	0.49	0.0211	0.91
Residence	0.0152	1.04	0.0187	1.14	0.0181	1.13
Use of mosquito nets (No use of nets)						
All children	0.0134	0.86	0.0041	0.23	0.0029	0.17
Some children	-0.0053	-0.34	-0.0172	-1.00	-0.0207	-1.21
Sex (male=1)	0.0172	1.57	0.0214*	1.75	0.0209*	1.74
Antenatal visits	0.0019	0.63	0.0013	0.41	0.0011	0.32
Preceding Birth Interval (>24 months)	-0.0151	-1.33	-0.0225*	-1.77	-0.0250**	-2.00
Tetanus Toxoid injection	0.0030	0.17	0.008	0.40	0.0104	0.53
Mass media	-	-	-	-	-	-

Dependent Variable (s)	Instrumental variable (2SLS) regression		Instrumental variable (2SLS) regression		Instrumental variable (2SLS) regression	
	Neonatal (Model 1)		Infant (Model 3)		Under 5 (Model 4)	
	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)	Marginal Effects	(t- statistics)
	No. of observation =1908 Wald chi2(20) =19.66 Prob > chi2 =0.4794 Root MSE = 0.15347		No. of observation =1908 Wald chi2(20) = 26.33 Prob > chi2 = 0.1552 Root MSE = 0.17188		No. of observation =1908 Wald chi2(20) = 32.34 Prob > chi2 = 0.0398 Root MSE = 0.1691	
Instrument (first stage)	t=-2.23 (P=0.026)		t=-2.23 (P=0.026)		t=-2.23 (P=0.026)	
F(1,1513)	4.89083		4.89083		4.89083	
Durbin (score) chi2(1)	6.51989 (p = 0.0107)		4.75941 (p = 0.0291)		3.64339 (p = 0.0577)	
Wu-Hausman F(1,1512)	6.46681 (p = 0.0111)		4.7163 (p = 0.0300)		3.60827 (p = 0.0591)	

Source *Author's*: *Calculation, KDHS 2014*

(***) (**) and (*) Significant at 1% 5% and 10% levels respectively.

Omitted variable: The variances were too low and thus dropped from the model.

Not estimable: The observations were either too few or there were no observations at all.

4.4 Discussions of the 2SLS Regression Results

Table 4.5 presents the results of the logit model. The regression model did not do well in terms of the joint significance since the overall p values for neonatal, post neonatal and infant models were found to be statistically insignificant at all levels. This is with the exception of under-five mortality model which was shown to have a joint significance at 5 percent level. Pseudo R2 of 12.75 implies that 12.75 percent of the variations in the post-neonatal death model in Nyanza is explained by the explanatory variables used in the model. To proceed, the study considered significant factors in the respective models for further discussion.

4.4.1 Neonatal and Post-Neonatal Mortality

In these models, maternal health knowledge, age of the mother, education levels, and ventilated improved toilet were found to be statistically significant in determining the probability of a neonatal mortality in Nyanza region. The rest of the variables were found to be statistically insignificant at all levels. Specifically, if a mother is aware on how to prevent transmission of HIV from mother to child, the probability of a neonatal mortality declines significantly by 24.5 percent holding other factors constant. This finding concurs with the study results obtained by Medrano et al. (2008) who found a notable positive influence of maternal health knowledge on the health of her child.

The study results also showed that the age of the mother significantly raised the probability of a neonatal mortality in Nyanza region. It was found that an additional year to the mother's age led to a significant increase in the probability of observing a neonatal death by 0.09 percent holding other factors constant. This may be as a result of a mother's increased likelihood of observing birth complications as a result of advanced age. As a mother ages, she is likely to have other competing commitments like work which makes her have less time with the new born resulting to less motherly care and even breastfeeding hence child death. This result agreed with the findings of Pandey et al (1998) who found that infant mortality increases when a mother gives birth at old age.

Further, the study found that mother's education significantly lowers the probability of neonatal deaths in Nyanza region. As a mother transits from one education level to another, the probability of experiencing a neonate death decreases by 2.2 percent holding other factors constant. This is in line with several other studies such as

Caldwell (1979), Hobcraft (1993), Medrano et al. (2008), Burchi (2009), Geale (2010), who all found a significant inverse relationship between maternal schooling and childhood deaths. Education has also been suggested as a way of empowering mother's socially and economically so as to improve child health (Elmahdi and Odimegwu, 2008; Kabubo et al. 2012).

Finally, the study revealed that access to sanitation significantly reduced the likelihood of observing neonatal mortality by 2.9 percent holding other factors constant. Better sanitation reduces the likelihood of bacterial infection which may lead to diarrhoea and other infectious diseases. This is in agreement with Kabubo et al. (2012) who found a significant association between physical environment and childhood mortality in Kenya. Anderson et al (2002) also found that households with clean drinking water and the type of sanitation facility had substantial effect on determining child health.

The study found no variable under consideration was significant in determining post-neonatal mortality at all levels of significance despite some of them being significant in determining neonatal mortality. This concurs with Fikree et al., (2006) and WHO, (2016) who pointed that issues that determine neonatal deaths are different from those that are associated with post-neonatal deaths.

4.4.2 Infant Mortality.

For infant mortality, mother's education level, sex of the child and preceding birth interval of >24 were found to be statistically significant in determining the probability of an infant death in Nyanza region. The remaining variables were found to be statistically insignificant at all levels. In this case, if a mother's education improves from one level to another, the probability of experiencing infant death reduces significantly by 2.3 percent given that all other factors remain constant. This is because educated mothers are likely to interact with her peers and learn ways of taking care of the infant when sick or even ensuring that the infant does not contract diseases. Educated mothers are also likely to access child health knowledge from other sources like social media and mass media which in turn aids in keeping the infant healthy. The result agrees with the findings of the study by Omedi (2015) who found a significant connection between maternal education and Infant mortality.

The study also revealed that sex of a child has an impact on determining infant mortality. The probability of a male child dying at infant stage in Nyanza region is

significantly increased by 2.1 percent holding all other factors constant. This can be argued that male infants may be having weak genes which are prone to infectious diseases and other common diseases like diarrhoea, malaria and pneumonia. The study finding is in line with those of Elmahdi and Odimegwu (2008) who found sex of the new born to be significant in determining infant mortality.

In addition, preceding birth interval of greater than 24 months was found to significantly lower the probability of witnessing infant mortality by 2.3 percent when all factors constant. This is because with longer birth intervals, the mother is unlikely to experience complications during birth also a mother is likely to breastfeed for the required period of 24 months if she does not become pregnant within that period. Da vanzo et al. (2004) supports this finding whereby it was shown that preceding birth of interval below twenty-four months was linked highly with greater dangers of infant deaths. A study by Elmahdi and Odimegwu (2008) also support this finding stating that birth spacing plays a significant role in determining infant mortality in rural areas.

4.4.3 Under-5 Mortality.

The study found age of mother, education, economic status of the household, sex of child and preceding birth interval to be statistically significant in influencing under-5 mortality in Nyanza region. All other remaining estimated variables were found to be statistically insignificant at all levels. An addition of one year to Mother's age just like in neonatal model was found to significantly raise the probability of under-5 deaths by 0.1 per cent holding other factors constant. This is because as a mother ages, there are other competing interests like work which may bring about a lot of travelling creating less time for breastfeeding the infant, the mother is also likely to leave the child under the care of other individual who may not really pay much attention to the nutritional and health needs of the child resulting to early childhood death. This finding differs with a study by Finlay et al. (2011) who found that children to born to younger mothers are vulnerable to infant mortality and poor child health outcomes. This finding however agrees with Heady et al. (1955) which found under-5 mortality rate to increase with increasing age of mother.

As with neonatal and infant mortality, education was found to also significantly impact on under-5 health outcome. A mother with higher level of education significantly reduces the probability of experiencing under-5 deaths by 2.2 per cent holding all other

factors constant. This is because educated women are successful in reducing prevalence of childhood diseases. They are also likely have their children immunized as well as utilize prenatal and postnatal care factors which eventually ensure child survival (Hobcraft, 1993). Geale (2010) agrees with this finding by stating that maternal post primary education plays a significant role in determining child health outcome.

Further, the study revealed that households with higher wealth index reduces significantly the probability of observing under-5 mortality by 2.1 percent controlling for other variables. The result supports the findings by Iram and Butt (2008) who found a significant relationship between household income and child mortality. This result disagrees with the study by Edeme et al. (2014) who showed that household income (wealth) has significant effect on neonatal mortality rate but has insignificant effect on infant and under-5 mortality rates.

Finally, the study pointed that demographic factors such as sex of the child and preceding birth interval had a significant impact on under-5 health outcome. Holding all other factors constant, the probability of a child dying before its fifth birthday increases significantly by 2.1 per cent if the child is male concurring with the findings obtained by Elmahdi and Odimegwu (2008). Preceding birth interval of >24 reduces significantly the probability of an under-5 deaths by 2.5 percent when all other factors are held constant. The longer preceding birth intervals reduces sibling competition for resources enabling a child to breastfeed for longer period boosting the nutritional status of the child thus reducing chances of mortality due to malnutrition. The result backs the finding of Fotso et al. (2013) who showed that the length of the preceding birth interval is a key determinant of early childhood mortality. Da vanzo et al. (2004) supports this finding whereby the study proved that preceding birth of interval below twenty-four months was linked highly with greater dangers of neonatal deaths.

Table 4.6: Differentials in determinants of Early Childhood Mortalities in Nyanza Region

Variables	Model 1 (Neonatal)		Model 2 (Post-neonatal)		Model 3 (Infant)		Model 4 (Under-5)	
	Positive & significant	Negative & significant	Positive & significant	Negative & significant	Positive & significant	Negative & significant	Positive & significant	Negative & significant
Maternal Health Knowledge		✓						
Mother's age	✓						✓	
Mother's Education		✓				✓		✓
No. of children under-5 in household								
Household Wealth Index								✓
Source of drinking water								
Toilet facility	✓							
Household Size								
Residence								
Use of mosquito nets (No use of nets)								
Sex of Child					✓		✓	
Antenatal care visits								
Preceding Birth Interval						✓		✓
Tetanus Toxoid injection								

Source *Author's***:** *Calculation, KDHS 2014*

Factors that determine neonatal mortality are different from those that determine post-neonatal mortality (Fikree *et al.,* 2006; WHO, 2016). In addition, socioeconomic factors have varying impact on childhood mortality across different child age cohorts (Mutunga, 2004). Table 4.5 presents factors that are significant in determining child mortality at different ages of life in Nyanza region. Maternal health knowledge and type of toilet facility were found to be significant in determining neonatal mortality while household socioeconomic status was found to significantly determine under-five mortality in general. However some factors were found to commonly determine early childhood mortality at different ages of life. For instance, mother's education reduces significantly neonatal, infant and under-five deaths while mother's age was found to significantly impact both neonatal and under-five mortality. Sex of a child if male was

found to significantly increase infant and under-five mortality while preceding birth interval of greater than 24 months reduces significantly the infant and under-5 deaths.

4.5 Discussions of the Logit Regression Results

Table 4.4 presents logit regression results for the four early childhood mortality models (neonatal, post-neonatal, infant and under-5). The regression model performed well for three models (neonatal, infant and under-5 mortality) in terms of the joint significance since the overall p values for these three models were found to be statistically significant at 1 percent. This is with the exception of post-neonatal mortality model which was shown to be jointly insignificant at 10 percent, 5 percent and 1 percent levels of significance.

4.5.1 Neonatal and Post-Neonatal Mortality

In these models, age of the mother (positive), mother's education levels (negative), household socioeconomic status (negative), and preceding birth interval of >24 months (negative) were found to be statistically significant in determining the probability of a neonatal death in Nyanza region. Maternal health knowledge was found to be insignificant in determining neonatal mortality in the presence of endogeneity unlike in the 2SLS model regression which found it to be statistically significant after exoginizing it in the model. The other factor found to be statistically insignificant in logit model but was significant in the 2SLS model is access to sanitation. No factor was found to significant in determining post-neonatal mortality.

4.5.2 Infant Mortality

For infant mortality model, mother's age (positive), mother's education level (negative), household socioeconomic status (negative), use of mosquito nets by the under-5 children (negative), preceding birth interval of > 24 months (negative), and access to mass media by mothers (positive) were found to be statistically significant in determining the probability of an infant death in Nyanza region. Only mother's education level and preceding birth interval were found to be statistically significant in determining infant mortality for both the logit and 2SLS models, however, birth spacing was found to be statistically significant in determining infant mortality at 1 percent level of significance for logit model while for the 2SLS the level of significance was at 10 percent.

4.5.3 Under-5 Mortality.

The study found age of mother (positive), education (negative), economic status of the household (negative), household size (positive), use of mosquito net (negative) and preceding birth interval (negative) to be statistically significant in influencing under-5 mortality in Nyanza region. However, from the significant factors in this model, net use by the under-five and household size of four plus members were found to be statistically insignificant at all levels in the 2SLS regression model for under-5 mortality.

Overall, education level of the mother, household socioeconomic status and preceding birth interval of >24 months were found to be statistically significant in reducing neonatal, infant and under-5 mortality but at differing levels of significance while an increase in a mother's age was found to increase mortality for all the three models. No factor was found to be significant in determining post-neonatal mortality (Table 4.4).

CHAPTER 5: SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1. Introduction

This chapter presents the summary of the study results with comprehensive conclusions in relation to the objectives upon which key policy recommendations are made. Suggestions for further studies are also made.

5.2. Summary

Despite the significant progress made in curbing early childhood mortality, it is still high in Kenya by international standards. This is regardless of various measures Kenya has put in place to combat childhood deaths. Interestingly, childhood mortality in Nyanza region exhibits a contrary trend whereby it records low neonatal mortality and high post-neonatal mortality. This study therefore was conducted with two main objectives that is to determine the main determinants of early childhood mortality in Nyanza, and secondly establish the impact of maternal health knowledge and behavior on early childhood mortality in Nyanza.

The study employed descriptive analysis and it was found that 4,254 women from Nyanza region were interviewed during the 2014 KDHS. The respondents reported total births of 2,085 children born five years prior to the survey year. On mortality indicators, it was revealed that neonatal deaths were 1.87 percent with 1.54 percent being post- neonatal deaths. Approximately 3.41 percent of the deaths were infant deaths while under five mortality was 4.08 percent.

The study conducted endogeneity test in each of the four models estimating child health outcomes where maternal health knowledge was found to be exogenous in post-neonatal model while it was found to be endogenous in the other three models (neonatal, infant and under-five models). The suggested instrument which was exposure to mass media was found to be relevant and valid though very weak. Therefore, estimation in this study employed both logit regression and 2SLS regression in estimating early childhood mortality models.

The significance was tested at 1%, 5% and 10% levels. From the study, maternal health knowledge, age of mother, education level of the mother and sanitations were found to individually have significant impact on neonatal mortality when 2SLS was employed while mother's age, mother's education level, household socioeconomic

status and preceding birth interval of >24 months were found to be individually significant in determining neonatal mortality under logistic regression. All the variables in the model did not have any significant impact on post-neonatal mortality. This shows that factors that determine neonatal deaths may differ from those that influence post-neonatal deaths. Sex of the child, preceding birth interval of >24 and education level of mother was found to have significant impact of health outcome of the child at infant and under-five stages. Household economic status (wealth) and age of mother was found to have effect on under-five mortality.

Overall, education level of the mother, sex of the child, age of the mother, preceding birth interval, maternal health knowledge, sanitation and household economic status were found to have significant association with early childhood health outcome in Nyanza region of Kenya under the 2SLS regressions. For logistic regression models, mother's age, mother's education level, household socioeconomic status, preceding birth interval of >24 months, use of mosquito nets by the children under-five and household size were found to have statistically significant association with early childhood health outcome in Nyanza region.

5.3. Conclusions

Literature reveal several factors that are associated with childhood mortality. However, due to increased awareness on child health and increased interventions, some of the traditionally known determinants of child health are having no significant impact on early childhood mortality. The study findings lead to suggestion of effective child health intervention programs in light of limited resources available at national and devolved units in Kenya.

5.4. Policy Suggestions

For Kenya to achieve the sustainable development goals (SDGs) it has to improve child health outcomes in all its regions including Nyanza region.

Based on the study findings, child health stakeholders should design programs geared towards empowering mothers' economically through improved education such as adult education and also encourage self-employments to improve household economic status. This will enable mothers to make independent decisions such as deciding on nutrition requirements of the child and taking child to hospital when sick. This will also make mothers independent and therefore be able to make informed

independent choices like birth spacing which has been shown to have an impact in determining early childhood mortality.

The health stakeholders should also increase child health education programs in our mass media and even in social media and churches. This will enable mothers from Nyanza region and other regions of Kenya learn on how to keep child healthy, know of the need to take child for health care when sick and also understand nutritional requirements of the child and needs for immunization.

It is suggested that the primary causes of childhood mortality vary as the child ages, from dynamics related to demographics to causes associated with the environment. Based on the study results demographically there is a need for a program to enlighten women on the safe age brackets to give birth so as to reduce cases on adolescent births and births at late ages which the study has shown have a positive effect on early childhood health outcome.

5.5. Areas for Further Study

Many factors have been marked as possible determinants of early childhood mortality ranging from demographic, environmental and socioeconomic factors to behavioral, health knowledge and uptake healthcare services. This study widely explored most of these factors and focused in Nyanza region. Therefore, there is need for future studies to establish the same but do a comparative study across different regions or counties. Similarly, there is need to still study the factors that determine post-neonatal mortality in Nyanza region exploring different variables and different dataset since the study did not find any which was statistically significant. Finally, future studies should also focus on addressing heterogeneity in child health models.

References

Alves, D., & Belluzzo, W. (2005). "Child health and infant mortality in Brazil". *Seminar on Child Health, Poverty and the Role of Public Policies*. Paper No.1. Inter-American Development Bank, Washington DC.

Anderson, A., Romani, H., Phillips, E., & Van Zyl, A. (2002). Environment, access to health care, and other factors affecting infant and child survival among the African and coloured populations of South Africa, 1989–94. Population and Environment, Vol 23 issue 4, pp.349-364.

Bascle, G. (2008). Controlling for endogeneity with instrumental variables in strategic management research. Strategic organization, vol 6 issue 3, pp.285-327.

Blencowe, H., Lawn, J., Vandelaer, J., Roper, M., & Cousens, S. (2010). Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *International journal of epidemiology*, *39* (suppl_1), pp. 2-109.

Burchi, F. (2009). On the contribution of mother's education to children's nutritional capabilities in Mozambique (No. 0101). Department of Economics-University Roma Tre.

Buwembo, P. (2010). Factors associated with under-5 mortality in South Africa: trends 1997-2002 (Doctoral Dissertation, University of Pretoria)

Caldwell, J., Cess, D., Carlson, E., Tokunaga, T., Gillett, C., & Nolt, G. (1979). Temporal characteristics of the Jovian atmosphere. The Astrophysical Journal, Vol 234, pp. L155-L158.

Desai, S., & Alva, S. (1998). Maternal education and child health: Is there a strong causal relationship? Demography, vol 35 issue1, pp. 71-81.

Edeme, K., Innocent, I., & Okereke, S. (2014). Relationship between household income and child mortality in Nigeria. American Journal of Life Sciences, vol 2 issue 6-4, pp. 1-12.

Ettarh, R., & Kimani, J. (2012). Determinants of under-five mortality in rural and urban Kenya. Rural Remote Health, vol 12, issue 1812.

Fayehun, A. (2010), "Household environmental health hazards and child survival in sub-Saharan Africa" DHS Working Papers No. 74, Calverton, Maryland, USA: ICF Macro.

Fikree, F., Azam, I., & Berendes, W. (2002). Time to focus child survival programmes on the new-born: assessment of levels and causes of infant mortality in rural Pakistan. Bulletin of the World Health Organization, vol 80 issue 4, pp. 271-276.

Finlay, E., Özaltin, E., & Canning, D. (2011). The association of maternal age with infant mortality, child anthropometric failure, diarrhoea and anaemia for first births: evidence from 55 low-and middle-income countries. BMJ open, vol 1 issue 2, e000226.

Fotso, C., Cleland, J., Mberu, B., Mutua, M., & Elungata, P. (2013). Birth spacing and child mortality: an analysis of prospective data from the Nairobi urban health and demographic surveillance system. Journal of biosocial science, vol 45 issue 6, pp. 779-798.

Geale, K. (2010). The effects of mothers' education on the nutritional outcomes of their children in Nicaragua. Studies by Undergraduate Researchers at Guelph, vol 3 issue 2, pp. 23-30.

Glewwe, P. (1999). Why does mother's schooling raise child health in developing countries? Evidence from Morocco. Journal of human resources, pp.124-159.

Government of Kenya, (2010), "Kenya Health Policy Framework (1994-2010): Analysis of Performance, Analytical Review of Health Progress, and Systems Performance" Ministry of Medical services and Public health publications.

Heady, J. A., C. Daly, and J. N. Morris. "Social and Biological Factors in Infant Mortality. 11. Variation of Mortality with Mother's Age and Parity." Lancet (1955): 395-7.

Hill, K., Bicego, G., & Mahy, M. (2001). Childhood mortality in Kenya: An examination of trends and determinants in the late 1980s to mid-1990s. Johns Hopkins Population Center Working Paper.

Hobcraft, J. (1993). Women's education, child welfare and child survival: a review of the evidence. Health Transition Review, 159-175.

Hobcraft, J. N., McDonald, J. W., & Rutstein, S. O. (1984). Socio-economic factors in infant and child mortality: a cross-national comparison. Population studies, 38(2), 193-223.

Ikamari, L. D. (1996). Factors affecting child survival in Kenya (Doctoral dissertation, University of Nairobi).

Ikamari, L. D. (2004). An Upsurge in early childhood mortality in Kenya: a search for explanations. African journal of health sciences, 11(1), 9-20.

Iram, U., & Butt, M. S. (2008). Socioeconomic determinants of child mortality in Pakistan: Evidence from sequential probit model. International Journal of Social Economics, 35(1/2), 63-76.

Kabubo-Mariara, J., Karienyeh, M. M., & Kabubo, F. M. (2012). Child Survival and Policy Options in Kenya: Evidence from Demographic and Health Surveys. Journal of Reviews on Global Economics, 1, 13-26.

Kaldewei, C., & Pitterle, I. (2011). Behavioural Factors as Emerging Main Determinants of Child Mortality in Middle-Income Countries: A Case Study of Jordan. New York: DESA Working Paper, (103).

Kembo, J., & Van Ginneken, J. K. (2009). Determinants of infant and child mortality in Zimbabwe: Results of multivariate hazard analysis. Demographic Research, 21, 367-384.

Kichamu, G. A. (1986). Mortality estimation in Kenya with special case study of vital registration in Central Province (Doctoral dissertation, University of Nairobi).

Klaauw, Van der B. & Wang, L. (2011). Child mortality in rural India. Journal of Population Economics, 24(2), 601-628.

Klaauw, Van der B. and L. Wang (2003) 'Child Mortality in Rural India', World Bank Working Paper, Washington DC: World Bank.

Kovsted, J., Pörtner, C. C., & Tarp, F. (2002). Child health and mortality: Does health knowledge matter? Journal of African Economies, 11(4), 542-560.

Lange, K. (2003). Mathematical and statistical methods for genetic analysis. Springer Science & Business Media.

Liu, D. (2014). Determinants of Infant Mortality in Kenya-Analysis of Kenya DHS 2003 and 2008/9.

Mashreky, S. R., Rahman, F., Rahman, A., Talab, A., & Rahman, Z. (2015). Role of mass media in increasing knowledge and practices of mothers on IYCF: findings from a community trial in rural Bangladesh. South East Asia Journal of Public Health, 5(1), 18-24.

Medrano, P., Rodríguez, C., & Villa, E. (2008). Does mother's education matter in child's health? Evidence from South Africa. South African Journal of Economics, 76(4), 612-627.

Minakawa, N., Dida, G. O., Sonye, G. O., Futami, K., & Njenga, S. M. (2012). Malaria vectors in Lake Victoria and adjacent habitats in western Kenya. PloS one, 7(3), e32725.

Mosley, W. H. (1989). Will Primary Health Care Reduce Infant and Child Mortality? Selected Readings in the Cultural, Social and Behavioural Determinants of Health. Canberra, Australia: Health Transition Centre, Australian National University, 261-294.

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

Mott, Frank L. 1979. "Infant mortality in Kenya: Evidence from the Kenya Fertility Survey," Scientific Report No. 32, World Fertility Survey, London.

Mulugeta, F. Z. (2011). Socioeconomic Factors Affecting Childhood Mortality in Ethiopia: An Instrumental Variable Approach. *Ethiopian Journal of Economics*, *20*(2), 63-82.

Muriithi, D. M., & Muriithi, D. K. (2015). Determination of Infant and Child Mortality in Kenya Using Cox-Proportional Hazard Model. American Journal of Theoretical and Applied Statistics, 4(5), 404-413.

Murray, M. P. (2006a). Avoiding invalid instruments and coping with weak instruments. Journal of economic Perspectives, 20(4), 111-132.

Murray MP (2006b) The Bad, the Weak, and the Ugly: Avoiding the Pitfalls of instrumental Variables Estimation. Social Science Research Network Working Paper No.843185.

Mustafa, H. E., & Odimegwu, C. (2008). Socioeconomic determinants of infant mortality in Kenya: analysis of Kenya DHS 2003. J Humanit Social Science, 2(8), 1934-722.

Mutunga, C. J. (2004). “Environmental determinants of child mortality in urban Kenya.” Unpublished masters of Arts Research Paper. University of Nairobi.

Mwabu, G. (2008). The production of child health in Kenya: a structural model of birth weight. Journal of African Economies, 18(2), 212-260.

Omariba, D. W. R., Beaujot, R., & Rajulton, F. (2007). Determinants of infant and child mortality in Kenya: an analysis controlling for frailty effects.Population Research and Policy Review, 26(3), 299-321.

Omolo, S. (2014), “Socioeconomic determinants of under-five mortality in principal cities of East Africa Community: A case study of Nairobi, Dar-es-salaam and Kigali”. Unpublished Masters of Arts Research Paper .University of Nairobi.

Osita, E. K., Agho, K. E., Dibley, M. J., Hall, J. J., & Page, A. N. (2015). Risk factors for post-neonatal, infant, child and under-5 mortality in Nigeria: a pooled cross-sectional analysis. BMJ open, 5(3), e006779.

Otieno, J.A.M. and Kichamu, G.A., 1986. Estimation of mortality levels and differentials in Keya: A look at regional differences in infant and child mortality. A seminar paper presented in Zamardi, Hungary.

Oyekale, A. S. (2014). Factors Explaining Child Survival in Ethiopia: Application of Two-Stage Probit Model. *African Development Review*, *26*(2), 237-249.

Rosenzweig, M. R., & Schultz, T. P. (1983). Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight. Journal of political economy, 91(5), 723-746.

Santerre, R. E., & Neun, S. P. (2012). Health economics: Theory, insights, and industry studies. Cengage Learning.

Schultz, T. P. (1984). Studying the impact of household economic and community variables on child mortality. Population and Development Review, 10, 215-235.

Schultz, T. P. (1984). Studying the impact of household economic and community variables on child mortality. Population and Development Review, 10, 215-235.

Shea, J. (1997). Instrument relevance in multivariate linear models: A simple measure. Review of Economics and Statistics, 79(2), 348-352.

Stock, J. H. (2010). The other transformation in econometric practice: Robust tools for inference. Journal of Economic Perspectives, 24(2), 83-94.

Stock, J. H., & Yogo, M. (2002). Testing for weak instruments in linear IV regression.

Uddin, M. (2009). Child Mortality in a Developing Country: A Statistical Analysis. Journal of Applied Quantitative Methods, 4(3), 270-283.

United Nations Children's Fund, World Health Organization, The World Bank, & United Nations Population Division. (2007). Levels and trends in child mortality in 2006: estimates developed by the Inter-agency Group for Mortality Estimation.

Wichmann, J., & Voyi, K. (2006). Influence of cooking and heating fuel use on 1–59 month old mortality in South Africa. Maternal and child health journal, 10(6), 553-561.

World Health Organization. (2013). Children: reducing mortality. Geneva (Fact Sheet No. 178).