DETERMINANTS OF INFANT AND CHILD MORTALITY IN MALAKAL IN UPPER NILE STATE, SOUTH SUDAN

BY

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DECLARATION

I hereby declare that this thesis is my own original work. To the best of my knowledge, it has not been submitted before in part or in full for any other university or for any other degree award, publication or other use. Where the works of others are quoted appropriate references have been given.

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DEDICATION

I dedicate this work to my beloved family; my wife Luciana Juma Mayik and my daughters Mijwok and Tekjwok and my son Pwocjwok who provided relaxed environment for the organizing of this work. Your participation is appreciated. May God bless my family and my footprint while ascending academic ladder. Particular gratitude should go to my much-loved father Abol Amum Ajak and my mother Nyatait Papiti Ajak for arranging a good basis of schooling for me.

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ABSTRACT

This study sought to establish the determinants of infant and child mortality in Malakal. The study used primary data collected from a random sample of 1317 women in the reproductive age (15-49 years) in Malakal. Descriptive statistics, direct method of estimation and multivariate Cox regression analysis were the methods of data analysis.

The Bivariate analysis findings showed that mother's education, mother's employment, family income, parity, birth order, preceding birth interval, source of drinking water, type of toilet facility, type of floor of the house, place of delivery and duration of breastfeeding were significantly associated with both infant and child mortality. Age of the mother at first birth and source of cooking fuel were significantly associated with child mortality.

The multivariate Cox regression analysis results showed that place of delivery, duration of breastfeeding and family income were significantly associated with both infant and child mortality. Besides, mother's employment, zone of residence, parity, birth order and sex of the infant were significantly associated with infant mortality. Mother's employment, source of cooking fuel and type of floor of the house were significantly associated with child mortality. In addition, age of the mother at firth birth, preceding birth interval, and source of drinking water were also significantly associated with child mortality.

The study recommends for policy that preceding birth intervals should be longer, increase maternity leave for employed mothers in order to improve breastfeeding status, use of improved water supply, use of clean fuels for cooking, and increase preventive and therapeutic medical interferences to risk zones (northern and central), mothers aged 30+ years should be encouraged to attend antenatal care and encourage delivery of babies at health facilities. The study also recommends that further research is needed, using qualitative methods, on infant and child mortality so as to discover other factors influencing infant and child mortality in Malakal and to provide insights into the pathways of influence.

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LIST OF ABBREVIATIONS AND ACRONYMS

BDHS Bangladesh Demographic and Health Survey

CBS Central Bureau of Statistics

CI Confidence Interval

CMR Child Mortality Rate

Deff Design effect

DHS Demographic and Health Survey

EAs Enumeration Areas

EDHS Ethiopia Demographic and Health Survey

GDHS Ghana Demographic Health Survey

GDP Gross Domestic Product

GHS General Household Survey

HR Hazard ratios

IMR Infant Mortality Rate

KDHS Kenya Demographic and Health Survey

LPG Liquid Petroleum Gas

MDGs Millennium Development Goals

MDHS Malawi Demographic and Health Survey

MICS Multiple Indicator Cluster Survey

MDHS Mozambique Demographic and Health Survey

NDHS Nigeria Demographic and Health Survey

PAR Population Attributable Risk

PIF Potential Impact Fractions

PSU Primary sampling units

SADHS South Africa Demographic and Health Survey

SDGs Sustainable Development Goals

SDHS Sudan Demographic and Health Survey

SHHS Sudan Household Health Survey

SSNBS South Sudan National Bureau of Statistics

SSSMS South Sudan Safe Mother Survey

SPHC Sudan Population and Housing Census

SPSS Statistical Package for the Social Sciences

TDHS Tanzania Demographic and Health Survey

UN United Nations

UNICEF United Nations Children Emergency Fund

WHO World Health Organization

ZDHS Zimbabwe Demographic and Health Survey

CHAPTER ONE

INTRODUCTION

1.1.Background to the Study

Infant and child mortality have received renewed attention as a part of the United Nation's sustainable development goals (SDGs). They are frequently used as indicators of the socioeconomic development of a nation and quality of life (Madise et al, 2003). According to Espo report (2002), nearly 10 million children still die each year worldwide before reaching their fifth birthday, with great disparities in infant and child death rates and trends across areas and nations.

According to Val (1976), infant and child death rates had dropped whole over the globe in the past 55 years. Between the end of the World War II and near the beginning of the 1970s, infant and child death rates even in less developed nations were decreased by halve (Val; 1976). A major part of these improvements was bought by interventions that targeted childhood diseases which have been main causes of infant and child death.

In spite of the wide progress towards child health, the decrease in levels of infant and child death rates in numerous African nations have been still slower since the 1980 than in the 1960s and the 1970s (UNICEF Report, 2010, 2009). From the thirty nations with the globe's highest infant and child death rates, twenty seven were in Sub-Saharan Africa (UNICEF Report, 1999). In 1998, child death rate was 173 per 1000 live births compared with 70 per 1000 live births the lowest goal of globally approved in the 1990 World Summit for children (UNICEF Report, 2000).

Despite the substantial literature on infants and children mortality, reasons infants and children mortality rates stay very high in different Sub-Saharan African nations in spite of initiative policies and interferences made are still meager (Mutunga, 2007). It has been indicated that eighteen of the twenty nations across the globe with the highest infant and child death were in Sub-Saharan Africa (United Nations report; 1995). A main hindrance to improvement may be the chronic or protracted civil wars and political instability that characterize several nations in Sub-Saharan Africa (Macassa et al, 2003).

Despite the recent decline, the infants and children mortality in South Sudan are still among the highest in the globe. The 1993 Sudan Population Census showed very high levels of infants and children mortality which were 141 and 210 per 1000 live births, respectively (Sudan Population Census, 1993). However, the 1999 South Sudan Safe Mother Survey revealed that infants and children mortality were 93 and 123 per 1000 live births, consecutively (SSSMS, 1999). This indicates downward trend in infants and children fatality in South Sudan.

The results of Sudan Demographic and Health Survey 2006 showed that infants and children mortality rates were 82 and 110 deaths per 1000 live births, respectively in Malakal (SDHS, 2006). However, the study by Abol et al (2009) showed that infants and children death rates were 86 and 108 per 1000 live births, respectively. No other recent study has been undertaking to estimate infant and child mortality as well as establish their determinants. Therefore, the current determinants of infant and child mortality in Malakal are largely unknown and thus poorly understood. This is the focus of this study.

1.2.Background Information of South Sudan

South Sudan is situated in East Africa. It shares borders with Sudan in north, Ethiopia in east, Uganda in south, Kenya in southeast, Central African Republic in west, Democratic Republic of Congo in southwest. It covered surface area around 644,329 square kilometres. South Sudan's population was estimated to be around 8.26 million people; halve of the population were beneath eighteen years of age and the population of the children aged 0-4 years is around 16 percent of the total population (Sudan Population Census, 2008). The most of the population 51 percent lives under national poverty line (lower than $1 per day). Poverty is focused in rural areas, with about 55.4 percent of the populations in the rural areas living under the poverty line, while the population in urban areas was about 24.4 percent (World Bank Report, 2011a).

It became the globe's newest nation on 9 July 2011. Despite a new state, it has the double defiance of handling with the patrimony of more than fifty years of civil war and persisted insecurity, alongside with massive development requirements. Government institutions are

being constructed from a very low foundation and ability of government to draft plans and put into action is limited. Therefore, eight in ten women were uneducated, one in seven women were dying in childbirth, one in three persons never attended school, one in nine children died before reaching five years of age, more than half of the civilians did not have a primary education, and halve of the populations had no access to safe sources of drinking water. Chronic poverty and enduring underdevelopment impacted hugely on the capacity of the new nation to provide services (UN, 2014). It has a few of the worst health indicators in the region and in the globe. The average life expectancy at birth was 54 years, infant and child death rate was 75 and 105 per 1000 live births, respectively in the 2010 SHHS II, while maternal death rate was 2,054 deaths per 100,000 live births, one of the top in the globe greatly accounted for by the deteriorated of health facilities and shortage of skilled doctors (WHO, 2014).

It is the mainly oil-reliant state in the globe, with oil calculating for nearly the entirety of export, and contributes about 60 percent to the state's GDP and to nearly all external exchange revenues, therefore making the economy extremely susceptible to fluctuations in oil prices and oil production levels. The state's GDP per capita was around ($1,111) in year 2014. The present civil war has cost up to 15 percent of the potentials GDP in year 2014. However, the effects of the civil war on the population participated to a decline of the standards of living and the collapse in services have had profound economic and social results for a state where human development is really among the worst in the globe (World Bank Report, 2015).

1.3. Problem Statement

Although several studies on the determinants of infant and child mortality have been undertaken in some parts of South Sudan particularly in Malakal, they did not include all the factors that are often associated with infant and child mortality (Paul and Damien, 2011; Abol et al, 2009; Erica and Balan, 1990). For instance, the study by Abol et al (2009) did not include environmental, maternal health seeking behavioral and nutritional factors, and no study to date has addressed their effects on infant and child mortality in Malakal. Furthermore, the study used a relatively small sample (N=384) to permit a robust analysis of infant and child mortality determinants in Malakal.

Many studies have confirmed importance of environmental, health seeking behavioral and nutritional factors of infant and child fatality in developing nations. For example, evidence indicates that the effects of environmental risk factors are identified as leading mortality risks in infants and young children (UNICEF, 2012; Wichman, 2008; Davis, 2007; Pruss, 2006; WHO, 2002). Scientific evidence indicates that the place of delivery is a crucial factor which affects the health and well-being of mother and newborn and is a significant predictor of infant mortality (Justice et al, 2012; Deb and DasGupta, 2009; Murthy et al, 2007). Also, evidence supports strongly the importance of breastfeeding in promoting healthy development of children and is a significant factor in child survival (K'Oyugi, 2014; Ogbe, 2008; WHO, 2000; Khan, 1991).

Secondly, effects of determinants of infant and child mortality change over time (Buwembo, 2010; DaVanzo and Habicht, 1986; Merrick, 1985; Preston, 1980, 1976). However, it is possible that the effects of some of the factors included in the previous studies (Paul and Damien, 2011; Abol et al, 2009; Erica and Balan, 1990) may have changed by now due to the social and structural changes taking place in South Sudan in the last five years.

Thirdly, there are contradictory findings among some of the previous studies in South Sudan regarding the effects of some of key determinants of infant and child mortality with respect to the effects of maternal education. For instance, several previous studies cited that it has significant effect on infants and children mortality (Lemani, 2013; Mekonnen, 2011; Abed et al, 2010; Olabisi, 2010; Buwembo, 2010; Abol et al, 2009;Goro, 2007; Ezra and Gurum, 2002; Kabir et al, 2001; Murthi et al, 1995; Erica and Balan, 1990), while other studies found that it had insignificant effects on infants and children mortality (Paul and Damien, 2011; Eshetus, 1998). However, another study cited that it has significant effects on childhood mortality (Vikram et al, 2010).

Family income revealed conflicting findings. One study cited indicates that it has significant effects on infant and child mortality (Abol et al, 2009); while other earlier studies found that it had insignificant effects on infants and children mortality (Richardson et al, 2015; Erica and Balan, 1990). Another study cited that it has significant effects on infant mortality (Kittur, 2014; Sarah and Stephen, 2004). Also, another study cited that it has significant effects on child mortality (Buli, 2013).

The type of place of residence of the mother showed contradictory findings. Several previous studies found that it had significant effects on infants and child mortality (Buwembo, 2010; Macassa et al, 2003); while another study found that it had insignificant effects on infants and child mortality (Eshetus, 1998). Other studies indicate that it had significant effects on infant mortality (Dede, 2013; Adetunji, 1994).

The proposed study seeks to resolve the above contradictory results and the limitations of the previous studies through undertaking a more comprehensive study of the current levels and differentials in infants and children mortality and their determinants using a large sample size.

1.4. The Study Questions

The questions that the study attempts to answer are:

1. What are the levels and differentials of infant and child mortality in Malakal?
2. What factors are associated with infant and child mortality in Malakal?

1.5. Objectives of the Study

1.5.1. The General Objective

The general objective of this study is to establish the determinants of infant and child mortality in Malakal.

1.5.2. The Specific Objectives

The specific objectives of the study are as follows:

1. To establish the levels and differentials in infant and child mortality in Malakal.
2. To identify the factors associated with infant and child mortality in Malakal.

1.6. Justification of the Study

Despite the fact that the determinants of infant and child mortality have been studied in Malakal in 2009, the various factors affecting infant and child death are still not fully understood. For instance, the study by Abol et al (2009) did not include all the factors such as environmental factors, health seeking behavioral, and nutritional factors that are often associated with infants and children mortality. Effects of these factors on infants and children mortality in South Sudan are yet to be known. A comprehensive understanding effects of the

various factors on infant and child mortality is important for proper planning and development of interventions in Malakal.

Furthermore, a review of the previous studies shows contradictory results with respect to the effects of maternal education, family income and mother place of dwelling on infant and child mortality. It is significant to resolve these contradictions through undertaking a more comprehensive study and using a large sample size. This study hopes to resolve these contradictions.

This study is therefore expected to contribute to the present literatures on determinants of infant and child mortality in general and in Malakal in particular by employing survival analysis. This study will be useful to government, policymakers, researchers and demographers to identify significant fields they want to concentrate on, in order to formulate plans and programs to decrease infant and child fatality in the future in Malakal, and also will form a basis for further study.

1.7. Scope and Limitations of the Study

The study focuses on the determinants of infant and child mortality in Malakal. It used primary data obtained from field work survey conducted in Malakal. This survey collected data on following information: background characteristics and the whole birth histories of mothers in the reproductive age (15-49 years), socio-economic, biological and maternal, environmental factors, health seeking behaviour, and nutritional factor. The study consisted of sample size of 1109 infant live births (0-11 months) from the representative sample of 1,317 women aged 15-49 who were interviewed from 1,020 households to provide information on their infants and children.

Studies of infant and child mortality are confronted with data limitations in South Sudan where mortality is considered as a sorrowful occasion that mothers do not like to remember; for that reason, there is tendency for underreporting of child deaths and this might affect the level of infant and child mortality levels. Other limitations were the matter of language. Few of the mothers could not understand English; therefore questions were asked orally in Arabic or Local language and this may imprecise the meaning of the question. Few of the mothers also did not know precisely their ages at birth. Also, few of the households were displaced during

the time of the survey due to the civil war in the country because of fear from insecurity, few of the mothers altered their minds and declined to be interviewed fearing that the information they gave might be used against them.

1.8. The Organization of the Study

This study composed of six chapters, Chapter one; introduction, covering background of the study, background information of South Sudan, problem statement, research questions, study objectives, study justification, scope and limitation of the data, Chapter two is for literature review and theoretical framework, including theoretical perspectives, empirical studies, summary of empirical studies, theoretical/conceptual frameworks, the proposed conceptual framework, operational framework to guide the study, study hypotheses and operational definitions of variables, Chapter three is for the study area and methodology, covering the study area, study design, study population and sampling methods, data collection methods, data collection tools, ethical considerations, data processing procedures, data analysis methods, Chapter four is for determinants of infant mortality, Chapter five is for determinants of child mortality, Chapter sixth is for summary, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORKS

2.0 Introduction

The purpose of this chapter is to shed light on eight aspects:, the first focuses on theoretical perspectives, the second part looks at empirical studies; and the third part looks at summary of empirical studies, the fourth at theoretical/conceptual frameworks, the fifth at the conceptual framework for the study, the sixth at the operational framework, the seventh at hypotheses and the last at operational definitions of variables.

2.1 Theoretical Perspectives

Theoretical perspectives present foresights on several schools of ideas that direct the thought on infant and child mortality. This section reviews; the economic theory, the social theory, the political theory, the dependency theory and some of previous quantitative studies of infant and child mortality to determine different economic variables, political variables, social variables and dependency variables that have been beneficial during previous efforts to explain for transnational difference in infant and child mortality rates.

2.1.1 The Economic Perspective

Economic theory sights development as filling the vacuum between developed countries and less developed nations through a mimic operation. Augments in economic development lean to create a higher living standards, and better access to sophisticated medical technologies which in turn reduce infant and child mortality (Rostow. 1990). Also, economic development promotes upgrading in education, nutrition, housing, sanitation, health care, and different services that decrease infant and child mortality (Field and Frey. 2000). Several studies found the reverse association between economic forecasters such as stage of development and infant and child mortality (London and Lena. 1993; Beck and Firebaugh. 1994; Field and Frey. 2000; Williamson and Shen. 2001; Shandra et al. 2004). Additionally, Easterlin (1998) argued that decreases in infant and child mortality were generally owing to economic prosperity, better food, better quality housing, medical improvements, technological innovations and improvements in public health services and policies.

2.1.2 The Social Perspective

Social theory attempts to explain the turn education play as an internal operator in the development operation inside a nation. Incrementing education levels in less developed nations consequences in higher revenues in the wages labour markets, which typically interpreted into increments in economic expansion (Bellew et al. 1992). Economic growth in role increases echelons of industrializations, which frequently yield higher living standards, and better reach to sophisticated medical technologies. Just as indicated formerly, augments in living standards, and improvements in technologies could reduce infant and child mortality all over the less developed nations (Rostow, 1990). Various previous studies found that female education assists to decrease infant and child mortality in less developed countries (London and Lena, 1993; Frey and Field. 2000; Shandra et al. 2004).

Declines in infant and child mortality could also be associated to education of the mothers through fertilities decreases (Caldwell. 1982). Beneath situations of scarceness wealth, lowering the proportion of kids lets the donor to allot more time and funds to every kid. These kids will be best cared for, typically best fed and then healthiest. Furthermore, best educated women will be most well-informed concerning health (more expected to seek health care for their children, capable to talk to health care providers, and have positive impacts on the household balance in expressions of baby care) and safeties hazards as well as feeding, all of which upgrade the health of kids and decrease infant and child mortality. Additionally, Glewwe (1999) argued that mothers who are more educated are more expected to have greater family resources and income than mothers who are less educated. Therefore, they have greater access to better food, housing, and recent health services, which leads to better child health. Further, Goldberg et al (1987) put it that increased female education increases the percentage of fully vaccinated children, improves diarrhoea management, increases use of modern family planning, increases use of health facilities and improves the nutritional status of the household. Several previous studies display facts behind the assumed advantageous effects of female educational achievement on infant and child mortality (London and Lena, 1993; Williamson and Boehmer, 1996; Frey and Field., 2000; Shandra et al., 2004). Also, various previous studies recommend that mother's education is one of the major significant determinants of infant and child mortality (Caldwell. 1979; Martin et al. 1983). The higher

the level of education of the mother, the lower the infant and child mortality (Frey and Field. 2000).

2.1.3 The Political Perspective

The levels of political democracy should impact the levels of infant and child mortality in less developed nations. Specifically, a few scientists propose that democracies in the less developed countries are quick to respond to people view, popular demands and social movements interested with health associated matters such as infant and child mortality, whereas dictatorships (non-democracies) tend to react to international companies interests not associated with such health results (Rich,. 1994; Jenkins and Crenshaw,. 1996; Karliner,. 1997; Fischer,. 1999). Since democracy is generally quicker to respond to popular demands and social interests of civil society, infant and child mortality should be fewer in democratic countries. Some studies found that political rights are associated with lower infant and child mortality (Boone, 1996; Navia and Zweifel, 2000). On the contrary, political oppressive can guide to increments in infant and child mortality, as oppressive governments are less expected to react to people view, popular demands and social movements interested with health matters (Leonard, 1988; Ross and London, 1995). Only one study has found the reverse connection between indicators of democracy and infant and child mortality (London and Lena,. 1993). Additionally, democracies are associated with greater freedom of the press, which can consequence in better policy options and execution capabilities and better health, education and economic development (Sen, 1999; Przeworski et al, 2000). In fact, Przeworski et al (2000) found the rate of infant mortality is higher beneath despotisms (dictatorships) and lower beneath democracies.

2.1.4 The Dependency Perspective

Dependency theory explains that the capitalist international system sustains a worldwide segmentation of labour that obstructs the national economies of several less developed countries, decreases the rate of economic development, raises revenue disparity, and unfavorably influences felicity to a large fraction of a people (Wimberly and Bello, 1992; Gereffi, 1989; Wallerstein, 1983, 1974; Frank,1967). But, there has been a large effect of gross domestic product over decline in the infant and child mortality rates (Brenner. 1979).

Dependency scholars debate that commerce dependance has exacerbated the vacuum between center and marginal nations since the commerce of resources for manufactured commodities is intrinsically unbalanced (Bunker, 1984) and prices for primary commodities have practiced long run drop relative to prices for manufactured commodities (Frank,. 1967; UNICEF, 1989). Also, especially in the export of crude resources guides to a deformed and an unstable financial system. Thus, the country's capacity to increase incomes is destabilized and the consequential shortage of incomes influences the financing of health services. Lacking the availabilities of such plans, infant and child mortality is possible to rise. Several studies have found the assumed, detrimental impacts of commerce dependance on infant and child mortality (Dixon, 1984; Adams and Cutright, 1984; Williams and London, 1990; Bradshaw and Ragin, 1992; London and Lena, 1993; Williamson and Boehmer, 1996; Williamson and Shen, 2001).

In the theory, authors have indicated the altering character of global economic interchange of center-marginal relations that have taken position in the latest four decenniums, as the leaning for international companies to operate in manufacturing production in the margin has augmented (Frank. 1967; Chase-Dunn and Bornschier, 1985; Trachte and Ross, 1990). The authors propose that overseas straight investments encourage undergrowth in less developed nations. Generally, international companies impede health, education, and other social services; by hindering regime plans that are useful too much of the people however detrimental to the wellbeing of international companies (Evans. 1979; Chase-Dunn and Bornschier, 1985; Trachte and Ross, 1990). Specifically, less developed nations are frequently seen as inexpensive factors of production for international companies that are headquartered in the center (Jenkins and Crenshaw. 1996; Karliner. 1997).

Marginal nations keen to maximize external investments in attempts to widen domestic production, technology and employment are frequently in the place of rivaling with one another. Consequently, marginal nations display a diversity of economic inducements counting wages and taxes decreases (Leonard. 1988; Ross and London. 1995; Trachte and Ross. 1990). As a result, international company investments corrode taxes income employed to finance essential services, which may guide to an augment in infant and child mortality. Several previous studies found the assumed, positive association between international

company infiltration and augmented infant and child mortality (Wimberly, 1990; London and Lena, 1993; Williamson and Shen, 2001; Shandra et al, 2004).

Since earlier 1970s, numerous less developed countries have become captured in the global debts crises. External debts widening and associated austerities measures ordered by institutions that provide them funds have affixed a new aspect to center-marginal dependency relations (Huang and Bradshaw, 1991; Bell, 1999; Harper, 2001). Debts and interest payments exhaustion really limited funds away from investment in the domestic financial system and, thus, hinder economic growth. This lessens government expenditure on education and health services, hindering any decline in infant and child mortality. Several studies recommend that debts acquired from external assistances have detrimental impacts on infants and children mortality (Sell and Kunitz, 1987; Huang and Bradshaw, 1991; Bradshaw et al, 1993; Williamson and Shen, 2001; Field and Frey, 2000; Shandra et al, 2004).

2.2 Review of Empirical Studies on Infant and Child Mortality

This section provides a theoretical framework intended to facilitate the interpretation of the results and findings of this study. A factor of death can be distinct as a variable that would change a mortality level if its own rate was changed. However, there is no general theory concerning the determinants of mortality and the mechanisms by which those determinants operate. Various conceptual frameworks have been adopted for the conditions determining health and sickness in childhood, and they do agree on the following points.

Several research works had been conducted using survey and census data at different levels and different places across the developing world in an attempt to find out how determinants in a population influence the infant and child mortality and these several studies have identified these determinants in many developing countries. However, the following pages attempt to overview these studies.

Richardson et al (2015) conducted a study to examine the relationship between household income and child mortality in Nigeria. The study used data from Multiple Indicator Cluster Survey 2012 (MICS) and Genera Household Survey 2012 (GHS). The results of logistic regression showed that household income has insignificant effect on infant and child mortality. Also, results showed that household size has significant effect on infant mortality.

Furthermore, health spending has insignificant effect on child mortality rate but has significant effect on neonatal mortality rate. Thus, the study concluded that health spending especially on programs like safe drinking water should be sustained to reduce child mortality.

Kittur (2014) conducted a study aimed to establish the factors influencing infant mortality in Kenya, using data from the 2008-2009 (KDHS. The results showed that birth order and wealth index have significant effects on infant mortality. The study concluded that future study should focus on infant mortality using qualitative methods in different urban settings.

Buli (2013) carried out a study to identify the effects of factors on child mortality in Ethiopia; utilizing data from the 2005 EDHS. The results showed that mother's education, father's education, wealth index, family size, sex of the child, birth order, breastfeeding and source of drinking water have significantly associated with child mortality in Ethiopia. The study concluded that government should improve society services to reduced child mortality.

Lemani (2013) conducted a study to establish the variables of infant and child mortality in Malawi, using data from the 2010 MDHS. The results showed that mother's education, father's education, wealth index, and mother's age at first birth, preceding birth interval, birth order and sex of the child have significant effects on infants and children mortality. This study concluded that rising knowledge on importance of mother's education to decrease infants and children mortality.

Dede (2013) his study aimed to examine the determinants of infant mortality in Tanzania. Data from the 2010 TDHS was used. The binary logistic regression was conducted to examine the independent effect of background variables on infant mortality. The results obtained indicated that zones of residence, place of delivery, duration of breastfeeding and preceding birth interval were the significant determinants of infant mortality. The study recommends that, the individual-level variables should be considered in future studies of infant mortality.

Ong'era (2013) conducted a study to establish the effects of environmental risk factors on infant and under-five mortality in Kenya, using (KDHS). The study used survival models to determine association and then simulate using measures of Population Attributable Risk (PAR) and Potential Impact Fractions (PIF). The following inferences are made: first, children who were not exclusively breastfed, firewood for cooking, unimproved sources of

drinking water, residing in houses with wooden floors and near to the ground socio-economic category of households were significantly associated with child mortality. Second, effects of environmental risk factors have generally remained the same over the 19 years period 1989 to 2008. Third, for all risk factors except use of non-improved sources of drinking water, reduced exposure levels promise greater gains in infant mortality than U-5 mortality and fourth, environmental health risks have a huge impact on childhood mortality as only modest reductions in exposure translate to substantial gains in mortality. Based on these findings, the study recommend the adoption of less polluting cooking fuels, e.g. Liquid Petroleum Gas (LPG), electricity and biogas among others, the use of clean and safe sources of drinking water. The study also urge policy makers to first address environmental risk factors before embarking on other risk factors.

Muluye and Wencheko (2012) carried out a study to establish the effects of factors on infant mortality in Ethiopia, using data from 2005 EDHS. The results showed that mother's education, mother's age at first birth, birth order, sex of child, duration of breastfeeding and source of drinking water have significant effects on infant mortality. The study recommended that awareness to encourage mother's education, longer birth spacing, longer duration of breastfeeding, improve water supply and discourage teenage pregnancy to reduce infant mortality.

Adepoju et al (2012) aimed to establish the determinants of child mortality in Nigeria, using data from the 2008 NDHS. The results of the Logit regression analysis showed that mother's education, place of delivery, age of the mother at first birth, duration of breastfeeding, sex of the child, type of birth have significantly association with child mortality. The study recommended that awareness of benefits of maternal education, duration of breastfeeding, access to adequate health care should be encouraged to reduce child mortality in Nigeria.

Mojekwu and Mesike (2012) conducted a study to establish the environmental determinants of child mortality in Nigeria, using data from the 2008 NDHS. The findings showed that use of non-improved toilet facilities, high polluting fuels; mothers with no education and source of drinking water were positively associated with child mortality. The study concluded that use of clean cooking fuel should be encouraged to reduce child mortality.

Aigbe and Zannu (2012) conducted a study to highlight the unevenness in childhood mortality rates in Nigeria, using the data from 1999 and 2008 NDHS. The results showed that geo-political zones have significant effects on infant and child mortality rates. This study recommended that enhance accessibility to medical service, and education of the mother to reduce childhood mortality rates.

Paul and Damien (2011) used three different proportional hazards regression models to analyze the factors related to infant and child mortality in South Sudan. The findings cited that maternal education has insignificantly associated with infant and child mortality, while wealth has significantly associated with child mortality. On the other hand, age of the mother at first birth, birth order; preceding birth interval and sex of child had significant impacts on infant and child mortality.

Mekonnen (2011) carried out a study to establish the determinants of infant and child mortality in Ethiopia, using data from the EDHS Survey The results showed that, mother's education, family size, sex of the child, marital status, preceding birth interval, birth order, and type of birth have significantly associated with infant and child mortality, while duration of breastfeeding has significantly associated with infant mortality. The study concluded that policies should be revised focusing on mother's education and father's education and longer duration of breastfeeding to reduce infants and children mortality.

Vikram et al (2010) their study tried to determine the impacts of maternal education on infant and child mortality in India, utilizing data from India Human Development Survey 2005. The results showed that maternal education has significantly associated with infant and child mortality. The study concluded that maternal education will be encouraged to decrease infants and children mortality. This study though did not describe the association between environmental risk factors and mortality at the population level.

Abed et al (2010) their study attempted to establish the demographic and socioeconomic factors of infant and child mortality in Sudan. The findings of Bivariate analysis showed that preceding birth interval, child immunization and mother's education have significant association with infant and child mortality. The study concluded that policy makers and

researchers should provide more concentration to improve the vaccination services and mother education to lower infant and child mortality.

Buwembo (2010) conducted a study to investigate whether the relationship of a specific factor to child mortality persists over time in South Africa using data from the 1997 October Household Survey and the 2002 General Household Survey. The results of logistic regression showed that mother's education, mother place of residence, age of the mother at first birth, birth order, preceding birth interval, sex, nutrient deficiency, and place of delivery have significant relationship with infant and child mortality during 1993-1997 periods. However, during the 1998-2002 periods, the results showed that mother's education, sex of child, preceding birth interval, type of dwelling and mother place of delivery have significant connection with infant and child mortality during 1993-1997 period. The study showed that changing in factors has correlated to infant and child mortality for the period 1993-2002. Therefore, government should monitor and evaluate existing programs regularly in order to revise or r-design programs which are more relevant to the factors which are predominant in determining child survival.

Olabisi (2010) conducted a study to examine mother's related socioeconomic and demographic determinants of infant and child mortality in the Eastern Cape, South Africa. The study utilized variables obtained from 1998 South Africa Demographic and Health Survey (SADHS) dataset for children. The results showed that mother's age at first birth, preceding birth interval, birth order, mother's education, and mother place of birth have significant related to infant and child mortality. Therefore, postponement female age at birth with an appropriate child spacing, nonetheless, the improvement maternal education will enhance the lessening of infant and child mortality. Steps that may be taken towards improving the health status of infant and child, including ways by which infant and child mortality may be reduced are recommended.

Abol et al (2009) conducted a study aimed to identify the factors associated with infant and child mortality in South Sudan, utilizing primary data. The results of Bivariate analysis showed that family income, child immunization, preceding birth interval, mother's education and family size had significant connection with infant and child mortality. Study

recommended that expanding immunization of children, and encourages mother education to promote family planning services to lower infant and child mortality.

Uddin et al (2009) they conducted a study to investigate the interpreters of child mortality in Bangladesh, using data from the 1999-2000 BDHS. The results showed that father's education, father's occupation, standard of living index, birth order and duration of breastfeeding have significant impacts on child mortality. Study concluded that, attention should be given to mother education to improve duration of breastfeeding in order to reduce child mortality.

Mondal et al (2009) conducted a study to determine the influence of factors on infant and child mortality in Bangladesh. The results showed that duration of breastfeeding, child immunization, age of mother at first birth, preceding birth interval have significant effects on infants and children mortality. The study concluded that awareness supposed to be offered to mother education and increasing access to health services to decrease infants and children mortality.

Kembo and Ginneken (2009) their study aimed to identify the effects of factors on infant and child mortality in Zimbabwe, using data from the 2006 ZDHS survey. The results showed that preceding birth interval and birth order have significant effects on infants and children mortality. The study concluded that, use of contraceptive methods supposed to be increased to decrease infants and children mortality.

Goro (2007) his study to identify the determinants of infant and child fatality in Ghana, utilizing data from the 1993, 1998, and 2003 GDHS surveys. The result showed that mother's education has significant effects on infant and child mortality. Only birth order had significant effects on infant mortality. The study concluded that attention should be given to mother's education to longer birth order to decrease infants and children mortality.

Macassa et al (2004) their study aimed to establish the role of household environmental factors on childhood mortality in Mozambique, using data from 1997 MDHS survey. The findings showed that source of drinking water and types of toilet facility have significant contribution to childhood mortality. The study concluded that use of piped water and flush toilet to reduce the risk of childhood mortality.

Mutunga (2004) used survival analysis to investigate the impact of environmental factors on child mortality in Kenya, using the data from KDHS 2003 dataset. The results obtained showed that safe drinking water, low polluting fuels, sanitation and maternal education have significantly associated with children mortality. The study recommended that policies should be directed on improving household environmental factors to reduce child mortality.

Sarah and Stephen (2004) conducted a study to establish the probability that Uganda will meet the MDG of halving infant mortality by year 2015, using data from Uganda Demographic and Health Surveys 1974-1999. The results showed that family income has significantly associated with infant mortality. The study concluded that government and rule makers want to intensify their potentials to decrease infant and child mortality by half.

Esayas (2003) his study aimed to investigate the effect of work status of mother on infant mortality in Ethiopia, using data from the 2000 EDHS Survey. The results showed that type of the work has significantly associated with infant death. The possible solutions for alleviating this maternal burden are expansion of good-quality child care facilities which require massive public action and greater involvement by others, including men, in child care and house work.

Macassa et al (2003) they conducted a study to explain the trends of infant and child mortality in Mozambique (1973-1997) by mother place of residence. The results obtained showed that infants and children mortality rates were higher in rural areas than in urban areas. Gurum and Ezra (2002) their study aimed to establish the effects of birth interval on infant and child mortality in Ethiopia. The results showed that preceding birth interval and mother's education have significant effects on infants and children mortality. Study concluded that, policies are needed to encourage mothers to prolong birth intervals.

Kabir et al (2001) they conducted a study to investigate the influence of factors on infants and children mortality in Bangladesh, utilizing data from the BDHS Survey. The results showed that maternal education, sanitation and safe of drinking water have significant effects on infants and children mortality. This study concluded that awareness should be given to mothers to decrease infants and children mortality.

Kishor and Parasuraman (1998) conducted a study to examine the effect of woman's employment on infants and children mortality in India using data from the 1993 National

Family Health Survey. The results showed that mother's employment has significant effects on infants and children mortality.

Eshetu (1998) conducted a study to identify the impacts of maternal education on infant and child mortality in Kenya, utilizing data from 1993 (KDHS) survey. The results showed that mother's education, marital status of women, source of drinking water were significantly associated with infant and child mortality. The study suggested that role of parental education should not be oversimplified as parental education had significant effects on infants and children mortality. Therefore, future study should aim at finding the reasons why maternal and parental education affect mortality risk in infancy and childhood and which of the reasons are important in a particular setting along with investigating the mechanism through which maternal and parental education operate to affect child survival in Kenya.

Murthi et al (1995) they examined the effects of factors on child mortality in India, utilizing data from 1981 India Census. The results showed that female literacy was significantly associated with child mortality. Female labour was not significantly associated with child mortality.

Adetunji (1994) conducted a study to examine the impact of factors on infant mortality in Nigeria, using data from the Nigeria Fertility Survey. The results showed that infants born in hospitals had a decreased risk of mortality.

Ascherio et al (1992) conducted a research to estimate the effects of war and the economic embargo on infant and child mortality in Iraq during the 1991 war. The results showed that the Gulf war had significant effects on higher infants and children mortality rates in Iraq. The study concluded that Gulf war and trade sanctions increased infants and children mortality.

Erica and Balan (1990) conducted a study to establish the impact of UNICEF health care program on childhood mortality in South Sudan, using the data from 1985 survey in two major population centers, Juba and Wau. The results showed that child immunization, oral rehydration therapy and maternal education had significant effects on infants and children mortality.

DaVanzo and Habicht (1986) conducted a study to examine why the infant mortality had decline rapidly in Malaysia, using data from the Malaysia Family Life Survey (1946-1975). The study employed logistic regression to analyze the data. The results showed that significant augments in mothers' education and improvements in water and hygiene were significantly associated with infant mortality decline. But decrease in the length of breastfeeding had prevented the infant mortality rate from dropping. These results are similar to Preston's results based on country aggregates that showed that structural change explained infant mortality decline than did the changes in socioeconomic and other variables (Preston, 1980, 1976).

Preston (1980) argues that around halve of the increase in life expectancy in less developed countries between 1940 and 1970 was due to structural change in education. Also, similar to Merrick's results in a recent study in Brazil which found the relative roles of changes in maternal educational attainment and piped water explained the decline in children mortality in that country (Merrick, 1985).

2.3 Summary of Review of Empirical Studies on Infant and Child Mortality

The emerging research issues from the above literature review on the determinants are: Several studies have found conflicting or contradictory finding regarding the effects of various determinants of infant and child mortality. For example the review showed conflicting results regarding the effects of maternal education on infant and child mortality. Several previous studies found that it has significant effects on infants and children mortality (Buli ,2013; Lemani, 2013; Mekonnen, 2011; Abed et al, 2010; Olabisi, 2010; Buwembo, 2010; Abol et al, 2009; Goro, 2007; Ezra & Gurum, 2002; Kabir et al, 2001; Murthi et al, 1995; Erica & Balan, 1990), while a few studies found that it has insignificant effects on infants and children mortality (Paul & Damien, 2011; Eshetu, 1998). One study found that it has significant effect on infant mortality (Muluye and Wencheko, 2012). However, some studies confirmed that it has significant effect on childhood mortality (Adepoju et al, 2012; Vikram et al, 2010).

The review showed conflicting findings on the effects of family income on infant and child mortality. One study showed that it has significant impacts on infants and child mortality

(Abol et al, 2009), while other studies showed that it had insignificant impacts on infants and child mortality (Richardson et al, 2015;Erica and Balan, 1990), However, some studies showed that it has significant effects on infant mortality (Kittur, 2014; Sarah and Stephen, 2004). Only one study found that it has significant effects on child mortality (Buli, 2013).

The effects of the mother's place of residence showed contradictory findings. Many studies found that it has significant impacts on both infant and child mortality (Aigbe & Zannu, 2012; Buwembo, 2010); while one study found that it has insignificant impacts on infants and children mortality (Eshetus, 1998). Some studies showed that it has significant effects on infant mortality (Dede, 2013; Adetunji, 1994).

Studies on the preceding birth interval showed consistent findings. Several studies found that it has significant impacts on infant and child mortality (Lemani, 2013; Mekonnen, 2011; Paul and Damien, 2011; Olabisi, 2010; Buwembo, 2010; Abed et al, 2010; Abol et al, 2009; Mondal et al, 2009; Kembo & Ginneken, 2009; Ezra and Gurum, 2002). A few studies showed that it has significant effects on infant mortality (Miringu, 2016; Dede, 2013).

Studies on the sex of child showed consistent findings. Many studies showed that it has significant effects on infants and children mortality (Lemani, 2013; Mekonnen, 2011; Paul and Damien, 2011; Buwembo, 2010); while other studies showed that it has significant effects on children mortality (Buli, 2013; Adepoju et al, 2012). Only one study showed that it has significant effects on infant mortality (Muluye and Wencheko, 2012).

Similarly studies showed the environmental factors showed consistent findings. Many previous studies found that they have significant effects on child mortality (Dede, 2013; Mesike and Mojekwu, 2012; Mutunga, 2004).

Studies on safe of drinking water showed consistent findings. Some studies showed that it has significant effect on infants and child mortality (Macassa, et al, 2004; Eshetu, 1998), while another study found that it has significant effects on children mortality (Buli, 2013). Only one study found that it has significant effects on infant mortality (Muluye and Wencheko, 2012). Type of dwelling has significant effects on infants and child mortality (Buwembo, 2010).

Various studies found that the child's place of delivery has significant impact on infants and children mortality (Olabisi, 2010; Buwembo, 2010); while another study found that it has significant impacts on children mortality fatality (Adepoju et al, 2012). However, other studies found that it has significant effect on infant mortality (Dede, 2013; Adetunji, 1994).

Furthermore the literature review found that the duration of breastfeeding had consistent findings on infant and child mortality. Several earlier studies showed that it has significant effects on infants and children mortality (Buli, 2013; Mekonnen, 2011; Buwembo, 2010; Mondal et al. 2009; Uddin et al. 2009), while another study found that it has significant effects on child mortality (Adepoju et al, 2012). Other studies found that it has significant effect on infant mortality (Dede, 2013; Muluye & Wencheko, 2012).

2.4 Theoretical /Conceptual Frameworks

This section reviews several frameworks that have been used for studying child survival in many developing nations. These conceptual frameworks were established by Grossman model (1972), Mosley & Chen (1984), Dahlgren & Whitehead (1991) and Sastry (1996).

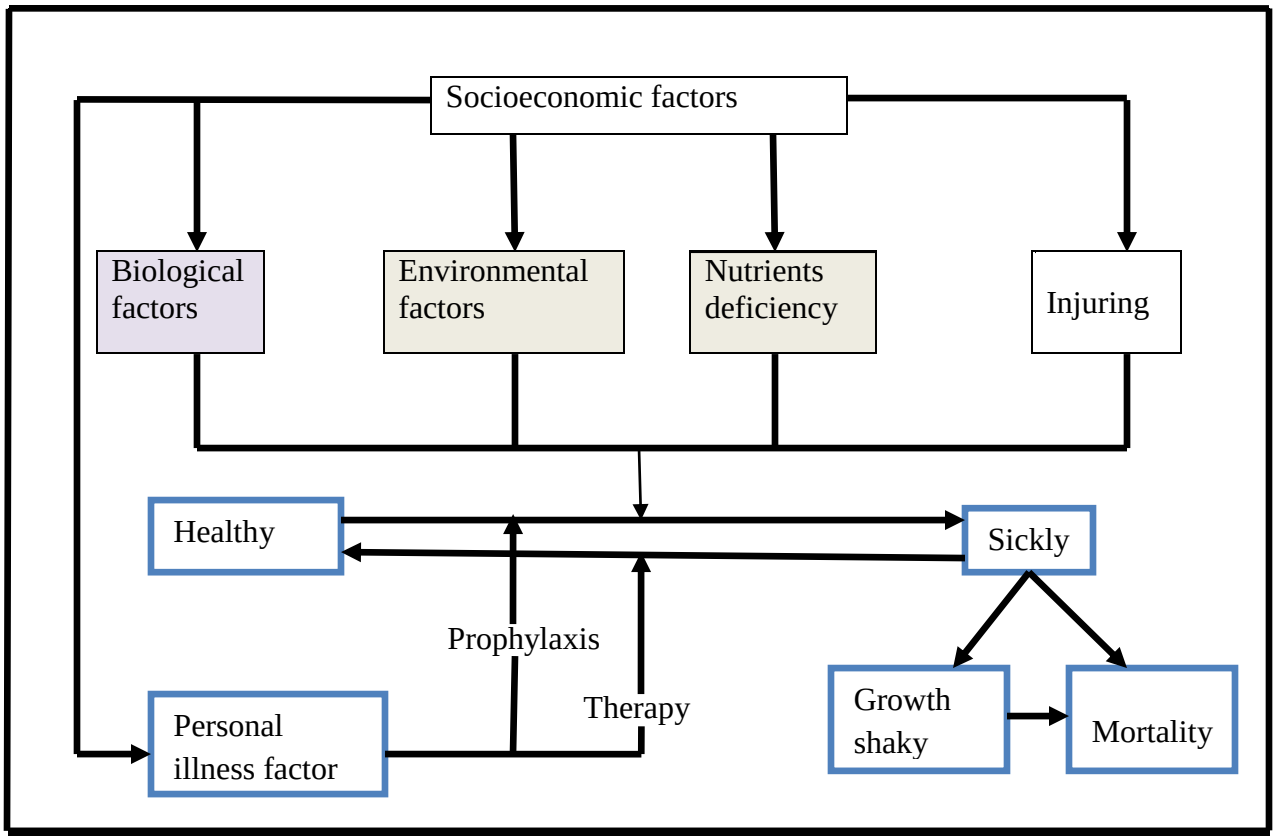
Grossman model (1972) considers age, education, health status and income as key variables in the production of health through the demand for health. The framework demonstrates that educated mothers engage in protective actions that enable them avert the risk factors for the lead killer diseases and wealthy households are able to afford health inputs, e.g. vaccinations, improved sanitation facilities and safe sources of drinking water that greatly improve their children's survival chances.

Mosley & Chen (1984) proposed logical framework (analytical framework) to offer a way on identifying the factors that influence child survival in various less developed counties. This framework put together the social and biological variables. It is established on the hypothesis that social factors have to work through a group of biological factors in order to affect death of infants and children because biological results of sickness and mortality are direct consequences of factors originating in the social circumstances of live and behaviors of households. Impacts of socioeconomic factors are considered indirect because they work through the biomedical factors. Biomedical factors (proximate determinants) are grouped into five sets consist of maternal factors; environmental contamination; nutrient deficiency;

injuries (impact the speed in which healthy babies turn out to be ill); and personal illness control (impact the occurrence of sickness through prevention and treatment). Each of these factors affect the speed of the occurrence of sickness through protection and healing of sickness, occasionally if no initiative is taken it consequences to mortality mostly.

Figure 2.1 demonstrate how Mosley and Chen through which the socioeconomic factors influence health and eventually infant and child mortality.

Figure 2.1 Mosley and Chen (1984) Conceptual Framework for Child Survival



Source: Mosley and Chen (1984)

Dahlgren and Whitehead's framework (1991) describes the social determinants of health in six distinct tiers. The first tier comprises of individual specific factors such as age, sex and heredity factors. The second tier is related to lifestyle choices, e.g. type of diet and frequency of physical activity. The third tier is on social and community networks. This category underscores the benefits of social inclusion and integration in the community at large. The fourth tier is the broad determinants of health and it covers a wide range of issues: agriculture and food production, education, water and sanitation, work environment,

living and working conditions and health systems. The fifth tier is concerned with the general socioeconomic, cultural and environmental conditions while the sixth tier is about globally operating cultural, social and economic forces. Given that we are interested in determining the association between environmental risk factors and childhood mortality, this study considers factors in the first, fourth and fifth tiers. However, this analytical framework does not relate child health production to household utility maximizing behavior.

Sastry (1996) built on the hypothesis proposed by the Mosley & Chen framework, classified the determinants into three large groups: behavioral, environmental and genetic. They can happen at three different levels of process: - individual, family, society; and give a reasonable association for factors that are possibly to impact infants and children mortality. The proposed framework emphasized that infants and children affiliating to the similar family are exposed to the similar family condition. Also the infants and children residing in the similar society are exposed to the similar communications, transportation, roads and rail network, type of weather, environment, and culture and socioeconomic. Furthermore, the infants and children are exposed to the similar sicknesses that are spread within the society during usual relation (Sastry, 1996).

2.5 Conceptual Framework for the Study

This study utilized the Mosley and Chen (1984) analytical framework to analyze variables that influence infants and children mortality in Malakal. Framework was selected for three reasons as follow: First, it is the most used framework in previous studies on infant and child mortality; Secondly, it attempts to incorporate study techniques utilized by social and medicinal scholars; and thirdly, it is strongly associated to Caldwell's hypothesis concerning the role of the mother's education in influencing child survival. Therefore, this framework (Figure 2.3) used to guide this study. Based on literature and Mosley and Chen framework the following factors are included in the study:

Socioeconomic factors: mother's education; mother's employment; family income; family size; and zone of residence.

Biological factors: age of mother at first birth; parity; preceding birth interval, birth order; and sex of the child.

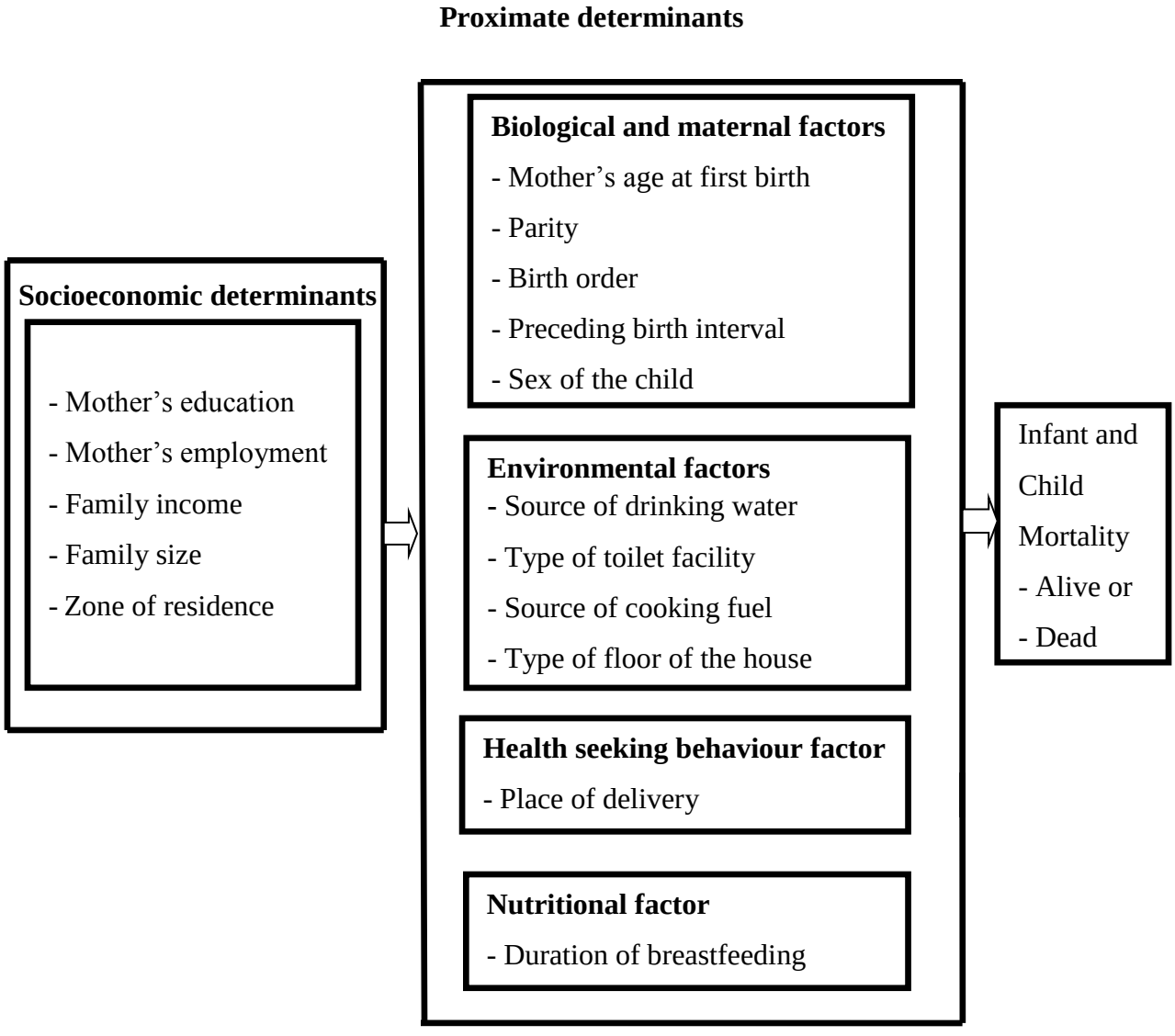
Environmental factors: source of drinking water; type of toilet facility; source of cooking fuel and type of floor of the house.

Health-seeking behavioural factor: place of delivery.

Nutritional factor: duration of breastfeeding.

Operational framework for this study is shown in Figure 2.3 below adopted from the Mosley and Chen (1984) framework.

Figure 2.3 Operational framework for the Study



Source: *adopted from Mosley and Chen (1984) Theoretical Framework*

2.6 Operational Study Hypotheses

The study is to test the following set of hypotheses;

1. Infants and children born to mothers with at least secondary level of education are expected to have lower the risk of infant and child mortality.
2. Infants and children born to mothers who are currently employed are expected to have lower the risk of infant and child mortality.
3. Infants and children born in households with high income are expected to have lower the risk of infant and child mortality.
4. Infants and children born in households with small family size are expected to have lower the risk of infant and child mortality.
5. Infants and children born to older mothers are expected to have higher the risk of infant and child mortality.
6. Infants and children of first birth order are expected to have higher the risk of infant and child mortality.
7. Infants and children of preceding birth interval of less than 24 months are expected to have higher the risk of infant and child mortality.
8. The risk of infant and child mortality is expected to have higher among male infants and children compared to female infants and children.
9. Infants and children born to households with non-improved source of drinking water are expected to have higher the risk of infant and child mortality.
10. Infants and children born to households with improved toilet facility are expected to have lower the risk of infant and child mortality.
11. Infants and children born to households with high polluting fuel are expected to have higher the risk of infant and child mortality.
12. Infants and children living in households with furnished floors are expected to have lower the risk of infant and child mortality.
13. Infants and children who were delivered hospital are expected to have lower the risk of infant and child mortality.
14. Infants and children who were breastfed for six months or more are expected to have lower the risk of infant and child mortality.

2.7 Operational Definitions of Dependent and Independent Variables

Table 2.1 definitions of variables

S/N	Variable and classification	Definition	Coding
(a)	Infant mortality	Death during age 0 to 11 months	Infant survival status at the end of 11 months (0) Alive (1) Dead
(b)	Child mortality	Death during age 12 to 59 months	Child survival status at the end of 59 months (0) Alive (1) Dead
(c)	**Socioeconomic factors**		
1.	Mother's education	Highest level of education attained by mother	(0) No education, (1) Basic/primary, (2) At least level secondary
2.	Mother's employment	Employment status of the mother	(1) Employed (2) Not employed
3.	Family income	Total income of the family (father income and mother income)	(1) Low income (2) Medium income (3) High income
4.	Family size	Number of household members	(1) ≤ 4 persons (3) 5 - 6 persons (2) 7 persons or more
5.	Zone of residence	Geopolitical area where respondent lives	(1) Northern (2) Central (3) Southern
(d)	**Maternal factors**		
1.	Mother's age at first birth	Age of the mother at first birth	(1) 15-19 years, (2) 20–24 years,

			(3) 25–29 years, (4) 30 + years
2.	Parity	Number of living children the respondent had at the time of the survey	(1) 1-3 children, (2) 4-5 children, (3) 6 or more children
3.	Birth order	Rankings of the child at birth	1) First births, (2) 2-3 birth order (3) 4 + birth order
4.	Preceding birth interval	Number of months between the births	(1) Less than 24 months (2) 24 months or more
5.	Child's sex	Sex of the child	(1) Male, (2) Female
(e)	**Environmental factors**		
1.	Source of drinking water	The main sources of drinking water for household	(1) Improved drinking water (piped water) (2) Non-improved drinking water (river water, water vendor and water transported by tankers)
2.	Type of toilet facility	The main type of toilet facility used to dispose human waste for the household	(1) Improved toilet (flush toilet, pit latrine with slab) (2) Non-improved toilet (no toilet, pit latrine without slab, open pit, bucket toilet)
3.	Source of cooking fuel	Household main source of cooking fuel	(1) Low polluting fuel (gas and electricity) (3) Medium polluting fuel (charcoal) (5) High polluting (firewood)

4.	Type of floor of the house	Type of main floor of the household	(1) Natural floor (earth) (2) Furnished floor
(f)	**Maternal health seeking behavior**		
1.	Place of delivery	Place where the child was born	(1) At hospital (2) At home or elsewhere
(g)	**Nutritional factor**		
1.	Duration of breastfeeding	Breastfeeding duration in months	(1) less than 6 months (2) 6 months or more (3) Not breastfed

CHAPTER THREE

THE STUDY AREA AND METHODOLOGY

3.0 Introduction

This chapter presents methodology that used in this study. The chapter covers the description of the study area, study design, study population, sample size determination, sample allocation, sampling procedures, data collection methods, data collection tools, training of the field staffs, pre-testing of the research tools, ethical considerations, quality assurance measures, and data processing procedures, and data analysis methods.

3.1 The Study Area and Rationale for Selection

The study was conducted in Malakal in Upper Nile State in the northeast of South Sudan, near to the international boundaries with Ethiopia and with Republic of Sudan. It lies on eastern bank of White Nile River, no far north of its concourse with the Sobat River and it is the second largest city in South Sudan. It has a surface area of 737 kilometres square. It is the capital of Upper Nile State and serves as the headquarters of Makal County, in which it is situated. It has three zones such as central, southern and northern zones. According to the preliminary results of the 2008 Census of Population and Housing in South Sudan, the population of Malakal was estimated at 114,528 comprising 60,440 males and 54,088 females (CBS, 2010). Its population is a mixture of different tribal groups of South Sudan. The climate of conditions is characterized by two seasons, dry and wet or rainy seasons. The dry season starts in November up to April, whilst the wet season begins in May up to October. The average temperature is 35°C in the day.

The reasons for selection study area are:

First, the findings of the national survey conducted in 2010 showed that infant and child mortality rate was 75 and 105 per thousand live births, respectively higher in Malakal than in any other area of the country. Thus, carrying out this study in this area will provide the information on the major factors affecting infant and child mortality.

Secondly, the area is suitable for United Nations proposed Goal number three to decrease death of children less than 5 years of age. Therefore, carrying out this study in this area will

provide useful information that can be used achieving Sustainable Development Goals in the area and in the country at large.

3.2 Study Design

This study was cross-sectional in design and used a structured questionnaire to collect primary data from a random sample of women of reproductive in Malakal. A cross-section study is comparatively expeditious, easy, and cheap to carry out over short period of time; data on all variables is collected only once (Hennekens, 1987).

3.3 Study Population

The data was collected from the women of reproductive age (15-49 years) who had at least a child in the last five years preceding the survey. The unit of analysis was the child born within 5 years preceding the survey.

3.4 Sample Size Determination

Following formula was used to estimate the required sample size is:

$$N = \frac{[z^2(r)\ (1-r)\ (k)]}{[(e^2)\ (p)\ (\bar{n}h)]} \times (f) \quad \text{(SSNBS and UNICEF, 2010)}$$

Wherein:

N = is the demanded sample size (number of households).

z = is 1.96 rounded to 2.

r = 0.20 is the anticipated diarrhea prevalence of the indicator from the SHHS (2006).

k = 1.1 is the factor to increase sample size by 10 percent for non-response: (response rate 95%).

f = 1.5 is the sample design effect based on estimates from previous surveys.

e = 0.17r is the proportion of margin of error (SHHS, 2006).

p = 0.16 is the percentage of children aged 0-4 years in the entire population (SPHC, 2008).

$\bar{\mathbf{n}}_{\mathbf{h}}$ = 6 is the average family size (number of individuals per household) (SPHC, 2008).

The key indicator that was used to compute the sample size is the 20% prevalence of diarrhea among children aged 0-4 years from the SHHS (2006). The value of the design effect (deff) is

taken to be 1.5 based on estimate from prior surveys, p is 16% [ratio of children aged (0-4 years) in the entire population], and $\bar{n}_h$ is 6 (average household size) (SPHC, 2008).

$$N = \frac{[2^2(0.2)\ (0.8)\ (1.1)]}{[(0.17*0.2)^2\ (0.16)\ (6)]} \times (1.5) = \frac{[0.704]}{[0.001]} \times (1.5) = 704 \times (1.5) = \mathbf{1056}households$$

3.5 Sample Allocation

The Table 3.1shows the allocation of 1056 sample size to each zone based on the number of households in each zone in the Sudan Population and Housing Census (2008). For example, in northern zone, there are 5,302 households divided by 15,732 total households equal to 33.70% household proportion multiplied by 1056 total sample. A sample size of 356 households is to be interviewed in the Northern zone. Thus, we randomly selected 356 of the likely 5,302 in Northern zone. Also there are 4,616 eligible households in the Central zone divided by 15,732 total households equals to 29.34% household proportion multiplied by 1056 total sample size. This gives a sample size of 310 households are to be interviewed in the Central zone.

Table 3.1: Sample size distribution of eligible households by zone for random sampling

Zone	Number of Households	Household proportion	Sample Size
Northern	5,302	33.70%	356
Central	4,616	29.34%	310
Southern	5,814	36.96%	390
Total	**15,732**	**100.00%**	**1056**

Source: Sudan Population and Housing Census (2008)

3.6 Sampling Procedures

The study used a two stage sampling procedure to select the 1056 households in Malakal using systematic random sampling procedure.

In the first stage of sampling, 40 clusters are selected from a list of master sampling frame of primary sampling units (PSUs) (14 clusters in the Northern zone, 11 clusters in the Central zone, and 15 clusters in the Southern zone) with the systematic probability of selection relative to the population size.

In the second stage of sampling, 26 households (1056/40) are selected in each cluster in each of the zone, using equal probability systematic random sampling selection procedures. A listing of the households is done in each cluster, from which random selection of 26 household is drawn.

3.7 Data Collection Methods

3.7.1 Primary Data Collection

Primary data was collected from eligible women of reproductive age (15-49) who have ever given birth. A detailed questionnaire was administered by trained research assistants (interviewers) to the eligible women in the sampled households. The selection was limited to either 2 or 3 eligible mothers in each household. If there were more than 3 eligible women, only there were randomly selected.

3.7.2 Secondary Data Collection

These published survey reports, statistical records, information from references in libraries, public records and internet searches.

3.8. Data Collection Tools

The main data collection tools were the structured questionnaires. These were administered to the respondents by the trained interviewers. Two kinds of questionnaires were utilized in this study: household questionnaire and individual questionnaire. The individual questionnaire was utilized to obtain information on the background characteristics and entire maternity histories. The entire birth histories of mother consist of data on the number of births a mother has ever had and for every live birth, the sex and the month of birth was registered in addition to whether the child is still alive at the time of interview. If a child had died, the age at which the child died was also obtained. The household questionnaire was used to elicit information regarding the household characteristics which consisted of housing structure and housing facilities, for example, the sources of water, type of toilets, fuels used for cooking and material used to construct the house.

3.9 Training of Research Assistants

The research assistants were recruited and trained on how to use the study tools for data collection. Field staff that had previous experience in conducting field research or had previous experience in data collection methods were selected and recruited as research assistants since they were familiar with the area and fluent in English to translate the questionnaire questions into Arabic or into the local languages during the data collection process. A survey team consisting of 3 supervisors and 14 interviewers carried out the fieldwork. The survey team was trained for two days on the study objectives, study methodology, sampling procedures and the conduct of interviews.

3.10 Pre-testing of the Study Tools

The study was pretested. The research assistants used this chance to practice using the tools. The tools were pretested at Malakal in the three zones on a small sample of households consisted of 15 women of the target age group (15-49 years. The mistakes that were noted in the pretest practice as well as the interview procedure were corrected.

3.11 Ethical Considerations

In order to protect the anonymity and confidentiality of the information from the respondents, names and house numbers were not identified in the questionnaires and in the data set. Permission to carry out the study was obtained from the local Government Authorities. In addition to that the leaders of the three zones were contacted to discuss the objectives of the study and to obtain their consent. Oral informed permission was obtained from every eligible mother (respondent) who is requested to participate in the study before conducting the household questionnaires. Also, respondents were free to terminate meeting at any time once they if wanted to do so.

3.12 Quality Assurance Measures

These should include hiring educated, honest and experienced research assistants. Effective and close supervision during data collection and during data processing was required. Completed questionnaires were checked by the field supervisors for completeness,

consistency and accuracy every day. At the ending of every data collection day all field questionnaires were handed in for secure storage.

3.13 Data Processing Procedures

This study was followed the steps of data processing which are: data editing, data coding, data tabulation, and data entry. Data should be edited before being displayed as facts. This work ensures that the facts provided are correct, full and reliable. Data could be coded according to groups (categories) and sub-groups (sub-categories) pinpointed by interpreting and re-interpreting the data collected. Groups (categories) and sub-groups (sub-categories) present facts pertinent to the subject studied and utilized to assist discover and elucidate the study problem. Data could be putted into a table and set in a methodical arrangement by laying it in a table so that it could be analyzed.

3.14 Methods of Data Analysis

The main methods of data analysis for this study are descriptive statistics, direct estimation method and Cox regression (Cox proportional hazards regression model). These methods are described as below:

3.14.1 Descriptive statistics

The descriptive statistics analysis was carried out to describe background characteristics of the mothers regarding to suitable variables in terms of frequencies and percentages distribution.

Percent was used and computed as follows:

$P = \frac{\mathrm{F}}{N} \times 100$

Where: **P** = percent **F** = Frequency **N** = Total number of population

To test for significance, Chi square test was used and computed as follows:

$$\boldsymbol{\chi^2} = \frac{\Sigma[\mathrm{f(O)} - \mathrm{f(E)}]^2}{\Sigma f(E)}$$

Where: χ^2 =Chi-square **f (O)** = Observed frequencies **f (E)** = Expected frequencies.

Σ = Symbol for summation.

3.14.2 Direct method of estimation of infant and child mortality rates

Infant mortality rate is the likelihood of death between birth and the first birthday – during age 0 to 11 months, multiple by 1000. From the definition, it is clear that the infant mortality rate does not take into consideration either to fetal death or stillbirth, but only live births and infant deaths. The following formula is employed to estimate infant mortality rate:

Infant Mortality Rate (IMR)=

$$\frac{\text{Infant deaths } (0-11 \text{ months }) (D0)}{\text{Live births } (0-11 \text{ months}) \ (B0)} \times 1000$$

Child mortality rate is the likelihood of death between the exactly age one and the fifth birthday– during age 12 to 59 months, multiple by 1000. The following formula is employed to estimate child mortality rate:

Child Mortality Rate (CMR) =

$$\frac{\text{Child deaths } (12-59 \text{ months})(D0)}{\text{Live births } (12-59 \text{ months}) \ (B0)} \times 1000$$

3.14.3 The Cox Proportional Hazards Model

Data analyses were carryout using Cox regression model (Kleinbaum and Klein, 2005) in aim to identify the effect of the selected variables on infant and child mortality. The utilizing of Cox regression model in studying child survival in developing countries is clearly in the literatures (Ikamari, 2005; Arnaldo, 2004; Gyimah, 2003; Bracher and Santow, 1998).

This model was developed by Cox in 1972. It is appropriate to be applied for data that contain censored observations. It also takes into account the fact that the likelihood of experiencing an event varies with the period of exposures to risk. This implies that, using Cox regression analysis, both the occurrence of infants and children mortality and the time when the infant or the child died was considered as the outcome variables(Cox, 1972).The outcome variables in this study treated as the time between birth and death of a child under age one year (infant mortality), or time between age one and death of age five years (child mortality), or until the observation is censored.

The likelihood of infant and child mortality is called the risk.

The risk was computed using the following formulas:

$\lambda(t) = \lambda_0(t) \times \exp(b_0 + b_1 x_1 + b_2 x_2 + ... + b_k x_k)$ ---------- (1)

Wherein: $x_{1,}..., x_k$ are covariates (denote the socioeconomic and proximate factors of infant or child mortality) and $\lambda_0(t)$ is the risk function at time t. Dividing (1) by $\lambda_0(t)$, and taking logarithms, the formula (1) will become:

$\text{Log}[\lambda(t) / \lambda 0(t)] = b_0 + b_1 x_1 + b_2 x_2 + ... + b_k x_k$ ---------- (2)

Where $\lambda(t) / \lambda_0(t)$ is the hazard ratio (HR) (the risk of mortality for a child at time t before reaching the age of five years). The coefficients $b_{1,}..., b_k$ are estimated as the coefficient of the independent variables).A positive coefficient (HR >1) for an interpreter covariate means that the risk (hazard) of dying is higher. On the other hand, a negative coefficient (HR <1) for an interpreter covariate means that the risk (hazard) of dying is lower. The analysis was conducted using Statistical Package for Social Sciences (SPSS) version 23. Furthermore, the analyses were run separately for infant mortality and separately for child mortality to identify the factors affect infant and child mortality.

CHAPTER FOUR

DETERMINANTS OF INFANT MORTALITY

4.0 Introduction

This chapter presents three sections; the first section shows percent distribution of the births aged (0-11months) by the study variables, section two describes the levels and differentials of infant mortality rate by the study variables and the last section represents the results of the multivariate analysis on infant mortality.

4.1 Percentage Distribution of live births (0-11months) by the Study Variables

Infant mortality rate measures the quality of life of a society. Table 4.1 showed percentage distribution of infants by the study variables. Majority 92.8% of the infants were alive, while slightly 7.2% were died. This translated to an infant mortality rate of 72 per 1000 live birth in Malakal.

The results show that more than half (55.6%) of the infants belonged to mothers with no education. 28.0% of the infants belonged to mothers with primary education, while slightly 16.4% of the infants belonged to mothers with at least secondary education. In respect to mother's employment status, the distribution of infants by their most recent employment of the mothers of 45.0% of the infants was employed, while mothers of more than half of the infants were unemployed.

With respect to family income, the results further showed that the mothers of 50.7% of the infants resided in households with low income, for 26.0% of the infants their mothers lived in households with medium income, while for 23.3% of the infants, the mothers lived in households with high income. This it agrees with the findings of World Bank (2011a) in which about 51% of the households in South Sudan were found to be poor.

In respect to family size, the results in Table 4.1 showed that majority 63.1% of the infants belonged to households with a family size of at least 7 persons, 29.9% of the infants belonged to households with family size 5-6 persons, while 7.0% of the infants belonged to households with a family size of less than 4 persons.

The results in Table 4.1 showed that 37.8% of the infants lived in the Southern zone 32.2% of the infants lived in the Northern zone, while 30.0% of the infants lived in the Central zone.

Regarding mother's age at first birth, 36.0% of the infants were born to young mothers aged 15-19 years, followed by infants born to mothers aged 20-24 years 29.1%. 23.7% of the infants were born to mothers aged 25-29 years, while 11.2% of the infants born to mothers aged 30 years or more.

The results of distribution of parity showed that 44% of the infants belonged to mothers with parity (1-3), 31.7% of the infants belonged to mothers with parity 4-5, while 24.4% of the infants belonged to mothers of parity 6 or more.

With regard to birth order, the results showed that slightly 7.9% of the infants were of the first birth order 36.3% of the infants belonged to birth order 2-3, while majority 55.8% of the infants belonged to birth order 4 or more.

Relating the preceding birth interval, the results also showed that the majority 89.3% of the infants had a preceding birth interval of less than 24 months, while a little 2.8% of the infants had preceding birth interval of at least of 24 months. More than half 50.9% of the infants were females, while 49.1% of the infants were males.

The majority (77.2%) of the infants resided in households that used water from a non-improved water source, while slightly 22.8% of the infants resided in households that used water from improved drinking source. The majority (74.9%) of the infants belonged to households that used non-improved toilet facility; while more than quarter 25.1% of the infants belonged to households that used an improved toilet facility.

With respect to the type of cooking fuels, the results indicate that 43.4% of the infants lived in households that used high polluting fuel (firewood) for cooking. 46.0% of the infants lived in households that used medium polluting fuel (charcoal), while the minority 10.6% of the infants lived in households that used low polluting fuel (gas and electricity).

The majority 57.8% of the infants lived in households with natural floor, while 42.2% of the infants lived in households with furnished floor. More than half 52.0% of the infants were delivered at home, while 48.0% of the infants were delivered at hospitals.

The results showed that 51.9% of the infants were breastfed for at least 6 months while 48.1% of the infants were breastfed less than 6 months.

Table 4.1: Percentage Distribution of Infants by the Study Variables

Variable	No. of Infants	Percentage
Infants survival status		
Alive	1029	92.8
Dead	80	7.2
Mother education		
No education	617	55.6
Basic/Primary	310	28.0
Secondary +	182	16.4
Mother employment		
Employed	499	45.0
Not employed	610	55.0
Family income		
Low income	562	50.7
Medium income	289	26.0
High income	258	23.3
Family size		
$\leq$ 4 persons	77	7.0
5 – 6 persons	332	29.9
7 persons or more	700	63.1
Zone of residence		
Northern	357	32.2
Central	333	30.0
Southern	419	37.8

Source: *Field Survey in Malakal, 2016*

Table 4.1: Continued

Variable	No. of Infants	Percentage
Mother's age at first birth		
15-19 years	399	36.0
20-24 years	323	29.1
25-29 years	263	23.7
30 + years	124	11.2
Parity		
1 - 3 children	487	43.9
4 - 5 children	351	31.7
6 + children	271	24.4
Birth order		
First birth order	88	7.9
2-3 birth order	402	36.3
4 + birth order	619	55.8
Preceding birth interval		
First births	88	7.9
< 24 months	990	89.3
24 + months	31	2.8
Sex of the infant		
Male	545	49.1
Female	564	50.9
Source of drinking water		
Improved water	253	22.8
Non-improved water	856	77.2
Type of toilet facility		
Improved toilet	278	25.1
Non-improved toilet	831	74.9

Source: *Field Survey in Malakal, 2016*

Table 4.1: Continued

Variable	No. of Infants	Percentage
Source of cooking fuel		
Low polluting	117	10.6
Medium polluting	510	46.0
High polluting	482	43.4
Type of floor of the house		
Natural floor	641	57.8
Furnished floor	468	42.2
Place of Delivery		
At hospital	577	52.0
At Home	532	48.0
Duration of breastfeeding		
Less than 6 months	576	51.9
6 + months	533	48.1

Source: *Field Survey in Malakal, 2016*

4.2 Levels and Differentials of Infant Mortality by the Study Variables

The level of infant mortality rate in Malakal was 72 deaths per 1000 live births. The results in Table 4.2 showed the levels and differentials of infant mortality according to the study variables. Infant mortality was lower among infants whose mothers with at least secondary level of education 22 deaths per thousand live births, followed by infants for mothers by primary education 35 deaths per thousand live births, whilst higher among infants for mothers by no education 105 deaths per thousand live births. The result proposes that deaths among infants are more major among infants for mothers by no education pursues by infants for mothers by primary education.

The results in Table 4.2show that mother's employment status was significantly associated with infant mortality. However, infant mortality rate was higher among infants whose mothers who were employed (108 deaths per thousand live births) while lower among the infants whose mothers who were not employed (43 deaths per thousand live births). Several historical

studies in the 19th and 20th centuries point out that the highest infant death rate in households with employed mothers. The high infant mortality was explained in terms of lack of mother's time for baby care, early preface of non-natural feeding and bad living conditions (Graham, 1994 and Brandstrom, 1988).

The results in Table 4.2 showed that family income was significantly associated with infant mortality. As expected, infant mortality was lower among infants that belonged to households with high income 8 deaths per thousand live births, while higher among infants that belonged to households with low income and medium income (94 deaths and 87 deaths per thousand live births, respectively).

The results in Table 4.2 showed that family size was insignificantly associated with infant mortality at the 0.05 confidence level. As expected, infant mortality was lower among infants belonged to family size ≤ 4 persons (39 deaths per thousand live births), while higher among infants belonged to family size 7 or more and 5-6 persons (81deaths and 60 deaths per thousand live births, respectively).

The results in Table 4.2 showed that zone of residence also was not significantly associated with infant mortality at 5% confidence level. Infant mortality was higher among infants living in than Southern and Northern zones (74 and 73 deaths per thousand live births), respectively, whereas lower among infants living in the Central zone (69 deaths per thousand live births).

The results in Table 4.2 showed that the age of the mother at first birth was insignificantly associated with infant mortality. Infant mortality was higher among infants born to older and those born to younger. Parity was also significantly associated with infant mortality. Infant mortality rate was higher among infants belonging to mothers of parity 6 or more but lower among infants belonging to mothers of parity (1-3) and parity (4-5)

Table 4.2 also showed that birth order was significantly associated with infant mortality. Infant mortality was higher among infants of the first and higher order births 4 or more while lower for infants of birth order (2-3).

Table 4.2: Levels and Differentials in Infant Mortality by the Study Variables

Variables	Infant live births	Survival Status		IMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Infant mortality	1109	**92.8** (1029)	**7.2** (80)	72.0	
Mother's education					**0.000** (23.231)
No education	617	**89.5** (552)	**10.5** (65)	105.0	
Basic/Primary	310	**96.5** (299)	**3.5** (11)	35.0	
Secondary +	182	**97.8** (178)	**2.2** (4)	22.0	
Mother's employment					**0.000** (17.643)
Employed	499	**89.2** (445)	**10.8** (54)	108.0	
Not employed	610	**95.7** (584)	**4.3** (26)	43.0	
Family income					**0.000** (20.997)
Low income	562	**90.6** (509)	**9.4** (53)	94.0	
Medium income	289	**91.3** (264)	**8.7** (25)	87.0	
High income	258	**99.2** (256)	**0.8** (2)	8.0	
Family size					**0.238** (2.871)
≤ 4 persons	77	**96.1** (74)	**3.9** (3)	39.0	
5-6 persons	332	**94.0** (312)	**6.0** (20)	60.0	
7 persons or more	700	**91.9** (643)	**8.1** (57)	81.0	
Zone of residence					**0.965** (0.071)
Northern zone	357	**92.7** (331)	**7.3** (26)	73.0	
Central zone	333	**93.1** (310)	**6.9** (23)	69.0	
Southern zone	419	**92.6** (388)	**7.4** (31)	74.0	
Mother's age at first birth					**0.174** (4.970)
15-19 years	399	**92.5** (369)	**7.5** (30)	75.0	
20-24 years	323	**94.7** (306)	**5.3** (17)	53.0	
25-29 years	263	**92.8** (244)	**7.2** (19)	72.0	
30 + years	124	**88.7** (110)	**11.3** (14)	113.0	

Source: *Field Survey in Malakal, 2016* ***IMR*** *= Infant Mortality Rate*

Table 4.2: Continued

Variables	Infant live births	Survival Status		IMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Parity					**0.000** (25.783)
1 - 3 children	487	**94.3** (459)	**5.7** (28)	57.0	
4 - 5 children	351	**96.0** (337)	**4.0** (14)	40.0	
6 + children	271	**86.0** (233)	**14.0** (38)	140.0	
Birth order					**0.000** (109.700)
first birth order	88	**68.2** (60)	**31.8** (28)	318.0	
2-3 birth order	402	**99.8** (401)	**0.2** (1)	2.0	
4 + birth order	619	**91.8** (568)	**8.2** (51)	82.0	
Preceding birth interval					**0.000**(86.618)
First birth	88	**68.2** (60)	**31.8** (28)	318.0	
< 24 months	990	**94.8** (939)	**5.2**(51)	52.0	
24 + months	31	**96.8** (30)	**3.2** (1)	32.0	
Sex of the infant					**0.121**(2.409)
Male	545	**91.6** (499)	**8.4** (46)	84.0	
Female	564	**94.0** (530)	**6.0** (34)	60.0	
Source of drinking water					**0.045** (4.022)
Improved water	253	**95.7** (242)	**4.3** (11)	43.0	
Non-improved water	856	**91.9** (787)	**8.1** (69)	81.0	
Type of toilet facility					**0.015** (5.879)
Improved toilets	278	**96.0** (267)	**4.0** (11)	40.0	
Non-improved toilets	831	**91.7** (762)	**8.3** (69)	83.0	
Source of cooking fuel					**0.224** (2.988)
Low polluting	117	**94.9** (111)	**5.1** (6)	51.0	
Medium polluting	510	**91.4** (466)	**8.6** (44)	86.0	
High polluting	482	**93.8** (452)	**6.2** (30)	62.0	

Source: *Field Survey in Malakal, 2016* ***IMR*** *= Infant Mortality Rate*

Table 4.2: Continued

Variables	Infant live births	Survival Status		IMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Type of floor of the house					**0.000** (26.152)
Natural floor	641	**89.4** (573)	**10.6** (68)	106.0	
Furnished floor	468	**97.4** (456)	**2.6** (12)	26.0	
Place of delivery					**0.000** (76.403)
At hospital	577	**99.3** (573)	**0.7** (4)	7.0	
At home	532	**85.7** (456)	**14.3** (76)	143.0	
Duration of breastfeeding					**0.000** (12.881)
Less than 6 months	576	**90.1** (519)	**9.9** (57)	99.0	
6 + months	533	**95.7** (510)	**4.3** (23)	43.0	

Source: *Field Survey in Malakal, 2016* ***IMR*** *= Infant Mortality Rate*

The results in Table 4.2 showed that the preceding birth interval was significantly associated with infant mortality at the 0.05 confidence level. As expected, infant mortality was higher among infants with a preceding birth interval less than 24 months and lower among infants with a preceding birth interval of 24 months or more .This finding is supported by previous study conducted by Mekonnen (2011) in Ethiopia; who found that shorter birth interval increases the probability of infant mortality.

The results in Table 4.2 showed that the sex of the infant also was not significantly associated with infant mortality. As expected, infant mortality rate was higher among males than among females. This supported by several studies that male infants die more at any infancy age than female infants due to biological factors faced by male infants (Chowdhury and Kabir. 1993; Bhuiya and D'Souza. 1982; Chen et al. 1981).

Table 4.2 showed that the source of drinking water was significantly associated with infant death at 5% confidence level. As expected, infant mortality was higher among infants living in households that used water from non-improved sources, whereas lower among infants living in households that used drinking water from improved source.

The results in Table 4.2 showed that the type of toilet facility was significantly associated with infant mortality at the 0.05 confidence level. As expected, infant mortality was lower

among infants lived in households that used an improved toilet facility and higher among infants lived in households that used unimproved toilet facility.

Table 4.2 showed that the source of cooking fuel was not significantly associated with infant mortality at 5% confidence level. Infant mortality rate was higher among infants living in households that used medium polluting fuel and was lower among infants living in households used that low and high polluting fuels.

The type of the floor of the house was significantly associated with infant mortality at the 0.05 confidence level. The results found that infant mortality was lower among infants living in households with furnished floor while higher among infants living in households with natural floor.

The results in Table 4.2 showed that place of delivery was significantly associated with infant mortality at the 0.05 confidence level. Infant mortality was lower among infants born at hospitals than among those born at home.

Table 4.2 showed that duration of breastfeeding was significantly associated with infant mortality at 0.05 confidence level. As expected, infant mortality was lower among infants who were breastfed for at least 6 months than among infants who were breastfed less than 6 months. Previous study has showed the advantageous duration of breastfeeding on the dietary status of babies (Hobcraft et al, 1984).

4.3 Results of the Multivariate Analysis of Infant Mortality

This section represents the results of multivariate analysis using the Cox regression model. It consisted of two models where the first model (Model I) was fitted by proximate determinants and then the main model (Model II) was fitted by including proximate and socioeconomic determinants to establish the net effects on infant mortality. These results were presented in Table 4.3 and Table 4.4 below, respectively.

The first model in Table 4.3 was fitted to show the effects of proximate determinants on infant mortality. From Table 4.3 it was clear that age of the mother was positively and insignificantly associated with infant mortality at 95% confidence level. As expected, the risk of dying among infants born to mothers aged 30 years or more was around 1.410 times higher than that

of the infants born to mothers aged 15-19 years. Infants for mothers aged 25-29 have a 0.945 times lower risk of dying as compared to infants for mother aged 30 years or more.

From Table 4.3 it was clear that parity was positively and significantly associated with infant mortality. The risks of dying for infants belonged to mothers with parity 4-5 and 6 or more were about 36.792 and 70.683 times higher, respectively than among infants belonging to mothers with parity 1-3.

The birth order was positively and significantly associated with infant mortality at 95% confidence level. The risks of dying among infants of first order of births and birth order 2-3 were around 175.772 times and 1.806 times higher, respectively compared to infants of birth order 4 or higher. The preceding birth interval was negatively and insignificantly associated with infant mortality at 95% confidence level. Similarly, the sex of the infant, the source of drinking water, type of toilet of facility and source of cooking fuel, type of floor of the house were each not significantly associated with the risk of dying during infancy.

However, the place of delivery was negatively and significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying was 0.035 times lower among the infants who were delivered at hospitals compared to the infants who were delivered at home in the reference category.

Table 4.3 showed that the duration of breastfeeding was negatively and significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying among the infants who were breastfed for at least 6 months about 0.069 times lower as compared to infants who were breastfed less than 6 months. This finding is concurred with the findings of several prior studies (Ong'era 2014; Dede, 2013, Buli, 2013; Muluye and Wencheko, 2012, Mekonnen, 2011; Buwembo, 2010; Mondal et al. 2009; Uddin et al. 2009).

Table 4.3: Model (I) Results of the Multivariate Cox's regression for Variables Associated with Infant Mortality

Variables	B	SE.	Sig.	HR	95% CI	
					Lower	Upper
Mother's age at first birth (**RC** =15-19 years)						
20 – 24 years	0.104	0.365	0.776	1.110	0.542	2.271
25 – 29 years	- 0.056	0.396	0.887	0.945	0.435	2.054
30 + years	0.343	0.420	0.414	1.410	0.619	3.212
Parity **(RC =** 1 - 3 infants)						
4 - 5 infants	3.605	1.176	0.002	36.792	3.670	368.884
6 + infants)	4.258	1.203	0.000	70.683	6.689	746.877
Birth order (**RC** = 4 + birth order)						
first birth order	5.169	1.572	0.001	175.772	8.073	3826.876
2-3 birth order	0.591	1.439	0.681	1.806	0.108	30.327
Preceding birth interval **(RC =**24 + months)						
First birth	5.169	1.572	0.001	175.772	8.073	3826.876
< 24 months	- 0.307	1.040	0.768	0.736	0.096	5.648
Sex of infant **(RC =** Female)						
Male	0.447	0.240	0.062	1.563	0.977	2.501
Source of drinking water (**RC=** Improved water)						
Non-improved water	- 0.325	0.401	0.419	0.723	0.329	1.587
Type of toilet facility **(RC =** Non-improved toilet)						
Improved toilet	- 0.497	0.379	0.190	0.608	0.289	1.279

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR*** *= Hazard Ratio*

Table 4.3: Model (I) Continued

Variables	B	SE.	Sig.	HR	95% CI	
					Lower	Upper
Source of cooking fuel						
(RC = Low polluting)						
Medium polluting	0.792	0.472	0.093	2.208	0.875	5.568
High polluting	- 0.387	0.503	0.441	0.679	0.253	1.819
Type of floor of the house						
(RC = Natural floor)						
Furnished floor	- 0.473	0.357	0.185	0.623	0.310	1.254
Place of Delivery						
(RC = At home)						
At hospital	- 3.366	0.617	0.000	0.035	0.010	0.116
Duration of breastfeeding						
(RC = Less than 6 months)						
6 + months	- 2.680	0.352	0.000	0.069	0.034	0.137

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR =*** *Hazard Ratio*

The main model (Model II) in Table 4.4 was fitted in order to establish the net effects of proximate and socioeconomic determinants on infant mortality.

Table 4.4 showed that mother's education was insignificantly associated with infant mortality. Surprisingly, the risk of dying among infants born to mothers with at least secondary level of education was around 2.571 times higher than among infants whose mothers had no education. The risk of dying was 0.920 times lower among infants whose mothers with primary education when compared to infants whose mothers had at least at least secondary education level. This finding is consistent with findings by (Paul and Damien, 2011; Eshetu, 1998) that mother education had no significant association with infant mortality.

The mother's employment status was positively and significantly associated with infant mortality. The risk of dying among infants whose mothers who were employed was about 1.923 times higher than among infants whose mothers who were not employed. This finding

is supported by Kishor and Parasuraman (1998) that the hazard of dying was significantly higher among mothers who were employed.

The results also in Table 4.4 showed that family income was negatively and significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying among infants belonging to households with high income was about 0.169 times lower as compared to infants belonging to households with low income. This finding is in line with the study hypothesis and consistent with the findings by Sarah and Stephen (2004) who established that household income had a negative significant association with infant death.

The result in Table 4.4 showed that the zone of residence was significantly associated with infant mortality at 95% confidence level. Infants residing in Northern and Central zones had higher risk of dying during infancy when compared to those residing in Southern zone. This it might be due to imbalanced distribution of health infrastructures between these zones. This finding is consistent with findings of several studies (Miringu, 2016; Dede, 2013; Aigbe and Zannu, 2012; Buwembo, 2010) who showed that zone of residence was significantly associated with infant mortality.

The results indicated that parity was significantly associated with infant mortality at the 95% significance level. Similarly, the order was positively and significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying among infants of first birth order was about 98.794 times higher as compared to infants of birth order 4 or above. This finding is concurred with earlier studies by (Miringu, 2016; Kittur, 2014; Lemani, 2013; Muluye and Wencheko, 2012; Paul and Damien, 2011; Mekonnen, 2011; Olabisi, 2010; Buwembo, 2010; Uddin et al, 2009; Kembo and Ginneken, 2009; Goro, 2007).

The results in Table 4.4 showed that preceding birth interval was negatively and insignificantly associated with infant mortality at the 95% significance level. Several earlier studies showed that infants of short preceding birth interval are at higher hazard of mortality (Kembo and Ginneken, 2009; Abol et al, 2009).

The results showed that sex of the infant was significantly associated with infant mortality at 95% confidence level. As expected, the risk of dying for male infants was about 1.731 times higher as compared to female infants in the reference category. This corroborates with

findings of most African countries that male mortality is higher owing to biological difficulties (Lemani, 2013; Muluye and Wencheko, 2012; Mekonnen, 2011; Paul and Damien, 2011; Buwembo, 2010; Mutunga, 2007).

From Table 4.4 it was clear that source of drinking water was insignificantly associated with infant mortality at 95% confidence level**.** Surprisingly, the risk of dying for infants living in households used non-improved water was about 0.787 times lower when compared to infants living in households that used improved water.

The results in Table 4.4 showed that type of toilet facility was insignificantly associated with infant mortality at the 95% confidence level. Similarly, the source of cooking fuel was insignificantly associated with infant mortality at the 95% confidence level. This finding is consistent with Mutunga (2004) and inconsistent with Ong'era (2014) that using firewood was a positive association with infant mortality. Further, the results show that type of floor of the house was insignificantly associated with infant mortality at the 95% confidence level.

The place of delivery was significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying among infants who were delivered at hospitals was about 0.025 times lower than among infants who were delivered at home. This finding is consistent with several studies (Dede, 2013; Olabisi, 2010; Buwembo, 2010; Mondal et al, 2009; Adetunji, 1994) that infant mortality is lower among infants who were delivered at hospitals than delivered at home.

The duration of breastfeeding was negatively and significantly associated with infant mortality at the 95% confidence level. As expected, the risk of dying among infants who were for breastfed for at least months was 0.060 times lower as compared to infants who were breastfed less than 6 months. This finding concurs with numerous prior studies (Ong'era, 2014; Dede, 2013; Buli, 2013; Muluye and Wencheko, 2012; Mekonnen, 2011; Buwembo, 2010; Mondal et al. 2009; Uddin et al. 2009).

Table 4.4: Model (II) Results of the Multivariate Cox's regression for Variables Associated with Infant Mortality

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Mother's education (**RC** = No education)						
Basic/Primary	- 0.082	0.396	0.832	0.920	0.423	1.997
Secondary +	0.944	0.714	0.186	2.571	0.634	10.427
Mother 's employment (**RC** = Not Employed)						
Employed	0.654	0.283	0.021	1.923	1.104	3.351
Family income (**RC** = Low income)						
Medium income	- 0.240	0.279	0.390	0.787	0.456	1.359
high income	- 1.779	0.777	0.022	0.169	0.037	0.774
Family size (**RC** = 7+ persons)						
≤ 4 persons	- 0.111	0.704	0.875	0.895	0.225	3.556
5 – 6 persons	0.065	0.329	0.845	1.067	0.559	2.034
Zone of Residence (**RC** = Southern zone**)**						
Northern zone	0.801	0.322	0.013	2.238	1.186	4.187
Central zone	1.001	0.348	0.004	2.721	1.375	5.383
Mother's age at first birth (**RC** =15 -19 years)						
20 – 24 years	0.032	0.398	0.935	1.033	0.473	2.255
25 – 29 years	- 0.122	0.435	0.780	0.885	0.378	2.077
30 + years	0.368	0.459	0.422	1.445	0.588	3.549

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR*** *= Hazard Ratio*

Table 4.4: Model (II) Continued

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Parity (**RC** = 1 - 3 infants)						
4 - 5 infants	2.921	1.313	0.026	18.569	1.415	243.603
6 + infants	3.315	1.317	0.008	33.549	2.537	443.690
Birth order						
(**RC** = 4 + birth order)						
First births order	4.593	1.718	0.008	98.794	3.408	2864.043
2-3 birth order	0.168	1.565	0.915	1.183	0.055	25.417
Preceding birth interval						
(RC =24 + months**)**						
First births	4.593	1.718	0.008	98.794	3.408	2864.043
< 24 months	0.216	1.003	0.829	1.242	0.174	8.870
Sex of the infant						
(RC = Female)						
Male	0.549	0.249	0.028	1.731	1.062	2.823
Source of drinking water						
(RC = Improved sources						
Non-improved sources	- 0.239	0.452	0.597	0.787	0.325	1.909
Type of toilet facility						
(RC = Non-improved)						
Improved toilet facility	- 0.346	0.428	0.418	0.707	0.306	1.635
Source of cooking fuel						
(RC = Low polluting)						
Medium polluting	0.941	0.515	0.068	2.562	0.934	7.027
High polluting	- 0.393	0.543	0.469	0.675	0.233	1.957
Type of floor of the house						
(RC = Natural floor)						
Furnished floor	- 0.239	0.396	0.546	0.787	0.362	1.712

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR*** *= Hazard Ratio*

Table 4.4: Model (II) Continued

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Place of Delivery (**RC**= At home)						
At hospital	- 3.670	0.722	0.000	0.025	0.006	0.105
Breastfeeding duration (**RC=** Less than 6 months)						
6 + months	- 2.820	0.387	0.000	0.060	0.028	0.127

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR*** *= Hazard Ratio*

CHAPTER FIVE

DETERMINANTS OF CHILD MORTALITY

5.0 Introduction

This chapter shows the results of determinants of child mortality. It presents three sections; first section shows percent distribution of child live births aged (12-59 months) by the study variables, section two describes the levels and differentials of child mortality rate by the study variables and the last section represents results of the multivariate analysis on child mortality.

5.1 Percentage Distribution of Child live births (12-59 months) by the Study Variables

Table 5.1 showed percentage distribution of the children aged (12-59 months) by the study variables. The results in Table 5.1 showed that majority (90.9%) of the children were alive, while slightly 9.1% of the children were died. This implies that the child mortality is 91 per 1000 live births in Malakal.

The results showed that 58.4% of the children belonged to mothers with no education. 26.4% of the children belonged to mothers who had primary education, while slightly 15.2% of the children belonged to mothers with at least secondary level of education. The results showed that 55.5% of the children belonged to mothers who were not employed.

The results in Table 5.1 showed that the majority (52.1%) of the children belonged to households with low income, 25.7% of the children belonged to households with medium income while slightly 22.2% of the children belonged to households with high income.

Regarding to family size, the majority (64.6%) of the children belonged to households with family size of 7 or more persons, 31.7% of the children belonged to households with 5-6 persons while slightly 3.7% of the children belonged to households with ≤ 4 persons.

The results showed that 38.5%, 29.1% and 32.4% of the children living in the Southern, Northern and Central zones, respectively. With reference to age of the mother at first birth, the results showed that 29.9% of the children born were to mothers aged 15-19 years, 28.6% of the children to mothers aged 20-24 years, 28.2% of the children to mothers aged 25-29 years while slightly 13.3% of the children to mothers aged 30 years or more.

The results regarding the distribution of the children according to the other variables are showed in the Table 5.1.

Table 5.1: Percentage Distribution of Child live births by the Study Variables

Variables	No. of Children	Percentage
Children survival status		
Alive	2027	90.9
Dead	202	9.1
Mother's education		
No education	1303	58.4
Basic/Primary	588	26.4
Secondary +	338	15.2
Mother's employment		
Employed	992	44.50
Not employed	1237	55.50
Family income		
Low income	1161	52.1
Medium income	572	25.7
High income	496	22.2
Family size		
$\leq$ 4 persons	83	3.7
5 – 6 persons	706	31.7
7 persons or more	1440	64.6
Zone of residence		
Northern zone	722	32.4
Central zone	649	29.1
Southern zone	858	38.5

Source: *Field Survey in Malakal, 2016*

Table 5.1: Continued

Variables	No. of Children	Percentage
Mother's age at first birth		
15 – 19 years	667	29.9
20 – 24 years	637	28.6
25 – 29 years	628	28.2
30 + years	297	13.3
Parity		
1 - 3 children	766	34.4
4 - 5 children	804	36.0
6 + children	659	29.6
Birth order		
First birth order	422	18.9
2-3 birth order	900	40.4
4 + birth order	907	40.7
Preceding birth interval		
First birth	422	18.9
< 24 months	1014	45.5
24 + months	793	35.6
Sex of the child		
Male	1026	46.0
Female	1203	54.0
Source of drinking water		
Improved water	416	18.7
Non-improved water	1813	81.3
Type of toilet facility		
Improved toilet facility	473	21.2
Non-improved toilet facility	1756	78.8

Source: *Field Survey in Malakal, 2016*

Table 5.1: Continued

Variables	No. of Children	Percentage
Source of cooking fuel		
Low polluting fuel	221	10.0
Medium polluting	937	42.0
High polluting	1071	48.0
Type of floor of the house		
Natural floor	1387	62.2
Furnished floor	842	37.8
Place of Delivery		
At hospital	1063	47.7
At home	1166	52.3
Duration of breastfeeding		
Less than 6 months	11	0.5
6 + months	2218	99.5

Source: *Field Survey in Malakal, 2016*

5.2 Levels and Differentials of Child Mortality Rates by the Study Variables

. The level of child mortality rate in Malakal was 91 deaths per 1000 live births. Table 5.2 showed that mother's level of education was significantly associated with child mortality at the 5% confidence level. As expected, child mortality was lower among children born to mothers with primary and those at least secondary levels of education.

The results in Table 5.2 showed that the mother's employment was significantly associated with child mortality at the 0.05 confidence level. As expected, child mortality rate was lower among children born to mothers who were employed whereas higher among children born to mothers who were not employed. The results in Table 5.2 showed that family income was significantly associated with child mortality at the 5% confidence level. As expected, child mortality rate was lower among the children that belonged to households with high income whilst higher among children belonged to households with low and medium income. This

result is in line with Abol et al (2009) who established that family income has effects on accessibility of medical services.

Table 5.2: Levels and Differentials of Child Mortality Rates by the Study Variables

Variables	Child live births	Survival Status		CMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Child mortality	2229	**90.9**(2027)	**9.1**(202)	91.0	
Mother's education					**0.000** (32.944)
No education	1303	**88.3** (1151)	**11.7** (152)	117.0	
Basic/primary	588	**92.7** (545)	**7.3** (43)	73.0	
Secondary +	338	**97.9** (331)	**2.1** (7)	21.0	
Mother's employment					**0.000**(23.856)
Employed	992	**94.3** (935)	**5.7** (57)	57.0	
Not employed	1237	**88.3** (1092)	**11.7** (145)	117.0	
Family income					**0.000** (28.101)
Low income	1161	**88.6** (1029)	**11.4** (132)	114.0	
Medium income	572	**90.6** (518)	**9.4** (54)	94.0	
High income	496	**96.8** (480)	**3.2** (16)	32.0	
Family size					**0.127** (4.126)
≤ 4 persons	83	**88.0** (73)	**12.0** (10)	120.0	
5 - 6 persons	706	**92.6** (654)	**7.4** (52)	74.0	
7 persons or more	1440	**90.3** (1300)	**9.7** (140)	97.0	
Zone of residence					**0.762**(0.543)
Northern zone	722	**90.3** (652)	**9.7** (70)	97.0	
Central zone	649	**91.4** (593)	**8.6** (56)	86.0	
Southern zone	858	**91.1** (782)	**8.9** (76)	89.0	
Mother's age at first birth					**0.000** (79.133)
15-19 years	667	**88.0** (587)	**12.0** (80)	120.0	
20-24 years	637	**94.3** (601)	**5.7** (36)	57.0	
25-29 years	628	**95.9** (602)	**4.1** (26)	41.0	
30 + years	297	**79.8** (237)	**20.2** (60)	202.0	

Source: *Field Survey in Malakal, 2016* ***CMR*** *= Child Mortality Rate*

Table 5.2: Continued

Variables	Child live births	Survival Status		CMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Parity					**0.000** (47.585)
1 - 3 children	766	**87.6** (671)	**12.4** (95)	124.0	
4 - 5 children	804	**96.5** (776)	**3.5**(28)	35.0	
6 + children	659	**88.0** (680)	**12.0** (79)	120.0	
Birth order					**0.000** (156.684)
First birth order	422	**78.0** (329)	**22.0** (93)	220.0	
2-3 birth order	900	**98.8** (889)	**1.2** (11)	12.0	
4 + birth order	907	**89.2** (809)	**10.8** (98)	108.0	
Preceding birth interval					**0.000** (108.986)
First birth	422	**78.0** (329)	**22.0** (93)	22.0	
< 24 months	1014	**93.0** (943)	**7.0**(71)	70.0	
24 + months	793	**95.2**(755)	**4.8** (38)	48.0	
Sex of the child					**0.103** (2.661)
Male	1026	**89.9**(922)	**10.1** (104)	101.0	
Female	1203	**91.9** (1105)	**8.1** (98)	81.0	
Source of drinking water					**0.000** (13.917)
Improved water	416	**95.7**(398)	**4.3** (18)	43.0	
Non-improved water	1813	**89.9** (1629)	**10.1** (184)	101.0	
Type of toilet facility					**0.000** (12.850)
Improved toilet	473	**95.1**(450)	**4.9** (23)	49.0	
non-improved toilet	1756	**89.8** (1577)	**10.2** (179)	102.0	
Source of cooking fuel					**0.001** (14.970)
Low polluting	221	**94.1** (208)	**5.9** (13)	59.0	
Medium polluting	937	**93.0** (871)	**7.0** (66)	70.0	
High polluting	1071	**88.5** (948)	**11.5** (123)	115.0	

Source: *Field Survey in Malakal, 2016* ***CMR*** *= Child Mortality Rate*

Table 5.2: Continued

Variables	Child live births	Survival Status		CMR (Per 1000)	Sig (χ^2)
		Alive	Dead		
Type of floor of the house					**0.000** (56.301)
Natural floor	1387	**87.4** (1212)	**12.6** (175)	126.0	
Furnished floor	842	**96.8** (815)	**3.2** (27)	32.0	
Place of Delivery					**0.000** (162.647)
At hospital	1063	**99.1** (1053)	**0.9** (10)	9.0	
At home	1166	**83.5** (974)	**16.5** (192)	165.0	
Duration of breastfeeding					**0.000** (27.750)
Less than 6 months	11	**45.5** (5)	**54.5** (6)	545.0	
6 + months	2218	**91.2** (2022)	**8.8** (196)	88.0	

Source: *Field Survey in Malakal, 2016* ***CMR*** *= Child Mortality Rate*

Table 5.2 showed that family size was insignificantly associated with child mortality at 0.05 confidence level. Similarly, the zone of residence was not significantly associated with child mortality at the 5% confidence level.

The results in Table 5.2 showed that mother's age at first birth was significantly associated with child mortality at the 0.05 confidence level. As anticipated, child mortality was higher among children born to older and younger mothers aged 30 years or more and 15-19 years while lower among children born to mothers aged 20-24.

Table 5.2 showed that parity was significantly associated with child mortality at the 5% confidence level. As expected, child mortality was higher among children belonged to mothers of parity (1-3) and mothers of parity 6 or more, lower among children belonged to mothers of parity (4-5).

The results in Table 5.2 showed that birth order was significantly associated with child mortality at the 0.05 confidence level. First and higher birth orders have higher child mortality rate. As expected, child mortality was higher among first order birth and children of birth order 4 or higher.

The results in Table 5.2 showed that preceding birth interval was significantly associated with child mortality at the 0.05 confidence level. As expected, child mortality rate was higher among children of preceding birth interval less than 24 months than among children with the preceding birth interval of 24 months or more.

The results in Table 5.2 showed that the sex of the child was not significantly associated with child mortality at the 5% confidence level. However, the source of drinking water was significantly associated with child mortality at the 5% confidence level. As expected, child mortality rate was 101 deaths per thousand live births among children residing in households that used drinking water from non-improved drinking water than among children residing in households that used improved drinking.

Type of toilet facility was significantly associated with child mortality at the 5% confidence level. As expected, child mortality was lower among children residing in households used improved toilet facility 49 deaths per thousand live births, while higher among children residing in households that used non-improved toilet facility 102 deaths per thousand live births.

The result in Table 5.2 showed that the source of cooking fuel was significantly associated with child mortality at the 5% confidence level. As expected, child mortality was lower among children living in households used low polluting fuel 59 deaths per thousand live births at the same time as higher among children living in households used higher and medium polluting fuel 115 and 70 deaths per thousand live births, respectively.

Type of floor of the house was significantly associated with child mortality at 0.05 confidence level. As expected, child mortality was lower among children residing in households with furnished floor higher than among children residing in households with natural floor

Table 5.2 also shows that that place of delivery was significantly associated with child mortality at the 5% confidence level. Child mortality was lower among children who were delivered at hospitals than among children who were delivered at home.

Furthermore, the results in Table 5.2 showed that the duration of breastfeeding was significantly associated with child mortality rate. Child mortality was lower among children

who were breastfed for 6 months or more 88 deaths per thousand live births, at the same time as higher among children who were breastfed for less than 6 months.

5.3 Results of the Multivariate Analysis on Child Mortality

This section represents the results of multivariate analysis using the Cox regression model. It consisted of two models where the first model (Model I) was fitted by including only proximate determinants in order to establish the gross effects and the main model (Model II) was fitted by including socioeconomic and proximate determinants to establish the net effect on child death. The results were presented in Tables 5.3 and 5.4 below respectively. The first model was fitted to show the gross effects of proximate determinants on child mortality.

From Table 5.3 it was clear that age of the mother at first birth was and significantly associated with child mortality at 95% confidence level. As expected, the risk of dying for children to mothers aged 30 years or more was 1.777 times higher than among children born to mothers aged 15-19 years. On the other hand, the hazards of dying for children born to mothers aged 20-24 and 25-29 years were 0.442 times and 0.272 times lower, respectively as compared to children to mothers aged 30 years or more. This finding is concurred with the findings of several prior studies (Lemani, 2013; Paul and Damien, 2011; Olabisi, 2010; Buwembo, 2010; Mondal et al, 2009).

The results in Table 5.3 showed that parity was negatively and insignificantly associated with child mortality at the 95% confidence level. Similarly, the birth order was positively and insignificantly associated with child mortality at 95% confidence level.

From Table 5.3 it was clear that preceding birth interval was negatively and significantly associated with child mortality at 95% confidence level. As expected, the risk of dying for children of preceding birth interval less than 24 months was about 3.614 times higher than among children of preceding birth interval 24 months or more. This finding consistent with the findings of several previous studies (Lemani, 2013; Buli, 2013; Mekonnen, 2011; Paul and Damien, 2011; Olabisi, 2010; Buwembo, 2010; Abed et al. 2010; Abol et al. 2009; Mondal et al. 2009; Kembo and Ginneken, 2009; Ezra and Gurum, 2002; Retherford et al.

1989) who established that preceding birth interval less than 24 months have increased risk of child mortality.

The results in Table 5.3 showed that the sex of the child was insignificantly associated with child mortality. However the source of drinking water was significantly associated with child mortality at 95% confidence level. As expected, the risk of dying among children living in households that used non-improved water was 1.873 times higher than among children residing in households that used improved water. This finding is consistent with findings of previous studies (Buli, 2013; Eshetu, 1998).

The results in Table 5.3 showed that type of toilet facility was negatively and insignificantly associated with child mortality at the 95% confidence level. The result showed that source of cooking fuel was negatively and insignificantly associated with child mortality at 95% confidence level. However, the hazard of dying for children residing in households that used high polluting fuel for cooking was 0.481 times lower than among the children residing in households that used low polluting fuel. On the other hand, the hazard of dying for children living in households used medium polluting fuel was 0.956 times lower than children living in households used low polluting fuel. This finding was similar to finding by Mutunga (2004) who established that children living in households used high polluting fuels as their main source of cooking had higher mortality compared to children living in households used low polluting fuels.

From Table 5.3 the type of floor of the house was significantly associated with child mortality at 95% confidence level. The hazard of dying among children living in households with furnished floor was 0.417 times lower than among children living in households with natural floor in the reference category. This finding is consistent with the findings by (Ong'era, 2014; Buwembo, 2010) that type of floor was significantly associated with child mortality.

From Table 5.3 it was clear that place of delivery was significantly associated with child mortality at 95% confidence level. As expected, the risk of dying among children who were delivered at hospital was about 0.047 times lower compared to the children who were delivered at home. This finding is consistent with the findings reported by (Adepoju et al, 2012; Olabisi, 2010; Buwembo, 2010).

The duration of breastfeeding was negatively and significantly associated with child mortality at 95% confidence level. As expected, the risk of dying for children breastfed for 6 months or more was about 0.070 times lower than among children who were breastfed less than 24 months. This finding is consistent with the findings of several previous studies by (Ong'era, 2014; Buli, 2013; Adepoju et al, 2012; Mekonnen, 2011; Buwembo, 2010; Mondal et al. 2009; Uddin et al. 2009).

Table 5.3: Model (I) Results of the Multivariate Cox's regression for Variables Associated with Child Mortality

Variables	B	SE.	Sig.	HR	95% CI	
					Lower	Upper
Mother's age at first birth (**RC**=15–19yrs)						
20 – 24 years	- 0.818	0.213	0.000	0.442	0.291	0.670
25 – 29 years	-1.302	0.247	0.000	0.272	0.168	0.441
30 + years	0.575	0.195	0.000	1.777	1.212	2.607
Parity (RC = 1-3 children)						
4 - 5 children	- 0.130	0.568	0.819	0.878	0.289	2.673
6 + children)	- 0.178	0.619	0.774	0.837	0.249	2.816
Birth order (**RC** = 4 + birth order)						
first birth order	1.052	0.621	0.090	2.863	0.848	9.670
2-3 birth order	- 2.373	0.407	0.000	0.093	0.042	0.207
Preceding birth interval **(RC** =24 + months)						
First birth)	1.052	0.621	0.090	2.863	0.848	9.670
< 24 months	1.285	0.206	0.000	3.614	2.412	5.416
Sex of the child (**RC**=female)						
Male	0.055	0.146	0.704	1.057	0.794	1.406

Source: *Field Survey in Malakal, 2016**RC** = Reference Category **HR** = Hazard Ratio*

Table 5.3: Model (I) Continued

Variables	B	SE.	Sig.	HR	95% CI	
					Lower	Upper
Source of drinking water						
(RC = Improved water)						
Non-improved water	0.628	0.315	0.047	1.873	1.009	3.476
Type of toilet facility						
(RC = Non-improved toilet						
Improved toilet	-0.367	0.290	0.205	0.693	0.392	1.222
Source of cooking fuel						
(RC = Low polluting)						
Medium polluting	- 0.045	0.308	0.884	0.956	0.523	1.747
High polluting	- 0.732	0.303	0.016	0.481	0.266	0.871
Type of floor of the house						
(RC = Natural floor)						
Furnished floor	- 0.874	0.219	0.000	0.417	0.272	0.641
Place of Delivery						
(RC= At home)						
At hospital	- 3.057	0.346	0.000	0.047	0.024	0.093
Duration of breastfeeding						
(RC= Less than 6 months)						
6 + months	- 2.656	0.454	0.000	0.070	0.029	0.171

Source: *Field Survey in Malakal, 2016**RC** = Reference Category **HR** = Hazard Ratio*

The main model (Model II) was fitted in order to establish the net effects of proximate and socioeconomic determinants on child mortality. Although mother education is one of the major vital factors for child mortality but in this study, mother's education was found to have a positive and insignificant association with child mortality at 95% confidence level. Surprisingly, the risk of dying for children belonging to mothers with at least secondary level of education was 1.114 times higher compared to children born to mothers with no education in the reference category. The risk of dying for children born to mothers with primary education was about 1.700 times higher when compared to children for mothers with no

education. Several studies show the reverse results. This finding consistent with the findings of previous studies by (Paul and Damien, 2011; Eshetu, 1998) that mother educational level was insignificantly associated with child mortality.

From Table 5.4 it was clear that mother's employment status was significantly associated with child mortality at 95% confidence level. As, The hazard of dying among children born to mothers who were employed was about 0.668 times lower when compared to children born to mothers who were not employed. This finding is consistent with the findings of previous study by Kishor and Parasuraman (1998) that working mothers was significantly associated with child mortality.

From Table 5.4 it was apparent that family income was negatively and significantly associated with child mortality at 95% confidence level. As expected, the hazard of dying among children living in households with high income was 0.562 lower than among children living in households with low income. This finding collaborates other results (Abol et al. 2009; Uddin et al. 2009) who established that children living in wealthier households experience lower mortality.

As indicated in Table 5.4 family size was and insignificantly associated with child mortality at 95% confidence level. Similarly, the zone of residence was insignificantly associated with child mortality at 95% confidence level. The age of mother at first birth was positively and significantly associated with child mortality at 95% confidence level. As expected, the hazard of dying for children born to mothers aged 30 years or more was about 1.565 times higher than children for mothers aged 15-19 years. On other hand, the hazards of dying for children born to mothers aged 20-24 and 25-29 years were around 0.449 times and 0.290 times lower, respectively than among children for mothers aged 30years or more. This finding is agreed with several prior studies (Lemani, 2013; Paul and Damien, 2011; Olabisi, 2010; Buwembo, 2010; Mondal et al. 2009)

Parity, sex of the child and the birth order of the child were each found to be insignificantly associated with child mortality. However, the preceding birth interval was positively and significantly connected with child mortality at the 95% confidence level. As expected, the risk of dying was 4.025 times higher among children of preceding birth interval less than 24

months compared to the children with of preceding birth intervals of at least 24 months. This finding is in line with several earlier studies (Lemani, 2013; Mekonnen, 2011; Paul and Damien, 2011; Olabisi, 2010; Buwembo, 2010; Abed et al. 2010; Abol et al. 2009; Mondal et al. 2009; Kembo and Ginneken, 2009; Ezra and Gurum, 2002; Retherford et al. 1989).

The source of drinking water was found to be significantly associated with child mortality. As expected, the hazard of dying for children living in households that used non-improved water was 1.947 times higher than among children living in households that used water from an improved source. This finding is similar to the findings of several previous studies (Buli, 2013; Mesike and Mojekwu, 2012; Mutunga, 2004; Eshetu, 1998) that unimproved water was positively and significantly associated with child mortality.

The source of cooking fuel was significantly associated with child mortality at 95% confidence level. Surprisingly, the hazard of dying for children residing in households that used high polluting fuel was about 0.508 times lower than children residing in households used low polluting fuel in the reference category. On the other hand, the hazard of dying among children living in households that used medium polluting fuel was 1.051 times higher than among children living in households used high polluting fuel (firewood). This finding is consistent with that of Mutunga (2004) and inconsistent with Ong'era (2014) that using firewood for cooking was positively associated with child mortality.

Furthermore the results show that the type of floor of the house was significantly associated with child mortality at 95% confidence level. As expected, the hazard of dying among children living in households with furnished floor was 0.404 times lower than among children living in households with natural floor in the reference category. This result is similar with numerous prior studies by (Ong'era, 2014; Buwembo, 2010)

The place of delivery was significantly associated with child mortality at the 95% confidence level. The risk of dying among children who were delivered at hospital was 0.039 times lower as compared to the children who were delivered at home. This finding is concurred with the findings of several earlier studies by (Adepoju et al, 2012; Olabisi, 2010; Buwembo, 2010).

Also the duration of breastfeeding was negatively and significantly associated with child mortality at the 95% confidence level. As expected, the risk of dying among children who

were breastfed for 6 months or more was 0.064 times lower as compared to children who were breastfed for less than 24 months. This finding is consistent with the findings several previous studies (Ong'era, 2014; Buli, 2013; Adepoju et al, 2012; Mekonnen, 2011; Buwembo, 2010; Mondal et al. 2009; Uddin et al. 2009).

Table 5.4: Model (II) Results of the Multivariate Cox's regression for Variables Associated with Child Mortality

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Mother's education						
(RC = No education)						
Basic/Primary	0.530	0.196	0.007	1.700	1.157	2.496
Secondary +	0.108	0.412	0.973	1.114	0.497	2.496
Mother's employment						
(RC = Not Employed)						
Employed	- 0.374	0.167	0.025	0.668	0.496	0.953
Family income						
(**RC** = Low income)						
Medium income	0.190	0.172	0.271	1.209	0.863	1.694
high income	- 0.557	0.292	0.049	0.562	0.317	0.996
Family size						
(RC = 7+)						
≤ 4 persons	0.394	0.363	0.277	1.483	0.728	3.022
5 – 6 persons	- 0.112	0.195	0.568	0.894	0.610	1.312
Zone of Residence						
(RC = Southern zone**)**						
Northern zone	0.019	0.186	0.918	1.019	0.707	1.469
Central zone	0.506	0.193	0.009	1.659	1.137	2.421

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR =*** *Hazard Ratio*

Table 5.4: Model (II) Continued

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Mother's age at first birth (**RC** =15–19 years)						
20 – 24 years	- 0.801	0.219	0.000	0.449	0.292	0.690
25 – 29 years	- 1.239	0.255	0.000	0.290	0.176	0.478
30 + years	0.448	0.206	0.029	1.565	1.046	2.341
Parity (**RC** = 1-3 children)						
4 - 5 children	- 0.146	0.561	0.794	0.864	0.288	2.593
6 + children	- 0.268	0.615	0.663	0.765	0.229	2.552
Birth order (**RC** = 4 + birth order)						
First birth order	0.998	0.622	0.108	2.714	0.803	9.176
2-3 birth order	- 2.406	0.418	0.000	0.090	0.040	0.205
Preceding birth interval (RC =24 + months)						
First births	0.998	0.622	0.108	2.714	0.803	9.176
< 24 months	1.393	0.210	0.000	4.025	2.670	6.070
Sex of the child (RC = Female)						
Male	0.032	0.145	0.824	1.033	0.777	1.373
Source of drinking water (RC = Improved water						
Non-improved water	0.666	0.323	0.039	1.947	1.033	3.668
Type of toilet facility (RC = Non-improved)						
Improved toilet	- 0.288	0.296	0.331	0.750	0.420	1.339

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR*** *= Hazard Ratio*

Table 5.4: Model (II) Continued

Variables	B	S.E.	Sig.	HR	95% CI	
					Lower	Upper
Source of cooking fuel						
(RC = Low polluting)						
Medium polluting	0.050	0.326	0.879	1.051	0.555	1.992
High polluting	- 0.678	0.311	0.029	0.508	0.276	0.935
Type of floor of the house						
(RC = Natural floor)						
Furnished floor	- 0.906	0.224	0.000	0.404	0.261	0.627
Place of Delivery						
(**RC**=At home						
At hospital	- 3.256	0.365	0.000	0.039	0.019	0.079
Duration of breastfeeding						
(RC = Less than 6 months)						
6 + months	- 2.746	0.466	0.000	0.064	0.026	0.160

Source: *Field Survey in Malakal, 2016* ***RC*** *= Reference Category* ***HR =*** *Hazard Ratio*

CHAPTERSIX

SUMMARY, CONCLUSIONAND RECOMMENDATIONS

6.0. Introduction

This chapter is divided into three parts. The first part presents summary of the study and results, the second part presents conclusion and the last part presents recommendations for policy and further research

6.1 Summary

The general objective of the study was to establish the determinants of infant and child mortality in Malakal. The study set out to achieve two specific objectives (1) to establish the levels and differentialsof infant and child mortality in Malakal (2) to identify the factors associated with infant and child mortality in Malakal. Mosley and Chen framework guided the study. The study variables included mother's education, mother's employment, family income, family size, zone of residence, mother age at first birth, birth order, preceding birth interval, parity, sex of the child, source of drinking water, type of toilet facility, source of cooking fuel, type of floor of the house, place of delivery and duration of breastfeeding.

Primary data for the study was collected in Malakal among random sample of 1317 women of the reproductive age. The women provided their complete maternity history from which 1109 infants 2229 children aged 1 and 4 years were identified and used in the study. The methods of data analysis used were descriptive statistics, direct estimation of infant and child mortality and the Cox regression analysis.

6.1.1 Infant Mortality

The study established that the infant mortality of Malakal was 72 per 1000 live birth and there significant socioeconomic and demographic differential in infant mortality in Malakal. The findings of Bivariate analysis showed that mother's education, mother's employment, family income, parity, birth order, preceding birth interval, source of drinking water, type of toilet

facility, type of floor of the house, place of delivery and duration of breastfeeding were significantly associated with infant mortality.

For example infant mortality was found to be lower among infants for mothers with at least secondary education level than among infants for mothers with no education. Unexpected, rate of infant mortality was higher among infants for mothers who were employed relative to infants whose mothers who were not employed. As expected, infant mortality was lower among infants living in households with high income than among infants living in households with low income. As expected, infant mortality was lower among infants that belonged to households with family size $\leq$ 4 persons whereas than among infants that belonged to households with family size 7 persons or more. Also, infant mortality was higher among infants living in Southern zone relative to infants living in Central zone.

Infant mortality was higher among infants born to mothers aged 30 years or more than among infants born to mother aged 20-24 years. Moreover, infant mortality was higher among infants belonged to mothers parity 6 or above than among infants born to mother of parity 4-5. As expected, infant mortality was higher among infants of first birth order while lower among infants of birth order 2-3. As expected, infant mortality was higher among infants with preceding birth interval of less than 24 months compared to the infants with preceding birth interval of at least 24 months. As expected, infant mortality was higher among male infants than among female infants.

As expected, infant mortality was higher among infants residing in households that used drinking water from non-improved sources than lower among infants residing in households that used water from improved source. Similarly, infant mortality was lower among infants belonging to households that used improved toilet facility than among infants in households used a non-improved toilet facility. Infant mortality was higher among infants living in households that used medium polluting fuel than among infants living in households that used low polluting fuel. As expected, infant mortality was lower among infants living in households with furnished floor while higher among infants living in households with natural floor. As expected, infant mortality was lower among infants who were delivered at hospital while higher among infants who were delivered at home. As expected, infant mortality was

lower among infants who were breastfed for 6 months or more than among infants who were breastfed for less than 6 months.

The findings of multivariate Cox regression model **(Model I)** showed that parity, birth order, place of delivery and duration of breastfeeding were significantly associated with infant mortality. Infants belonged to mothers of parity 6 or more have higher risk of dying than infants belonged to mothers of parity 1-3. Infants of first order had a higher risk of dying than infants of birth order 4 or higher. Infants who were delivered at hospital had a lower the risk of dying compared to infants who were delivered at home. Infants who were breastfed for 6 months or more had a lower the risk of dying than infants who were breastfed for less than 6 months.

The findings of multivariate Cox regression model **(Model II)** showed that mother's employment, family income, zone of residence, parity, birth order, sex of the infant, place of delivery and duration of breastfeeding were significantly associated with infant mortality. The risk of dying was found to be 1.923 times higher among infants whose mothers who were employed than among infants whose mothers who were not employed. As expected, infants living in households with high income had a lower the risk of dying than infants living in households with low income. The risk of dying was 2.238 times higher among infants living in Northern zone compared to infants living in Southern zone. Infants belonged to mothers of parity 6 or more had a higher risk of dying than infants belonged to mothers of parity 1-3. As expected, infants of first birth order had higher hazard of dying than infants of higher birth orders. As expected, male infants had a higher risk of dying than female infants. As expected, infants who were delivered at hospital had lower the risk of dying than infants who were delivered at home. As expected, infants who were breastfed for six months or more had lower the hazard of dying than infants who were breastfed less than six months.

6.2.2 Child Mortality

The study found that the child mortality of Malakal was 91 per 1000 live births. The study found that mother's education, mother's employment, family income, mother's age at first birth, parity, birth order, preceding birth interval, source of drinking water, type of toilet facility, source of cooking fuel, type of floor of the house, place of delivery and duration of breastfeeding were significantly associated with child mortality.

The findings of direct estimation showed that, as expected, child mortality was lower among children whose mothers had at least secondary education than among children born to mothers with no education. As expected, child mortality was lower among children whose mothers who were employed than among children whose mothers who were not employed. As expected, child mortality was lower among children living in households with high income than among children living in households with low income. Unexpected, child mortality was higher among children that belonged households having a family size ≤4 and lower for children belonged to family size 5-6. Moreover, child mortality rate was higher among children living in Northern zone and lower for children living in Central zone.

Child mortality was higher among children born to older mothers aged 30 years or more than among children for mothers aged 25-29 years. Furthermore, child mortality was higher among children belonged to mothers with parity 1-3 and lower among children belonged to mothers of parity 4-5. As expected, child mortality was higher among first born children or first birth order children than among children belonged to birth order 2-3. As expected, child mortality was higher among children with a preceding birth interval of less than 24 months than among children with a preceding birth interval 24 months or more. As expected, child mortality was higher among male children than among female children.

As expected, child mortality was found to be higher among children residing in households that used drinking water from non-improved sources than among children residing in households that obtained drinking water from improved sources. Child mortality was lower among children residing in households used an improved toilet facility than among children residing in households that used a non-improved toilet facility. Similarly, child mortality was higher among children residing in households that used high polluting fuel than among

children residing in households that used low polluting fuel. As expected, child mortality was lower among children residing in households with furnished floor than among children living in households with natural floor. As expected, child mortality was lower among children who were delivered at hospital than among children who were delivered at home. As expected, child mortality rate was lower among children who were breastfed 6 months or more while higher among children who were breastfed less than 6 months.

The findings of multivariate Cox regression model that included proximate variables only **(Model I)** showed that age of the mother at first birth, preceding birth interval, source of drinking water, and type of floor of the house, place of delivery and duration of breastfeeding were significantly associated with child mortality.

The findings of the multivariate Cox regression model **(Model II)** showed that mother's employment, family income, age of the mother at first birth, preceding birth interval, source of drinking water, and type of the floor of the house, place of delivery and duration of breastfeeding were significantly associated with child mortality. As expected, the risk of dying was lower among children for mothers who were employed than among children born to mothers who were not employed. As expected, children living in households with high income had a lower risk of dying than children living in households with low income. As expected, children born to mothers aged 30 years or more had a higher risk of dying than children born to mothers aged 15-19 years. The risk of dying was 4.025 times higher among children with a preceding birth interval of less than 24 months compared to children of preceding birth interval 24 months or more. As expected, children residing in households that used drinking water from a non-improved source had a higher risk of dying compared to children living in households that used drinking water from improved sources. As expected, children residing in households with furnished floor lower risk of dying 0.404 times than children residing in households with natural floor. As expected, children who were delivered at hospitals lower the hazard of dying 0.039 times than children who were delivered at home. As expected, children who were breastfed six months lower risk of dying 0.064 times than children who were breastfed less than six months.

6.2 Conclusion

The study established that the levels of infant and child mortality were 72 and 91 deaths per 1000 live births, respectively in Malakal. Also, the study established that the higher levels of infant and child mortality were among children born to mothers with no education, those lived in households with low income, born to mothers aged 30 or more, those who belonged to first birth order, children with a preceding birth interval less than 24 months, male children, those living in households used drinking water from non-improved sources, those living in households used non-improved toilet facility, those living in households with natural floor, those who were delivered at home and infants and children who were breastfed less than 6 months.

The study identified significant association both between infant and child mortality and mother's employment, family income, place of delivery, and duration of breastfeeding. Also, the study identified significant association between infant mortality and zone of residence, parity, birth order and sex of the infant. Furthermore, the study identified significant association between child mortality and mother's age at first birth, preceding birth interval, source of drinking water, source of cooking fuel and type of floor of the house.

The study did not identify any significant association both between infant and child mortality and mother's education, family size, type of toilet facility and source of cooking fuel. Additionally, the study did not identify any significant association between infant mortality and age of the mother at first birth, type of floor of the house, preceding birth interval and source of drinking water. Furthermore, the study did not identify any significant association between child mortality and birth order, sex of the child, zone of residence and parity.

6.3 Recommendations

6.3.1 Recommendations for Policy

The following recommendations can be made based on the findings of the study.

Mother's employment status was positively and significantly associated with infant death; it is recommended that maternity leave should be increased in order to improve duration of breastfeeding and therefore reducing the risk of infant mortality.

Zone of residence significantly associated with infant death; it is recommended that Northern and Central zones need vital concentration in terms of the preventive and therapeutic medical interferences to decrease the risk of infant mortality.

Since age of the mother at first birth was significantly associated with child mortality, it is recommended that mothers who want to give the birth at 30+ years should be encouraged to attend prenatal care from the start to the end and deliver at health facility. Also, increase preceding birth interval.

The result showed that children living in households that used drinking water obtained from non-improved sources has higher child mortality risks; it is recommended that government should make concerted efforts to improve the supply of clean drinking water in all households in Malakal in order to decrease the risk of child mortality.

Source of cooking fuel was significantly associated with child mortality; it is recommended that government should encourage the use of low polluting fuels to decrease child mortality.

The study has showed that family income was negatively and significantly associated with child mortality, the government should develop appropriate policies and programs to reduce poverty and improve the financial status of women. Finally, all expectant mothers should be encourage to deliver in a health facility and to make this possible the government increase access health facilities

6.3.2 Recommendations for further Research

The following are various areas need further research:
Further research is needed to be conducted to see whether the effects of determinants on infant and child mortality change over time. Similarly, research is needed to be carried out using on infant and child mortality, using qualitative methodologies, in order to explore other factors affecting infant and child mortality and to establish the pathways of influence.

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Appendix

The questionnaire

University of Nairobi

Faculty of Population Studies and Research Institute

PhD Programme in Population Studies

Questionnaire to study the determinants of infant and child mortality in Malakal in Upper Nile State, South Sudan

The questions in this survey are for the **Determinants of Infant and Child mortality** in the households in Malakal. This questionnaire is to be administered to all women aged 15-49 years.

Good morning. My name is _____. I am one of the Research Assistants of PhD Program in Population Studies which conducts this survey. The main objective of this research is to establish the determinants of infant and child mortality in Malakal. The study is confidential; your name will not be mentioned anywhere and the information provided by you will be presented only in a summarized form. The interview process will take 20 to 25 minutes. Can we start now?

Zone: _____ Cluster No. _____ HH No. _____

Interviewer Name: _____ Date of interview: _____

Section (1): Information about Woman's background and Complete Birth History (Child Survival)

1.	Is there any eligible woman resides in this household aged between 15 - 49 years, who has ever given birth? 1 = Yes 2 = No if there is no woman in the household, go to Section 2, Section 3 and Section 4	1 ☐ 2 ☐
2.	How many women in this household aged between 15- 49 years have ever given birth?	
3.	What are the names of the women have ever given birth?	Person number
	1. Name of the first woman……..……..…….. Give person number	
	2. Name of the second woman…….…. Give person number	
	3. Name of the third woman……..……..…...Give person number	

First name of woman……..…... Person number ☐

(1) In what year were you born? ☐

(2) How old are you now? (*Mark one code only*):

1= 15- 19 ☐ 2 = 20 - 24 ☐ 3 = 25 – 29 ☐ 4 = 30 – 34 ☐ 5 = 35- 49 ☐

(3) Have you ever attended school? 1= Yes ☐ 2 = No ☐

(4) What is the highest level of school you attended?

1= Basic/ primary ☐ 2 = Secondary or above ☐

(5) What is your current marital status?

1= Married ☐ 2 = Separated ☐ 3 = Divorced ☐ 4 = Widowed ☐

(6) What is your current employment status? (*Mark one code only*):

1= Employed ☐ 2 = Not employed ☐

(7) How many years ago did you have your first birth?

1= 15- 19 ☐ 2 = 20 - 24 ☐ 3 = 25 – 29 ☐ 4 = 30 – 34 ☐ 5 = 35- 49 ☐

(8) How many children (live births) have you ever given birth to? ☐

(9) How many of your children are still living? ☐ How many sons live with you? ☐

And how many daughters live with you? ☐

(10) Have you ever given birth to a son or daughter who was born alive but later died? 1= Yes ☐ 2 = No ☐

How many boys have died? ☐ And how many girls have died? ☐

Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had. Do not include stillbirths and children adopted by the mother. Now let us talk about each of your children:

LIVEBIRTH HISTORY TABLE

List of children All children, whether alive or dead: (from the eldest to the youngest) Record twins on separate lines and mark with a bracket	**All children** Is/was the child a Male or a Female		**All children** Date of birth In what year, Month and day was the child born?	**All children** Where was the child born? (Place of delivery of the child) 1 = At public/ private hospital 2 = At home or else where	**All children** Is the child still alive?		**If alive:** How old is he/she? Record age in completed months. Less than 12 months=0	**If dead:** How old was the child when he/she died? Record age in completed months. Less than12 months = 0	**All children** What is the Duration of Breastfeeding? 1= <6months 2 = 6 months or more 3= Not breastfed	**All children** What is the spacing of Birth interval? 1 = < 24 months 2 = 24 months or more
Name of child (Birth Order)	**M**	**F**	**Month & Year**	**Place of delivery**	**Yes**	**No**	**Age in months**	**Age at death in months**	**In months**	**In months**
1st	1	2			1	2				
2nd	1	2			1	2				
3rd	1	2			1	2				
4th	1	2			1	2				
5th	1	2			1	2				
6th	1	2			1	2				
7th	1	2			1	2				

8th	1	2			1	2				
9th	1	2			1	2				
10th	1	2			1	2				

First name of woman……..……..…... Person number ☐

(1) In what year were you born? ☐

(2) How old are you now? (*Mark one code only*):

1= 15- 19 ☐ 2 = 20 - 24 ☐ 3 = 25 – 29 ☐ 4 = 30 – 34 ☐ 5 = 35- 49 ☐

(3) Have you ever attended school? 1= Yes ☐ 2 = No ☐

(4) What is the highest level of school you attended?

1= Basic/ primary ☐ 2 = Secondary or above ☐

(5) What is your current marital status?

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(6) What is your current employment status? (*Mark one code only*):

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And how many daughters live with you? ☐

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Name of child (Birth Order)	M	F	Month & Year	Place of delivery	Yes	No	Age in months	Age at death in months	In months	In months
1st	1	2			1	2				
2nd	1	2			1	2				
3rd	1	2			1	2				
4th	1	2			1	2				
5th	1	2			1	2				
6th	1	2			1	2				
7th	1	2			1	2				
8th	1	2			1	2				
9th	1	2			1	2				
10th	1	2			1	2				

First name of woman …….. **Person number** ☐

(1) In what year were you born? ☐

(2) How old are you now? (*Mark one code only*):

1= 15- 19 ☐ 2 = 20 - 24 ☐ 3 = 25 – 29 ☐ 4 = 30 – 34 ☐ 5 = 35- 49 ☐

(3) Have you ever attended school? 1= Yes ☐ 2 = No ☐

(4) What is the highest level of school you attended?

1= Basic/ primary ☐ 2 = Secondary or above ☐

(5) What is your current marital status?

1= Married ☐ 2 = Separated ☐ 3 = Divorced ☐ 4 Widowed ☐

(6) What is your current employment status? (*Mark one code only*): 1= Employed ☐ 2 = Not employed ☐

(7) How many years ago did you have your first birth?

1= 15- 19 ☐ 2 = 20 - 24 ☐ 3 = 25 – 29 ☐ 4 = 30 – 34 ☐ 5 = 35- 49 ☐

(8) How many children (live births) have you ever given birth to? ☐

(9) How many of your children are still living? ☐ How many sons live with you? ☐

And how many daughters live with you? ☐

(10) Have you ever given birth to a son or daughter who was born alive but later died? 1= Yes ☐ 2 = No ☐

How many boys have died? ☐ And how many girls have died? ☐

Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had. Do not include stillbirths and children adopted by the mother. Now let us talk about each of your children:

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Name of child (Birth Order)	**M**	**F**	**Month & Year**	**Place of delivery**	**Yes**	**No**	**Age in months**	**Age at death in months**	**In months**	**In months**
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2nd	1	2			1	2				
3rd	1	2			1	2				
4th	1	2			1	2				
5th	1	2			1	2				
6th	1	2			1	2				
7th	1	2			1	2				
8th	1	2			1	2				
9th	1	2			1	2				
10th	1	2			1	2				

Section (2): Information about the Father of the Household (Husband):

(1) In what year was the father of the household born? ☐

(2) How old is the father of the household? ☐

1= < 20 ☐ 2 = 20 – 29 ☐ 3 = 30 – 39 ☐ 4 = 40 – 49 ☐ 5 = 50 – 59 ☐

(3) Does the father of the household attended school? 1 = Yes ☐ 2 = No ☐

(4) What is the highest level of school the father of the household attended? (*Mark one code only*):

1 = Basic/primary ☐ 2 = Secondary or above ☐

(5) What is the employment status of the father of the household? 1= Employed ☐ 2 = Not employed ☐

(6) Family income per a month (amount earned by mother and father) by South Sudan Pound ☐

1 = Low income (less than 1000) ☐ 2 = Medium income (1000 - 1499) ☐ 3 = High income (1500 or more) ☐

Section (3): Household Characteristics Module:

(1) How many rooms in this household are used for sleeping?

1 = One room ☐ 2 = Two rooms ☐ 3 = Three rooms ☐ 4 = Four rooms and more ☐

(2) What is the main material used for the Walls of the dwelling? (*Mark one code only*)?

1= Mud ☐ 2 = Bricks ☐ 3 = Cement block ☐ 4 = other (specify) ☐

(3) What types of main floor of the house (the dwelling)? (*Mark one code only*)

1= Earth (Natural) floor ☐ 2 = Furnished floor ☐

(4) What is the main material used for the roof of the dwelling?

1 = Thatch ☐ 2 = Zinc ☐ 3 = Concrete stone ☐ 4 = other (specify) ☐

(5) How many persons in the household? ☐

1 = ≤ 4 persons ☐ 2 = 5- 6 persons ☐ 3 = 7 persons and more ☐

(6) How many persons per room (Crowding)? 1 = Not overcrowded (Less than 2 persons) ☐

2 = Overcrowded (2 to 4 persons) ☐ 3 = highly overcrowded (4 and more persons) ☐

(7) Does this household have a connection to the mains electricity supply? 1= Yes ☐ 2 = No ☐

(8) What type of fuel does your household normally use for cooking?

1 = Electricity ☐ 2 = Gas ☐ 3 = Charcoal ☐ 4 = Firewood ☐ 5 = other (specify) ☐

(9) Is the cooking usually done in the house, in a separate room/or outdoors?

1 = in the house ☐ 2 = in a separate room ☐ 3 = Outdoors ☐ 4 = other (specify) ☐

(10) Thinking back five years ago, did this household have a connection to mains electricity supply, then?

1 = Yes ☐ 2 = No ☐ 3 = Household did not exist ☐ 4 = don't know ☐

Section (4): Water and Sanitation Module:

(1) What is the main source of drinking water for members of your household? *(Mark one code only)*

1= Piped water ☐ 2 = River water ☐ 3 = Water Vendor ☐ 4 = Water transported by tankers ☐

(2) What is the main source of water used by your household for cooking and other purposes such as hand washing?

1= Piped water ☐ 2 = River water ☐ 3 = Water Vendor ☐ 4 = Water transported by tankers ☐

(3) The water from the main source, is it safe to drink? 1= Yes (Safe) ☐ 2 = No (Unsafe) ☐

(4) If the answer No in Q2, do you treat your water in any way to make it safer to drink? 1= Yes ☐ 2 = No ☐

(5) What do you usually do to make the water safer to drink?

1= Boil ☐ 2 = Chlorine ☐ 3 = Use water filter ☐ 4 = Let it stand and settle ☐ 5 = other (specify) ☐

(6) Does your household have a toilet facility? 1 = Yes ☐ 2 = No ☐ (bush or field)

(7) If yes in Q4, What type of toilet facility do members of your household usually use to dispose of human waste?

1 = Flush toilet ☐ 2 = Pit latrine with slab ☐ 3 = Pit latrine without slab/ Open pit ☐ 4 = Bucket toilet ☐

(8) What do you mostly use to wash your hands? (*Mark one code only*)

1= Water only ☐ 2 = Soap and water ☐ 3 = don't care ☐

(9) When do you wash your hands? (*Mark one code only*)

1= after defecation ☐ 2 = before feeding children ☐ 3 = after feeding children ☐

You have come to the end of the interview for this household.

Thank the respondent for her co-operation