EFFECT OF MATERNAL EDUCATION ON INFANT MORTALITY IN KENYA: A COMPARATIVE ANALYSIS OF NYANZA AND CENTRAL REGIONS.

BY

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DECLARATION

This Masters Research project is my original work and has never been submitted for approval in this or any other University.

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DEDICATION

I dedicate my Masters Research Project to my spouse Robert Sangori and my kids Peter, Joy, Eunice and David for their unconditional and invaluable support during my study.

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LIST OF ABBREVIATONS

ANC	AnteNatal Care
IMR	Infant Mortality Rate
ITNs	Insecticide Treated Nets
KDHS	Kenya Demographic and health survey
MDGs	Millennium Development Goals
PSRI	Population Studies and Research Institute
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children's Fund
WHO	World Health Organization

ABSTRACT

Maternal education holds tremendous effect on child wellbeing as well as survival globally. Investing in female education is perceived to be the only powerful policy for bringing socioeconomic development in less developed countries. Currently, data gap on patterns of infant mortality exist at regional level. This study focused on comparing effect of maternal education on infant mortality in Nyanza and Central Regions. This study was based on three objectives; to determine the patterns of infant mortality by maternal education; and to establish unadjusted and adjusted effects of maternal education on infant mortality in Nyanza and Central Regions.

Secondary source of data namely, KDHS 2014 was used. Analyzing data involved using the child file which contained information on individual children born to women less than 60 months prior to interview date (0-59 months). The analysis was based on 20,964 children of which 2926 were from Nyanza Region and 1420 from Central Region. The life table probability of dying from birth to 60 months per 1000 live births was utilized to analyze patterns of infant mortality by maternal education in Nyanza and Central Regions. Analysis of unadjusted as well as adjusted effects of maternal education on infant death involved utilizing logistic regression.

This study revealed that patterns of infant mortality differed with maternal education levels both in Nyanza and Central Region. Mothers with secondary plus education had a lesser probability of infant deaths in comparison to mother's primary or without education in Nyanza together with Central Regions. The study findings also showed that in Nyanza Region preceding birth interval and source of drinking water had substantial effect on infant survival. While in Central Region maternal education had significant effect on infant mortality.

It is the recommendation of this study that innovative education programmes should be initiated to inspire females to accomplish at least secondary education in Nyanza as well as Central Regions. In Nyanza Region, family programmes should be intensified that encourage birth intervals of beyond 24 months. In addition, water programmes that ensure households have admission to safe water for drinking should be intensified. In Central Region, programmes aimed at improving child survival should be intensified while making efforts to establish the mechanisms through which maternal education acts to significantly reduce infant mortality.

CHAPTER ONE: INTRODUCTION

1.1 Background

Infant mortality is the probability attributed to a baby dying prior to attaining year one. Infant mortality used as an index of economic development and general welfare of the population as a whole (Blacker, 1991). Infant mortality is also the size of the allocation of resources with high infant mortality showing the uneven allocation of resources between regions and disparities in the allocation of maternal education which broadens regional differences in infant mortality (Nandita *et al* 2013). Basing on Kenya Demographic and Health Survey (KDHS 2014), Infant Mortality Rate (IMR) in Kenya was 39 deaths per 1000 live births. Although IMR has been declining there are high regional disparities. In Nyanza Region, the IMR is 50 deaths per 1000 live births which is above the Kenyan IMR of 39 deaths per 1000 live births. The KDHS data of 2003, 2008/9 and 2014 indicate that IMR has been reducing across all Regions in Kenya. Although IMR has been reducing in Kenya, Nyanza is among the Regions in Kenya that IMR remains to be high. For instance, the Nyanza Region had IMR of 133, 95 and 50 deaths per 1000 live births in 2003, 2008 and 2014 congruently. In Central Region IMR was 44, 42 and 38 deaths per 1000 live births in 2003, 2008 and 2014 congruently.

Variations in IMR exist in regions in Kenya. As per the KDHS reports, Nairobi Region had IMR of 67, 60 and 55 deaths per 1000 live births in 2003, 2008 and 2014 congruently. In Western Region, the IMR was reported at 80, 65 and 40 deaths per 1000 live births in 2003, 2008 and 2014 congruently. In Coast Region, IMR stood at 78, 71 and 44 deaths per 1000 live births in 2003, 2008 and 2014 congruently. As for the case of North Eastern Region, the IMR was reported to be 91, 57 and 37 deaths per 1000 live births in 2003, 2008 and 2014 congruently. In Eastern Region, IMR stood at 56, 39 and 36 deaths per 1000 live births in 2003, 2008 as well as 2014 congruently. It is imperative to note the key causative issues to reduced infant mortality. These includes use of insecticide-treated bed nets (ITNs), rise in immunization rates, deliveries in health services, exclusive breastfeeding, antenatal care, and post-natal care, admission to safe water for drinking as well as enhanced hygiene. (Demombynes and Trommlerova, 2012)

The Kenya status report of 2013 on Millennium Development Goals (MDGs) further highlights measures put in place by the Kenyan Government aimed at reducing infant mortality. These measures comprise of the improvement of standard procedures for a unified Health administration System, Malezi Bora approach that puts in place an all-inclusive combination of health services which comprises of upsurge in scope of immunization , Vitamin A supplements and vaccination of additional diseases such as influenza & pneumonia , enhanced treatment of common childhood diseases like polio vaccinations, giving out of Insecticide Treated Nets (ITNs) for averting malaria as well as enhanced Antenatal Care (ANC) for pregnant mothers. The Kenyan MDG target was to lower IMR to 22 deaths per 1000 live births by 2015. Though, the goal was never realized since IMR remains at 39 deaths per 1000 live births. The Kenya status report (2013) attributes challenges to reducing infant mortality to inadequate staff and skills capacity, poor health-seeking behavior and improper childcare practices among caregivers, scarce financial resources, and mothers with infants being far from health services and high cost of services, lack of enough referral systems and poor diets due to poverty for failure to achieve this goal. A rise in maternal education points to a drop in infant mortality, there exists a reverse linkage between maternal education and infant mortality (Cleland and Ginneken 1989). Many studies on infant mortality suggest a robust linkage amongst infant mortality with some form of schooling, (Hulya and Murat 2009).

1.2 Statement of the Problem

The IMR has been declining as depicted by results of Kenya demographic and health surveys. However, trend data shows that there still exist regional variations in infant mortality with Nyanza Region among the regions in Kenya that experiences high levels of infant mortality level in comparison to Central Region that is among the regions that experience low levels of infant mortality. Basing on 2003, 2008 and 2014 KDHS results, Nyanza Region recorded high IMRs of 133, 95 and 50 infant deaths per 1000 live births congruently. Contrarily, Central Region had IMRs of 44, 42 and 38 infant deaths per 1000 live births for the periods regarding 2003, 2008 and 2014, congruently. Further analysis of KDHS reports provides a strong linkage of the maternal education to infant mortality. In particular, higher levels of education give rise to a drop in infant mortality levels on the point of exposing mothers to information on key factors that regulate infant mortality levels including improved nutrition, access to contraceptives, and management of childhood

ailment. It is vital to take into consideration that within these regions there exist sub-regional variations in infant mortality. Even though Nyanza region is considered as a region with high mortality, it masks the differences in infant mortality within the counties. The Kenya population and housing census analytical report of 2009 gives infant mortality estimates at the county level. Counties in Central Region which includes Nyandarua, Nyeri, Kirinyanga, Muranga, and Kiambu had infant mortality estimates of 50, 40, 54, 40 and 48 respectively. Nyanza region has Siaya, Kisumu, Migori, Homabay, Kisii and Nyamira counties with estimated infant mortality rates of 142, 123, 112,112, 65 and 51 respectively.

The IMR is lower for mothers with primary complete and secondary complete as to mothers with no education. The 2003 KDHS outcomes show that mothers with no form of schooling, primary incomplete, primary complete and secondary plus education had IMR of 80, 97, 69 and 44 deaths per 1000 live births congruently. The 2008/9 KDHS outcomes depicts that mothers with no form of schooling, primary incomplete, primary complete and secondary plus education had IMR of 64, 73, 51 and 45 deaths per 1000 live births congruently. The 2014 KDHS report show that mothers with no form of schooling, primary incomplete, primary complete and secondary plus education had IMR of 36, 44,40 and 40 deaths per 1000 live births congruently.

Studies have been done regarding this matter. Misati (2013), observed that infant death varies by the maternal education. Additionally, he further noted that maternal education significantly affected infant death in high infant mortality Regions. Omedi (2015), observed that maternal literacy was negatively related with infant mortality, births to literate mothers have lower mortality compared to births to illiterate mothers. Danning Liu (2014), observed that mothers with higher education experienced decreased prospect of infant mortality. Bwanaja Samuel (1997), observed that the more educated mothers become the lower the infant mortality. Educated mothers had the least probabilities of infant deaths. Omedi and Wanjiru (2014), observed that maternal education was insignificant issue of infant mortality in rural Kenya. K'Oyugi (1992) asserts that mothers with below nine years of schooling had inconsequential shielding results on infant survival. Mustafa and Odimegwu (2008), observed that mother's education had important link with infant death. He further points out that, there was no important variation amid mothers with primary and without education in comparison to infant deaths. However, secondary education significantly

affected infant death in rural and urban Regions. Omariba *et al.* (2007), observed that mothers with secondary schooling holds lesser infant mortality levels in comparison to mothers with primary education. Kiptui (2001), observed that mother's education was a key factor of infant death in regions with highest and lowest mortality. His conclusion was that the possibility of infant death reduces with a rise in maternal education i.e. primary and secondary plus education reduces the likelihood of infant death in comparison to no education.

Regional differences in IMR is a major task to the Kenyan government whose aim has been to increase child survival. A majority of these studies mainly concentrated on how IMRs are different in various regions. However, these studies did not provide any information on patterns of infant mortality in high infant mortality region like Nyanza region and for low infant mortality regions such as Central by the level of education. Hence, the goal of this investigation is to fill the existing void through determining the patterns of infant mortality by mother's educational attainment levels in Nyanza and Central Regions of Kenya. The study also intended at finding out the unadjusted and adjusted effects of the maternal education on infant mortality in each of these two study regions in Kenya. The study therefore aimed also at finding out the proximate determinants that maternal education operates through to affect infant survival in Nyanza and Central Regions

1.3 Research Questions

1. What is the infant mortality pattern by maternal level of education in Nyanza and Central Regions?
2. What is the unadjusted effect of maternal education on infant mortality in Nyanza and Central Regions?
3. What is the adjusted effect of maternal education on infant mortality in Nyanza and Central Regions?

1.4 Objectives of the Study

1. The overall objective of this study was to determine the effect of maternal education on infant mortality in Nyanza and Central Regions.

1.4.1. Specific Objectives

1. To determine infant mortality pattern by maternal level of education in Nyanza and Central Regions.
2. To determine the unadjusted effect of maternal education on infant mortality in Nyanza and Central Regions.
3. To determine the adjusted effect of maternal education on infant mortality in Nyanza and Central Region.

1.5. Justification.

Knowledge on infant mortality is key to the nation as it aids in the formulation of population policies and programmes which can help lower infant mortality. Infant mortality is also regarded as an index that reflects poverty and a deprived population. The IMR is also an index used to monitor child health. In Kenya reducing IMR is one of its major targets, for instance, the Kenyan MDG objective was to lower IMR to 22 deaths per 1000 live births up to 2015, yet this goal was not attained since IMR stands at 39 deaths per 1000 live births. Nyanza is amongst regions in Kenya with high IMR (50 deaths per 1000 live births), thus it is considered a high mortality region. On the other hand, the Central Region is among regions in Kenya with low IMR (38 infant deaths per 1000 live births). Comparing high with low infant mortality region by the maternal education helps in policy formulation that assists in the realization of infant mortality reduction. In addition, comparing the two mortality regions (high and low) helps in finding out the factors that might have contributed to low and high infant mortality so that the high mortality region may put in place population policies and programmes that help further reduce infant mortality.

The study estimated patterns of infant mortality by the maternal education in Nyanza and Central regions. This is so because infant mortality patterns by maternal education are not available at the regional levels. IMRs are indicators of socioeconomic development of a nation, knowing patterns of infant mortality by the maternal education can lead to the implementation of policies that promote the education of females at national, regional and sub-regional (county) levels. This can lead to a further decline in IMR. For IMR to reduce, the patterns of mortality by the maternal education must be identified and more so the unadjusted and adjusted effect of maternal education on infant mortality must be identified with an aim of reducing disparities in infant mortality at

regional and county levels. So, the results of this study will guide county governments in coming up with appropriate population policies able to further lessen infant mortality. This investigation will likewise be valuable to students and researchers interested in studying the patterns of infant mortality by the maternal level of education since a comprehensive study investigating the patterns of mortality by the maternal level of education are still lacking at the regional and county level. Therefore, this study will open up new areas in research that deserve further investigation.

1.6. Scope and Limitation

This study compared the effect of maternal education on infant mortality in Nyanza and Central Region. This study relied on secondary data KDHS (2014), the KDHS data is collected for a wide range of purposes other than for this study hence it might not give the overall picture of the study areas. For instance, data on patterns of infant mortality by the maternal education is not there for various regions. This study looked at socioeconomic variables and proximate determinants that might have contributed to variations in a reduction in infant mortality. The child file was utilized to obtain important data on infants since the child is the unit of analysis.

Specific limitations linked to this study were that, it did not study entirely the proximate determinants that affect child survival. Immunization, breastfeeding, personal illness control and injury variables were excluded in analysis because this information for individual infants who died prior to the survey is not available. The survey month births were excluded in analysis to allow the infants to have same exposure time (at least a month) to the risk of death. This study was not able to establish after death of an infant the interval a mother in Nyanza region took before giving birth to another child. This study could not find out reverse causality of preceding birth interval influencing child birth in Nyanza region.

Several limitations were linked to the KDHS (2014) data: it was influenced by sampling and non-sampling inaccuracies. Non sampling inaccuracies are errors that emanate during data collection and data processing of infant mortality. The accuracy of estimated results of infant mortality is dependent on complete reporting of infants who did not survive. Reporting the wrong age at death misrepresents the shape of mortality. Displacement of dates of births also distorts infant mortality trends. Age heaping results into transfer of deaths from one age bracket to another. The data is also

affected by selective exclusion from childbirth histories of exact number of infants who did not survive leading to underreporting of infant deaths that occur soon after birth. In addition, infant deaths recorded in health facilities by mother's level of education are limited because most deaths do not occur in health facilities this also leads to underreporting of infant deaths. Even though there was evidence of exclusion and shifting of infants who did not survive from one age to another, infants who did not survive were not extremely underreported therefore the KDHS (2014) data was robust.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Kenya experienced decrease in IMR as depicted by KDHS results and as a consequence scholars have argued that declines in infant mortality were driven by increase in maternal education. This study reviewed literature relating to maternal education as particular socioeconomic variable of infant mortality. Other variables encompassed type of place of residence, household wealth index, maternal factors, environmental factors, and nutrient deficiency factors were used as control variables in data analysis.

2.2 Socio Economic Factors

2.2.1 Maternal Education

Maternal education attainment level is linked with infant survival. Mothers with the secondary plus education their infants have better likelihoods of infant survival because educated mothers are exposed to a nutritious diet, embrace birth control methods to increase birth intervals and information about diseases that occur during infancy and prevention of such diseases (Kamal 2012). There is a large variation in infant survival for mothers with secondary plus education as to mothers who had accomplished primary or no education (Woldemicael, 2007). Maternal education is linked with sanitation, proper care of infants, seeking medication when infants are sick (Stalling 2004). According to Root (2001), educated mothers have information and affluence which enable these mothers to use health facilities more adequately in comparison to mothers with no form of schooling. Glewwe (1999) postulates that maternal education is linked to infants' wellbeing and uptake of a nutritious diet in less developed nations because formal education teaches health knowledge to mothers; it also imparts skills to mothers that help them in diagnosing and treating infant health problems. It also, exposes mothers to be more receptive to modern medicine. Desai and Soumya (1998) assert that infants of mothers with some form of education are exposed to lower levels of infant mortality in comparison to infants whose mothers are not educated, investing in girl-child education is vital in decreasing infant mortality rate. Additionally, education to makes mothers adjust their child care behaviors leading to improved infant wellbeing. Increased years of mothers schooling delays childbearing hence reduced possibility of infant death due to mothers' physical immaturity, low maternal education is also linked with a large number of children ever

born and childbearing continues late in mothers' reproductive life increasing chances of infant deaths (Regina Fuchs *et al* 2010).

Cleland and Van Ginneken (1988) asserts that upsurge in mothers' level of education is linked with access to birth control methods, childbearing begins later and spacing of births. Formal education of mothers is important in promoting child health and preventing infant diseases (Pradip Muhuri 1995). Mosley and Chen (1984) postulate that maternal education influences infant mortality through skills of the mother in taking care of the health of the infant during conception such as taking vitamin supplements, nourishment, sanitation, protective care and management of diseases. Caldwell (1979) argues that educated women take good care of their infants when they are sick and put more resources in taking care of infants and take infants to health facilities when they are sick. Women with no or little education experience high infant mortality because they raise their infants in the unhygienic environment and rarely use modern medicine (Cleland and Van Ginneken 1989, Preston and Haines 1991). Kamal (2012) notes that, Mothers with secondary plus education experience reduced levels of infant mortality, this is because education opens up these mothers to knowledge on proper nutritious diet, using family planning methods that result in long birth intervals and provides information on diseases that affects infants and how such diseases can be treated.

Kibet (1981), Observed that mothers level of education is associated with infant survival. He further observed that differences in infant survival between counties in Kenya were due to existing educational differences among counties. Misati (2013), noted that maternal education has substantial effects in regions with high mortality, but in regions with low mortality maternal education had inconsequential influence on infant death. However, in the two regions that is high mortality and low mortality, mother's education shows a decreasing influence on infant deaths. Mothers without any education had the highest infant mortality rates. Mother's education is key in diffusing knowledge about childcare, cleanliness, sanitation, sterilization, medicine and immunizations needed and capacity to access and utilize services at hand (Hobcraft *et al*, 1984). Omedi (2015), observed that infant mortality is higher in the Nyanza region with maternal illiteracy accounting for higher infant mortality compared to mothers who have some form of education. Hobcraft (1993), noted that more educated women start childbearing later, have few children and are expected to use health services hence infants of educated mothers have

developmental advantages since educated mothers move from the mere notion of basic survival to quality children.

Masuy Stroobant (2001), observed that educational level of the mother is essential for it affects infant survival by influencing the mother's decisions and expanding her competence in infant well-being associated with family planning, proper diet, sanitation, seeking medication when infants are sick. Increasing the fraction of mothers with no less than six to ten years of schooling is key in the reduction of infant deaths (Hale Lauren *et al.* 2009). Jain (1994) argues that mothers with some form of schooling are expected to use preventive care in comparison to mothers with no form of education since education makes mothers modify their behavior to reduce risks during infancy.

2.3 Other Socio-Economic Proximate Determinants of Infant Mortality

2.3.1 Type of Place of Residence

According to Jain (1985), IMR is greater in rural Regions in comparison to urban Regions. High mortality patterns in rural areas are attributed to lower autonomy of women in rural areas, lack of contemporary health education and services which affect patterns of infant care. Reduced levels of infant mortality rate in urban areas is attributed to social development, good environmental conditions and proper sanitation, the advancement of social services for instance schools, health facilities, and transportation. Jain (1985) found out that infant mortality rate also reduces with arise in women's education, presence of clean water, preventive care and transport efficiency in rural areas. Amoateng A.Y. *et al* (2013) also argued that urban areas experience reduced infant mortality rates in comparison to rural regions. Urban mothers are expected to have knowledge of the advantages of family planning and some form of schooling and hence have lesser number of children in comparison to rural mothers. Moreover, mothers residing in urban areas generally have contact with proper health care than rural mothers. Studies done by Nandita *et al* (2013), indicated that IMR is higher in rural regions in comparison to urban regions they argued that rural disadvantage is attributed to "urban bias" which is improper gain by the urban populace in the sharing of public resources.

2.3.2 Household Wealth Index

According to Omedi & Wanjiru (2014), women from well off households can manage both antenatal and postnatal care from good hospitals, such women can also give birth in a hospital with

the assistance of qualified staff. Frenzen and Hogan (1982) note that poorer families experience high infant mortality due to inadequate standards of nutrition, sanitation, housing, and medical care. Mutunga (2007) asserted that Lower mortality is experienced in households with higher household wealth index because they have improved child survival chances. They possess improved living conditions, improved diet, improved schooling, more empowered and can seek improved medical attention thus greatly increasing the survival chances of their children.

2.3.3 Maternal Factors

Maternal factors affect infant survival via maternal health. These variables comprise of mothers age at child birth, preceding birth interval and birth order.

2.3.3.1 Mother's Age at Childbirth

The infant mortality shapes by mother's age and birth order are generally U-Curved. Mother's age at child delivery had substantial influence on infant survival (Omedi 2015). Omedi (2015) further argues that infants born to comparably old and young mothers had greater IMRs in comparison to other ages: teenage mothers are physiologically immature and are unlikely to receive antenatal and postnatal care services that aim at improving child survival. Young mothers also do not have experience in taking care of infants (Kibet, 2010). Besides, infants born after the very short and very long preceding birth intervals also experience high mortality rates. Omedi and Wanjiru (2014) postulate that Births to older mothers' experience high infant mortality; because older mothers are likely to experience malnutrition, anemia, and damage to their reproductive health due to births. Older mothers cannot produce enough breast milk hence this leads to early weaning for infants.

2.3.3.2 Birth Interval

According to KDHS (2014) infants born after very short and very long birth intervals experience high mortality rates, shorter preceding birth intervals are established to being linked to greater levels of infant mortality during infancy. Infants born preceding a very short birth interval, below two years, are approximately twofold probably not to survive as infants born preceding three or more than four years. Murphy and Wang (2001), asserts that the length of previous birth interval affects infant mortality, longer birth intervals improve infant survival chances while shorter birth intervals are linked to a greater probability of infant death. The reason given for this is that shorter

birth intervals affect mothers and infant health since it may result in premature birth. Miringu (2016) observed that mothers with previous birth interval of below 24 months were further inclined to experience infant deaths in comparison to mothers of the earlier birth interval exceeding 24 months. Desta Mekonnen (2011) argues that the birth interval hurts infant survival. Long birth intervals decreases the chances of infant deaths and increasing the previous birth intervals decreases the possibility of infant deaths.

2.3.3.3 Birth Order

Infant mortality is great for principal births and high order births; infant deaths however reduces in the second and third births and progressively increases subsequently (Gyimah, 2002). Kibet, (2010) asserts that, increased possibility of infant deaths amid the birth orders that occur first is associated to mother's young age and inexperience when taking care of the infant. According to Koenig *et al*, (1990) high order births also increase infant mortality, and this is associated to the point that mothers who have had more pregnancies will be physically drained and mostly where birth interval is shorter. Desta Mekonnen (2011) asserts that, arise in children birth orders have a greater and adverse effect on infant mortality, mostly for the second and third birth orders determines infant mortality. For infants with higher than seven birth orders they have no serious influence on infant survival.

2.3.4 Environmental Factors

Environmental factors relate to contamination of the environment which affects hygiene and sanitation. These factors encompass the source of drinking water and the nature of latrine structure.

2.3.4.1 Source of Drinking Water

Mutunga (2007), observed that having admission to a protected source of drinking water leads to decreased levels of infant deaths. Olufunke (2010) postulates that the origin of drinking water had greater influence on the wellbeing consequences of the mother together with the infant. His study further revealed that protected origin of drinking water is unlikely to be polluted compared to unprotected sources like surface water and uncovered wells which transmit infection-causing agents. Barbara *et al* (2002) asserted that the source of water affects infant mortality through the

period of breastfeeding and treatment for diarrhea. Availability of clean water affects sanitation which is an important factor that determines infant survival.

2.3.4.2 Type of Toilet Facility

Geruso and Spears (2015) observed that in 2014, more than one billion people globally were excreting in open places due to the absence of essential pit latrines. Their results indicated that infant deaths that occurred every year was because of poor levels of sanitation in the neighborhoods. Mutunga (2007), asserts that having access to a toilet facility reduces child mortality. Presence of a toilet facility in a household reduces infant mortality levels compared to households which do not have a toilet facility. K'oyugi (1992) observed that infants from households with modern toilet facility and with less contaminated water have significantly lower risk of death in rural Kenya. Omariba (2007), observed in his study that presence of a toilet facility is significant determinant of infant survival. He further found out that absence of a toilet facility increased prospects of infant death by twenty percent in relation to households with a pit latrine. However, Miringu (2016) in her study she observed that, environmental factors did not have any influence on infant mortality.

2.3.5 Nutrient Deficiency

Infant survival is dependent on uptake of foods with all the essential nutrients. Nutrient defiency affects infant survival through breast feeding and immunization.

2.3.5.1 Breast Feeding

Breastfeeding is a form of giving optimal nutrients for the well-being of infants. World Health Organization, advocates that infants shall entirely be given breast milk from birth to six months in order to attain excellent development. However, after 6 months of exclusive breast feeding are over, to accommodate increasing nutrient demands, it's imperative for infants to be given foods rich in essential nutrients while still being given breast milk. Babies are vulnerable to disease attacks all along the growth duration when complementary nourishment is started. Disrupted breastfeeding and improper complementary feeding escalates the probability of malnourishment, diseases and infant deaths (WHO 2003).

Giving infants' breast milk is essential for development and improved health of the infant (Ayisi and Wakoli 2014). In less developed nations giving infant's breast milk from birth to six months is a determinant of infants' mortality. It helps in preventing diarrhoea and respiratory diseases (WHO, 2011). Kenya remain to be classified as a country with impoverished infant feeding practices resulting into under nutrition (UNICEF, 2011). Ayisi and Wakoli (2014), observed that the optimal development is greatly liked to giving infants breast milk. They further found out that, giving only breast milk to infants eradicated the taking in of possibly infected meals. K'oyugi (2014), observed that breastfeeding periods of more than 13 months was linked with lower infant mortality in Kenya. He further observed that in cases of reduced breastfeeding periods, greater immunization coverage reduced infant mortality rates.

Wandai (2015), observed that breastfeeding is a crucial factor of infant mortality in Kenya; infants breast fed for 6 months and more were less inclined to die in comparison to infants' breastfed for below 6 months. Colostrum contained in the early breast milk is referred to as "first immunization" because it protects the newborn from infections. His study established that exclusive breastfeeding helps protect the infant from diarrheal and respiratory infections because of minimal or no contamination. Therefore, longer duration of breastfeeding improves child growth and survival. Betran *et al* (2001) observed that advocating for infants to be breastfed is essential factor in decreasing infant deaths. Their study further showed that infant mortality can be prevented with feeding infants on breast milk only from birth to at least three months and continued complementing of food intake with breast milk.

Marie Tarrant et al (2010) argued that giving infant's breast milk gives considerable safeguard for infants against diseases. Breastfeeding uninterruptedly for a short period decreased taking infants to hospitals for respiratory and non-gastrointestinal diseases. The study found out that early breast feeding leads to improvement in immune function which yield permanent defense against diseases and immune triggers. Wafula *et al* (2012) observed that the period the child is breastfed, education of the mother, and Human Immunodefiency Virus and malaria predominance accounted for increase in infant deaths. In a study done in Ethiopia Desta Mekonnen (2011) observed that, giving an infant breast milk is critical component for decreasing infant deaths. Breastfeeding infants for a period exceeding six months greatly decreased the prospect of infant death.

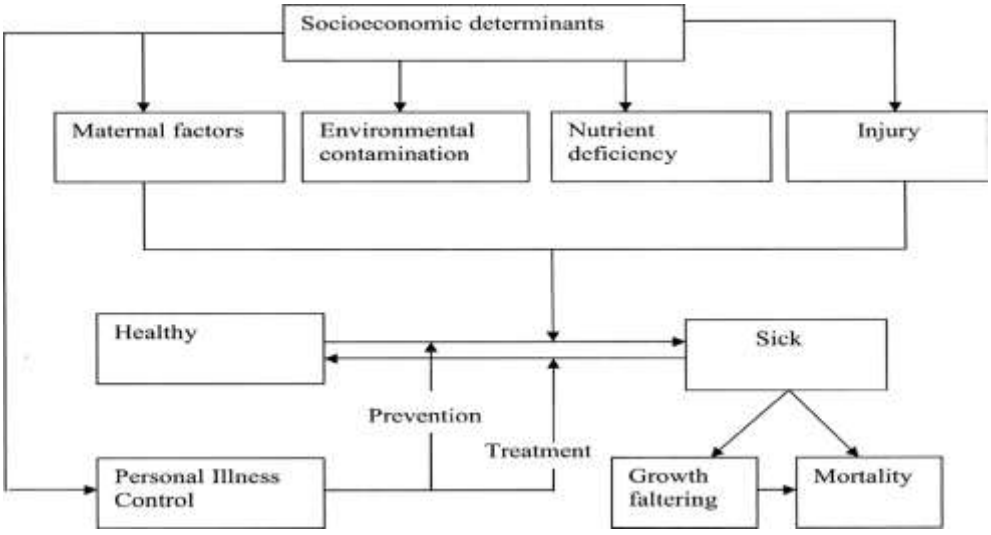
2.3.5.2 Immunization

Lakshmi et al (2003) asserted that giving infants a considerable dosage of vitamin A decreases child deaths in children between six months and five years in various less developed nations. Giving infants vitamin A immediately after birth considerably decreases level of infant deaths with the highest effect actually seen among infants who are two weeks to four months of age. Nazrul *et al* (2009) observed in their study that, vaccination of the infants is a vital aspect that accounts to infant survival. Some childhood ailments like Neonatal tetanus, whooping cough, polio and measles which accounts for huge levels of childhood deaths might be completely eradicated by immunization which saves children from dangerous diseases.

2.4. Conceptual Framework

This study used Mosley and Chen (1984) analytic model to give direction on variables that affect infant mortality in Kenya and more specifically in Nyanza and Central regions. It presents a theoretical illustration for researchers on child survival (Hill 2003).

Figure 2.1: Illustration of Conceptual Framework



Source: Adapted from Mosley, W. Henry and Chen, Lincoln, C (1984): "An analytical framework for the study of child survival in Developing Countries", population and development review 10: 25-45.

Other frameworks that were developed after Mosley and Chen include immunization models and reduced models (Hill 2003). Hill (2003) notes that immunization models incorporates both outcome variable with proximate factors and background factors. According to Hill (2003) modelling a proximate factor on background factor is important to the health sector for it provides insights on how to improve health systems but it does not provide a direct indicator of potential health gain. Another shortcoming of immunization model is that modelling which integrates both background and proximate factors of infant survival may be influenced by omitted variables preference, the net result of a background factor after proximate factors has been restricted is very difficult to explain the results. Hill (2003) further asserts that the reduced models shows the significance of how the outcome variable is affected by background variable although it does not provide information to health institutions that would help them establish what to focus on to promote child health.

Mosley and Chen framework thus remain the suitable model for research for it provides a theoretical ground for a variety research on infant mortality. Variables are organized into a coherent framework connected to each other and to child survival. The proximate determinants are categorized into fourteen factors and five groups which helps integrate both maternal and socio-economic factors of infant survival. The framework also helps clarify researchers understanding on factors involved in child survival to offer a foundation for formulation of policies and programmes (Mosley and Chen 1984).

As depicted in the studies conducted by Mosley and Chen (1984 P25-42) pentagonal groups of proximate aspects are noted to directly influence infant mortality as argued in the next segment.

1. Maternal factors: comprises of mother's age at child birth, birth order and preceding birth breaks. These influences infant mortality via maternal health.

2. Environmental contaminations: involves contamination of the environment through airborne, foodstuff, water, fingers, skin, soil, non-living objects and pests. This focusses on the hygiene and sanitation: all these determinants affect infant survival.

3. Lack of proper nutrients which encompasses food rich in all nutrients such as carbohydrates, proteins, vitamins and essential micro nutrients: Taking foods not rich in essential nutrients significantly influences infant survival. Its effect is more pronounced when the mother is pregnant, lack of proper diet during pregnancy affects birth weight and during breast feeding affects quantity and nature of breast milk.

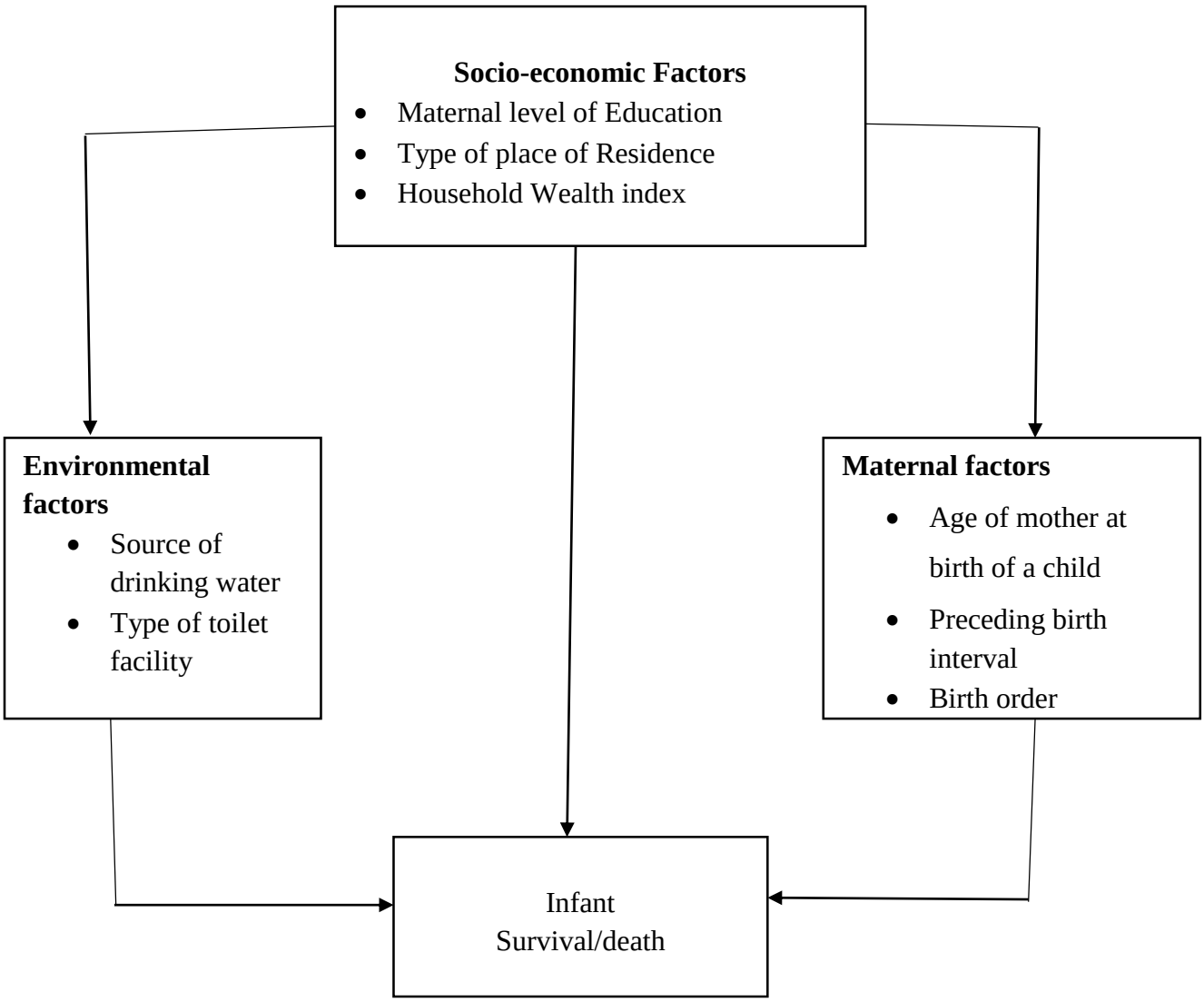
4. Injury includes bodily, burn and poisoning injury: Injuries severely alter the infant's health. Intentional injury may be the case of infanticide. Accidental injury reflects socioeconomic and environmental factors.

5. Personal illness control: This involves immunization, vaccinations, whether the mother takes the infant to health facility when sick or not. Vaccinations and antenatal clinics during mother's pregnancy and giving birth in health facilities are essential for they affect infant survival.

2.5. Operational Framework

The operational model was modified from conceptual framework revised by the researcher to provide direction on analysis. The operational framework excludes personal illness control and injury because this information for individual infants who died prior to the survey is not available.

Figure 2.2: Illustration of Operational Framework



Source: Modified from: Mosley, W. Henry and Chen, Lincoln. C. (1984)

The selected factors that were incorporated in the operational framework were established on vital factors identified from Kenya demographic and health survey (2014). Socioeconomic variables act through proximate factors to affect the risk of child survival. The socio economic variables that were incorporated in the operational framework were maternal education, residence as well as wealth index. Maternal factors also known as biological factors included were; mother's age at child birth, preceding birth break and birth order. Environmental factors that were incorporated are source of drinking water and category of latrine facility, while nutrient deficiency factors are breast

feeding and whether infant is immunized or not. Lastly the end result was possibility of death all through infancy.

2.5.1 Operational Hypotheses.

This study was based on the following operational hypotheses;

1. Infant mortality patterns by maternal level of education differ in Nyanza and Central Regions.
2. Unadjusted effects of maternal education on infant mortality differ in Nyanza and Central Regions.
3. Adjusted effects of maternal education on infant mortality differ in Nyanza and Central Regions.

2.6 Operational Definition of Variables.

Infant Mortality: is the likelihood of a baby dying before attaining year one in five years ahead of the survey per 1000 live births usually (0-11 months).

Maternal Education: is the uppermost education attained by the mother. It is measured in terms of the mother having not gone to school at all, having completed or not completed primary education, having attained secondary and above education. It is expectation of this study that mothers without education have the highest risk of infant deaths in comparison to mothers with secondary plus education.

Type of Place of Residence: is the expanse where the mother lives. It may be urban or rural area. It is expected in this study that rural mothers have the highest possibility of infant deaths in comparison to urban mothers

Household Wealth Index: is socioeconomic categorization of a household by standards of living. It expected in this study that mothers from households with low or middle wealth index have highest risk of infant deaths in relation to mothers from high wealth index.

Source of Drinking Water: is where water for drinking originates. it is expected in this study that drinking water from unsafe sources increases the chances of infant deaths in comparison to drinking water from safe sources.

Type of Toilet Facility: is kind of toilet a household uses to predispose human excretions. It is expectation of this study that households lacking a toilet facility had the greatest possibility of infant deaths compared to households with a toilet facility.

Age of Mother at Child: is the precise age of the mother at time child delivery. It is expected that mothers who give birth when they are below 18 years and those above 35 years have the highest possibility of infant deaths compared to mothers who give birth when they are between 18-34 years.

Preceding Birth Interval: is difference in terms of years from when one baby is born to when the next baby is born. It is expected that birth interval of below 24 months have the greatest possibility of infant deaths in comparison to birth intervals of above 24 months.

Birth Order: is the sequence in which a baby is born, it could be the first child, second child etc. The expectation of this study is that mothers with first and 5 and above birth orders possess the greatest possibility of infant deaths in comparison to mothers with birth order 2-4.

Breastfeeding: This refers to giving a child breast milk. It is expected that infants breastfed for below six months had the highest risk of infant deaths compared to infants breastfed for over six months.

Immunization: This refers to giving a child all the vaccinations required during childhood. It is expected that mothers whose infants are not immunized have the highest possibility of infant deaths in comparison to infants who are immunized.

CHAPTER THREE: METHODOLOGY

3.1 Data Source

As previously mentioned the study utilized Secondary data namely 2014 KDHS. Analysis involved the individual child file for children born 59 months prior to 2014 KDHS interview date to mothers interviewed during the survey.

3.2 Brief Description of the 2014 KDHS Sampling Design and Study Data

The 2014 KDHS data was delineated to yield ideal measures for variety of the survey pointers for the nation, for urban and rural parts, for Regions, and for a few indicators for counties. The sampling design had 9575 households from 383 clusters spread across both Nyanza and Central Regions, with 243 clusters in rural parts as well as 140 in urban parts. Nyanza Region had 5175 households from 207 clusters spread across the counties in Nyanza Region, urban areas had1825 households and rural areas had 3350 households, and the number of clusters were 73 clusters in urban parts and 134 clusters in urban parts. Central region had 4400 households from 176 clusters spread across counties in Central Region, urban areas had 1675 households and rural areas had 2725 households, the number of clusters were 67 clusters in urban parts as well as 109 clusters in rural parts. The child file utilized which contains information of individual children born to women less than 60 months prior to interview date (0-59 months). The analysis was based on 20,964 children born less than 60 months before the interview date with 2926 in Nyanza Region and 1420 in Central Region.

3.3 Data Quality.

The 2014, KDHS was influenced by sampling and non-sampling inaccuracies. Non - Sampling inaccuracies are imprecisions that arise amid data collection and data processing. Errors that occur during data collection include failing to identify and interview the appropriate household, misinterpretation of queries by either interviewer or interviewee and data entry errors. Even though great attempts were made to minimize non sampling inaccuracies, non-sampling inaccuracies are difficult to dodge as well as problematic to estimate.

However, sampling inaccuracies are errors that can be calculated statistically. The sample interviewees selected in 2014 KDHS is part of the various samples that may have been chosen from the corresponding population by applying identical sampling design and accepted result. Any of these samples would give outcomes that vary from outcomes of the definite sample chosen. Sampling errors are estimates of inconsistency among probable samples. Even though the level of inconsistency is unknown precisely it can be calculated from survey outcomes.

Sampling errors are generally moderated in expressions of standard error for a distinct statistic (mean, percentages, proportion, and ratio). The standard error is applied to estimate confidence intervals not beyond the correct worth of the population is simulated to range. For instance, for a particular statistic estimated from the sample, the true worth of the measurement ranges in a dimension of positive or negative twice the standard error for that measurement in ninety five percent of entire desirable units of exact magnitude and composition.

In KDHS 2014, quality of infant mortality measures, estimated from retrospective birth histories is dependent on complete reporting and recording of births and deaths. The precision of age on death reporting greatly affects childhood mortality estimates and distorts the mortality pattern. Misrepresenting age at death, leads to prejudiced mortality approximations, this occurs when the end results of the age misreporting leads to movement from one age bracket to another. To reduce inaccuracies in recording of age at death, the interrogators were advised to inquire for deaths stated at one year to decide on more accurate age in months.

Additional data quality issue in KDHS (2014) data is shifting of birth dates which leads to biased mortality trends. This happens when the interviewer deliberately records a death as appearing in a particular year; this happens when the interviewers' attempts to reduce their overall work assignment since live births happening at the time of the five years before the interview were susceptible to prolonged set of added queries. In the 2014 KDHS survey, the end year for inquiring on the queries was January 2009. It therefore follows that there was misreporting of dates of births for both children alive and dead. This trend has been noticed in preceding KDHS surveys and the reason for this is because some research assistants moved the date of birth out of the five-year reference duration to cut down their assignments. Cleland (1996) observed that, some interviewers

were enticed to disregard newly born infants or to change their dates of birth further behind, so that they are altogether moved farther from the reference time.

Selective exclusion from delivery accounts of the number of deliveries of babies that died is another data quality issue in KDHS (2014) data, this leads to inaccurate mortality estimates. This is most common for deaths that happens during infancy. One of the ways these exclusions can be identified is through checking the proportion of neonatal deaths with infant deaths. Evidence of death underreporting is identified when neonatal deaths are very low compared to infant deaths.

There is evidence thus that KDHS 2014 data had some omissions and shifting of infant deaths from one year to the other. However, total number of infant deaths were not severely underreported. In addition, KDHS 2014 questionnaire had detailed consistency checks that were in-built to ensure accuracy of information obtained from birth histories. However, it is possible that a few mothers may have left out some data on birth date and age of death. Birth dates data are important for any analysis of mortality by time period and ignoring cases with missing information would cause downward biases in childhood mortality estimates because statistics on the year and month of birth is more probable to be missing for dead children compared to children still alive. This may lead to distortion of patterns and differences in mortality since in general the date of birth is more likely to be missing for events placed further back in time and for children in certain sub-groups of the population (Ogolla 2012).

3.4 Methods of Data Analysis

In data analysis, both direct method of estimating infant mortality and logistic regression were utilized. The patterns of infant mortality by maternal level of education were analyzed using direct method of estimation of infant mortality. The direct estimation involved using life table method to calculate the likelihood of dying from birth to age x in months per 1000 live births ($_0q_1$). These probabilities were computed for Nyanza and for Central Region. Logistic regression analyzed the unadjusted and adjusted effect of maternal education on infant mortality. This analysis involved sub setting Nyanza and Central Region by maternal level of education.

3.4.1 Direct Method of Estimation

The life table probability of dying from birth to 60 months was utilized in calculate the patterns of mortality, which enabled analyze patterns of mortality by maternal education. The direct method of estimation was the most suitable to use in data analysis compared to indirect method of estimation since the later method tends to omit a large fraction of infant deaths and rarely uses estimates that begin with zero, hence it does not investigate deaths occurring during infancy (Preston 1984). Indirect method of estimation was also not suitable for study of age patterns of mortality nor for understanding of childhood mortality determinants and differentials (Adetunji 1996). Therefore, direct method of estimation was the most suitable method to use to estimate patterns of infant mortality with maternal education.

In order to compute the life table probability and risk of death during infancy information on infant deaths and total exposures in months was required. Therefore, a child file for children born below 60 months preceding the survey was utilized to give figures for age at death in months for a child who died during infancy and age in completed months for a child alive on interview date. For a child that was alive on the interview date, the age in completed months was recorded and for a child who died before the interview date age in total months lived was recorded. The total number of deaths during infancy were obtained by summing up all deaths during infancy. The total exposures in months were the sum of total exposure in months contributed by children who died during infancy and total exposure in months for children who lived beyond infancy. It is important to note that a child who lived beyond infancy contributed full exposure in months (12 months). This may be expressed as:

$$\text{Risk of Death} = \frac{\text{Total Infant Deaths}}{\text{Total Exposures (months)}}$$

Computation of total deaths and total exposures in months by maternal level of education in Nyanza and Central Region was made possible using the Statistical Package for Social Sciences (SPSS).

3.4.2 Logistic Regression

This method of analyzing data estimated the unadjusted and adjusted effect of maternal education on infant mortality in Nyanza as well as Central Region. Nyanza and Central Region were segmented using maternal education. Therefore, infant survival was the dependent variable in

logistic regression. It assisted in interpreting the correlation amongst explanatory and the response variable. It estimated the probability of infant survival centering on the predominant socio economic factors, demographic factors, environmental and nutritional conditions in high mortality region such as Nyanza and low mortality Region as such Central. Logistic regression was suitable for this study as it leads to biologically meaningful interpretations and estimates of the effect of explanatory variable on independent variable compared to other methods of data analysis. Logistic regression was selected since the response variable is binary which denotes whether an infant dies or survives.

The following equation presents the general form of logistic regression model that was utilized in this study: -

$$P(x) = \frac{e^{\beta 0+\beta 1X}}{1 + e^{\beta 0+\beta 1X}}$$

Where:

P (x) = possibility that the event will occur

e = a natural logarithm equal to 2.71828….

β_0 & $\beta 1$ = logistic coefficients approximated from the data

X = explanatory variable

The SPSS software was convenient in computing the statistical significance and confidence intervals using the t-test. SPSS provided the odds ratios in regression analysis. Since the odds ratio in the reference category is always one it then follows that odds ratios of greater than one indicated increased probability of mortality in relation to reference category, while odds ratio of below one indicated reduced probability of mortality in relation to reference category.

The independent variable was infant survival, it presumes the value of one if the infant dies and zero if the infant survives. Therefore, infant death is regarded as a success (one) while infant survival is regarded as a failure (zero). It is vital to put into consideration that for infant mortality the age intervals are 0-11 months and the variables level and their measurements are derived from Mosley and Chen Analytic Model (1984).

The independent variables were recoded into categories and each category had a reference category. A reference category in this case is the category with the highest risk of infant deaths. Provided below is description and categorization of control variables that were used in infant

mortality analysis. “Mother’s education (High risk if no education or primary and low risk if secondary plus); Household wealth index (high risk if low or middle and low risk if high); Type of place of residence (high risk if rural and low risk if urban); Age of the mother at birth (high risk if < 19 or 35+ and low risk if 20-34); preceding birth interval in months (high risk if short, <24 and low risk if long, first or 24+); Birth order (high risk if first or 5+ and low risk if 2-4); Type of toilet facility (high risk if unimproved and low risk if improved), source of drinking water (high risk if unsafe and low risk if safe); Duration of Breastfeeding (high risk if < 6 months and low risk if >6months) and Immunization (high risk if not immunized and low risk if immunized)”. The table below shows summary of variables and their categorization

Table 3.1: - Variables and their Categorization

Variables	**Categorization**
Infant survival	1-Dead 0-alive
Maternal education	1-none/primary 2-secondary plus
House hold wealth index	1-low 2-middle 3-high
Type of place of Residence	1-rural 2-urban
Mothers age at child birth	1-<19years/35+ 2-20-34
Birth interval	1-<24 months 2->24 months
Birth order	1-1/5+ birth order 2-2-4
source of drinking water	1-unsafe 2- safe
Type of toilet facility	1-unimproved 2-improved
Breast feeding	1-< 6 months 2->6 months
Immunization	1- not immunized 2- immunized

Source: study analysis data.

CHAPTER FOUR: MATERNAL EDUCATION AND INFANT MORTALITY IN NYANZA AND CENTRAL REGIONS.

4.1 Introduction

The core of this part was to resolve the research queries namely: (i) whether the patterns of infant mortality by maternal education in Nyanza and in Central Regions differ; and; (ii) whether the unadjusted and adjusted effect of maternal education on infant mortality differ significantly in these two Regions. Just as described in details already in chapter 3, the patterns of mortality were estimated using life table method while the effect of maternal education on infant mortality were estimated by logistic regression method. This study used secondary data notably 2014 KDHS.

The 2014 KDHS data was assessed prior to analysis and found to have some inherent errors but which were considered to be acceptable limitations for this study. For instance, it was established that only (0.94 %) of mothers omitted some data on the day of birth in addition to the age of death. Dates of birth data are important for any analysis of mortality by time period and ignoring cases with missing data would cause downward biases in childhood mortality estimates because figures on the year and month of birth is more probable to be missing for infants who have died than infants who were still alive. This may lead to distortion of trends and differences in mortality since in general the date of birth is more likely to be missing for events placed further back in time and for children in certain sub-groups of the population. Another limitation linked 2014 KDHS is heaping of deaths at age one year is prevalent a degree which leads to transference of deaths beyond the 12 months' limit which leads to underestimation of IMRs. It was difficult to figure out the degree of heaping of deaths at age one year in analysis owing to absence of essential detailed data

4.2 Patterns of Infant Mortality by Maternal Level of Education

Computation on the patterns of infant mortality involved excluding survey month births because they were not uncovered to the possibility of dying for a long extent. Therefore, in analysis exposures and infant deaths were done in months. The SPSS aggregate command was used to compute total sum of infant deaths and total sum of infant exposures by maternal level of education. This was followed by computing the probabilities of infant survival and probabilities of infant death.

4.2.1: The Patterns of Infant Mortality by Maternal Education in Nyanza Region.

There were 2926 live births in Nyanza Region five years prior the survey and total of 129 infant deaths with a total of 2886 infants being exposed to the risk of death during infancy. Table 4.1 shows the survival status of live births by maternal education in Nyanza Region.

Table 4.1: - Survival Status of Live Births by Maternal Education in Nyanza Region.

Maternal Education	Survival status		Proportion dead during infancy	Total
	Survived infancy	Died during infancy		
No education	31	2	0.06	33
Primary	1864	94	0.05	1958
Secondary plus	902	33	0.04	935
Total	2797	129	0.04	2926

Source: Study analysis data

The Table 4.1 Indicates that mothers without education had higher proportion of infant deaths as to mothers with primary and secondary education. Mothers without education had 0.06 proportion of their infants as to mothers possessing primary education who had 0.05 proportion of their infants dead. Mothers possessing secondary plus education had 0.04 proportion of their infants dead. In Nyanza Region the proportion of infants who did not survive infancy was 0.04.

The risk of death during infancy was computed by diving total deaths over total exposures during infancy. Mothers without education their infants had a greater risk of infant deaths as to mothers possessing primary education. Mothers possessing secondary plus education their infants bore a lesser risk of death in comparison to mothers possessing primary as well as without education. The probability of survival during infancy was computed using the following equation:

$$P = e^{-(\text{Risk of death} * 12)} \quad \text{..... (i)}$$

Table 4.2 indicates that mothers without education had a lesser probability of infant survival in comparison to mothers with primary as well as secondary plus education. Mothers possessing secondary plus education bore a higher probability of infant survival in comparison to mothers possessing primary and without education.

The probability of infant death was computed by subtracting probability of survival from one. The results in Table 4.2 below shows that mothers possessing secondary plus education bore a lesser probability of infant deaths in comparison to mothers possessing primary as well as without education. Mothers without education experienced a greater probability of infant death as to mothers possessing primary education.

Table 4.2: Infant Mortality Measures by Maternal Education in Nyanza Region

Maternal Education	Total infant deaths	Total exposures during infancy	Risk of death	Probability of survival	Probability of death
No education	2	370.00	0.0054	0.937	0.063
Primary	94	20121.73	0.0047	0.945	0.055
Secondary plus	33	9788.60	0.0034	0.960	0.040

Source: Study Analysis Data

4.2.2. The patterns of Infant Mortality by Maternal Level of Education in Central Region

There were 1420 live births in Central Region five years previously the survey and overall of 59 infant deaths with a total of 1415 infants being exposed to the risk of death during infancy. Table 4.3 below shows the survival status of live births and proportion dead during infancy by maternal level of education.

Table 4.3: -Survival Status of Live Births by Maternal Education in Central Region.

Maternal Education	Survival status		Proportion dead during infancy	Total
	Survived infancy	Died during infancy		
No education	9	0	0	9
Primary	740	44	0.06	784
Secondary plus	612	33	0.05	627
Total	1361	59	0.04	1420

Source: Study Analysis Data

The Table 4.3 Indicates that mothers possessing primary education bore a higher proportion (0.06) of their infants dead during infancy as to mothers possessing secondary plus education (0.05). Mothers possessing secondary plus education had lesser proportion of their infant death (0.05) during infancy. Central Region had 0.04 proportion of their infants dead during infancy. It is vital to interpret results for mothers with no education with caution due the few number births to mothers with no education who all survived infancy.

Table 4.4: Infant Mortality Measures by Maternal Education in Central Region

Maternal Education	Total infant deaths	Total exposures during infancy	Risk of death	Probability of survival	Probability of death
No education	0	108.00	0.0000	1.000	0.000
Primary	44	8211.03	0.0054	0.938	0.062
Secondary plus	15	6584.13	0.0023	0.973	0.027

Source: study analysis data

Table 4.4. Reveals that mothers with primary education had the highest infant deaths at 44.00 and highest total exposures during infancy at 8211.03 in comparison to mothers with secondary plus education whose total infant deaths and total exposure months during infancy were 15.00 and 6584.13 respectively. The computation of the risk of death, probability of survival and probability of death during infancy followed similar steps and formulae as what was done in Nyanza region.

Mothers possessing primary education bore a greater risk of infant death in comparison to mothers possessing secondary plus education. Mothers with secondary bore a greater probability of infant survival as to mothers possessing primary education. Mothers possessing secondary plus education bore a lesser probability of infant deaths in comparison to mothers possessing primary education.

4.2.3. Comparative Analysis of Patterns of Infant Mortality by Maternal Education in Nyanza and Central Regions.

Table 4.5 show that the risk of infant death reduces with rise in maternal education both in Nyanza and Central Regions. In addition to this infant mortality rates also decrease with rise in maternal education both in Nyanza and Central Regions. Mothers possessing secondary plus education have the lowest risk of IMR in both Regions. Mothers in Central Region have a lesser risk of infant death and infant mortality as to mothers in Nyanza Region. Infant mortality patterns of Nyanza Region of mothers with secondary plus education conforms to the overall national pattern. In Central Region the infant mortality pattern of mothers with secondary plus education was much lower than the national pattern.

Table 4.5. Patterns of Infant Mortality by Maternal Education in Nyanza and Central Regions.

Maternal education	Nyanza		Central		Kenya*
	Risk of death	IMR	Risk of death	IMR	IMR
No education	0.0054	0.063	0.0000	0.000	0.036
Primary complete	0.0047	0.055	0.0054	0.062	0.040
Secondary plus	0.0034	0.040	0.0023	0.027	0.040

Note * Source KDHS 2014 report from Table 8.2

Source: Study Analysis Data

4.4. Effect of Maternal Education on Infant Mortality in Nyanza Region.

4.4.1. Regression Analysis Models

The analysis for effects of maternal education on infant mortality involved screening of more explanatory variables that were included in the operational framework. The variables on immunization and breastfeeding were excluded due to data limitations. The analysis involved running bivariate logistic regression models of each explanatory variable with the outcome variable to determine the variables that were statistically significant.

Three multivariate logistic regression models were also run. Simply variables established to be statistically significant in bivariate analysis were incorporated into the final multivariate models. The first model (model 1) was on the effect of maternal education on infant mortality without adjusting for other confounding effects. The second model (model 2) was on the effect of maternal education on infant mortality while adjusting for other socio economic confounding effects. The third model (model 3) was on the effect of maternal education on infant mortality while adjusting for socio economic and proximate determinants effects.

4.4.2: Results of Bivariate Logistic Regression Models for Nyanza Region.

Table 4.6 illustrates the outcomes of bivariate analysis in Nyanza Region. The variables that were established to be statistically significant were household wealth index, previous birth interval and source of drinking water. Implying that there is an association between these variables and the outcome variable.

Table 4.6: Estimates of Bivariate Regression Coefficients and Model Parameters for Nyanza Region.

Variable	Regression coefficients				Model parameters		
	B	**S.E**	**P-value**	**Exp(β)**	**-2 Log likelihood**	**d.f**	**P-value**
Maternal education					1054.975	1	0.106
No education/primary-ref							
Secondary plus	-0.325	0.206	0.114	0.722			
Type of place of residence					1056.544	1	0.305
Rural –ref							
Urban	-0.204	0.202	0.312	1.227			
Household wealth index					1051.981	2	0.060
Low – ref							
Middle	0.095	0.214	0.657	1.100			
High	-0.507	0.251	0.044*	0.603			
Age of mother at child birth					1057.445	1	0.699
<19/35+ years- ref							
20-35 years	0.083	0.216	0.701	1.086			
Preceding birth interval					1051.143	1	0.011
<24 months-ref							
>24 months	-0.539	0.204	0.008**	0.583			
Birth order					1056.034	1	0.212
$1^{st}/5^{th}$ birth order- ref							
2-4 birth order	-0.226	0.181	0.213	0.798			
Source of drinking water							
Unsafe – ref					852.376	1	0.018
Safe	-0.476	0.201	0.018*	0.622			
Type of toilet facility					857.712	1	0.604
Unimproved – ref							
Improved	-0.104	0.201	0.604	0.901			

Note: * P < 0.05, **P<0.01, ***P<0.001, ref- reference category.

Source: Study Analysis Data

Household wealth index had significant effect on infant mortality. Mothers from high household wealth index were 0.603 less likely to experience infant mortality in comparison to mothers from low wealth index. Previous birth interval had significant effect on infant mortality. Mothers with long preceding birth interval (>24 months) were 0.583 less likely to experience infant mortality in comparison to mothers with short preceding birth interval (< 24 months). Source of drinking water had significant effect on infant mortality. Mothers with safe sources of drinking water were 0.622 less likely to experience infant mortality in comparison to mothers with unsafe sources of drinking water.

4.4.3:- Unadjusted Effects of Maternal Education on Infant Mortality in Nyanza Region.

The results of regression Model 1 provided in Table 4.7 shows that maternal education variable had insignificant effect on infant mortality in Nyanza Region.

Table 4.7: Regression Coefficient Estimates of Maternal Education and other Control Variables in Multivariate Models for Nyanza Region.

	Model 1			Model 2			Model 3		
Variable	**B**	**P-value**	**Exp (β)**	**B**	**P-value**	**Exp (β)**	**B**	**P-value**	**Exp (β)**
Maternal education									
No education/primary-ref									
Secondary plus	-0.325	0.114	0.722	-0.216	0.318	0.806	-0.114	0.522	0.866
Household wealth index									
Low-ref									
Middle				0.126	0.561	1.134	0.221	0.312	1.248
High				-0.424	0.108	0.654	-0.247	0.360	0.781
Preceding birth interval									
<24months-ref									
>24months							-0.492	0.017*	0.611
Source of drinking water									
Unsafe-ref									
Safe							-0.400	0.034*	0.670
Model parameters									
-2 Log likelihood	1054.975					1050.957			1029.730
d.f	1					3			5
P-value	0.106					0.084			0.006

Note: * P < 0.05, **P<0.01, ***P<0.001, ref- reference category, **Source: Study Analysis Data**.

4.4.4:- Adjusted Effects of Maternal Education on Infant Mortality in Nyanza Region.

Model 2 in Table 4.7 shows the effect of maternal education on infant mortality while adjusting for other socio economic confounding effects in Nyanza Region. Household wealth index, which was the single other socio-economic confounding variable incorporated in the model together with maternal education. As seen in the model 2 both socio economic factors had no effect on infant mortality in Nyanza region.

Model 3 in Table 4.7 also shows the effect of maternal education on infant mortality while adjusting for socio economic and proximate determinants confounding effects in Nyanza Region. The two proximate determinants variables incorporated in the model 3 just as controls, based on outcomes of bivariate regression, were length preceding birth interval and source of drinking water. Preceding birth interval had significant effect on infant mortality. Mothers with long preceding birth interval (>24 months) were 0.611 less likely to experience infant mortality in comparison to mothers with short preceding birth interval (< 24 months). Source of drinking water had also significant effect on infant mortality. Mothers with safe source of drinking water were 0.670 less likely to experience infant mortality as to mothers with unsafe sources of drinking water. Even though maternal education was statistically insignificant in Nyanza region, the coefficients were changing from -0.325 in model 1 to -0.216 in model 2 to -0.114 in model 3 signifying that there was link amongst maternal education and infant mortality and variables added in model 2 and 3 were capturing part of the effects of maternal education on infant mortality.

4.5. Effect of Maternal Education on Infant mortality in Central Region.

4.5.1. Regression Analysis Models.

Similarly, as was the case for Nyanza, analysis for Central Region involved running bivariate logistic models to determine the statistically significant variables including three multivariate regression models (1, 2 and 3) to determine adjusted and unadjusted effects of maternal education on infant mortality.

4.5.2. Results of bivariate logistic regression models for Central Region.

Table 4.6 indicates results of bivariate analysis in Central Region with only maternal education variable being statistically significant.

Table 4.8: Estimates of Bivariate Regression Coefficients and Model Parameters for Central Region.

Variable	Regression coefficients				Model parameters		
	B	**S.E**	**P-value**	**Exp(β)**	**-2 Log likelihood**	**d.f**	**P-value**
Maternal education					481.601	1	0.002
No education/primary-ref							
Secondary plus	-0.874	0.304	0.004**	0.417			
Type of place of residence					490.830	1	0.869
Rural –ref							
Urban	0.045	0.271	0.860	1.046			
Household wealth index					485.893	2	0.084
Low – ref							
Middle	0.708	0.407	0.082	2.029			
High	0.089	0.388	0.818	0.045			
Age of mother at child birth					490.837	1	0.888
<19/35+ years- ref							
20-35 years	0.043	0.306	0.888	0.958			
Preceding birth interval					490.550	1	0.579
<24 months-ref							
>24 months	-0.253	0.442	0.568	0.777			
Birth order					490.332	1	0.469
$1^{st}/5^{th}$ birth order- ref							
2-4 birth order	-0.194	0.264	0.467	0.824			
Source of drinking water					459.256	1	0.126
Unsafe – ref							
Safe	-0.439	0.282	0.120	0.645			
Type of toilet facility					461.509	1	0.762
Unimproved – ref							
Improved	-0.083	0.275	0.762	0.920			

Note: * P < 0.05, **P<0.01, ***P<0.001, ref- reference category.

Source: Study Analysis Data

Maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education.

4.5.3: - Unadjusted Effects of Maternal Education on Infant Mortality in Central Region.

Results of regression Model 1 provided on Table 4.9 shows that maternal education had significant effect infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education.

Table 4.9: Regression Coefficient Estimates of Maternal Education and Other Control Variables in Multivariate Models for Central Region.

	Model 1			Model 2			Model 3		
Variable	**B**	**P-value**	**Exp (β)**	**β**	**P-value**	**Exp (β)**	**B**	**P-value**	**Exp (β)**
Maternal education									
No education/primary-ref									
Secondary plus	-0.874	0.004 **	0.417	-0.874	0.006 **	0.417	-1.012	0.004 **	0.364
Household wealth index									
Low-ref									
Middle				0.768	0.060	2.155	0.807	0.049	2.241
High				0.404	0.313	1.498	0.390	0.350	1.477
Preceding birth interval									
<24months-ref									
>24months							0.033	0.946	1.033
Source of drinking water									
Unsafe-ref									
Safe							-0.301	0.308	0.740
Model parameters									
-2 Log likelihood	481.601					477.719			444.052
d.f	1					3			5
P-value	0.002					0.004			0.004

Note: * P < 0.05, **P<0.01, ***P<0.001, ref- reference category.

Source: Study Analysis Data

4.5.4: Adjusted Effects of Maternal Education on Infant Mortality in Central Region.

Model 2 on Table 4.9 provides the effect of maternal education on infant mortality while adjusting for other socio economic confounding effect in Central region. As was the case for Nyanza region, household wealth index was the only other socio-economic variable that was included as control variable in Model 2.

Maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education.

Model 3 on Table 4.9 shows the effect of Maternal Education on Infant Mortality while adjusting for Socio-Economic and Proximate determinants confounding effects in Central Region. Although the two proximate determinants variables used as controls in Nyanza Region regression model were established to be insignificant on bivariate analysis level in Central Region, they had to be included as controls in Central Region regression analysis to facilitate comparative analysis in this study. The two variables were previous birth interval and source of drinking water. Model 3 results show that maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.364 less likely to experience infant mortality in comparison to mothers possessing primary and without education. None of the variables included in model 2 and 3 captured the effect of maternal education on infant mortality.

4.6: Comparative Analysis of the Effects of Maternal Education on Infant Mortality in Nyanza and Central Regions.

Bivariate analysis results of Nyanza Region show maternal education insignificant effect infant mortality. Contrarily, in Central Region bivariate analysis indicated that maternal education was a significant factor of infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education. The bivariate regression models used to determine which other socio-economic and proximate determinants of infant mortality were to be included as controls in this study yielded mixed findings in the two regions. Household wealth index had significant effect in Nyanza region. Mothers from high household wealth index were 0.603 less likely to experience infant mortality in comparison to mothers from low household wealth index. While in Central Region household wealth index had insignificant effect on infant mortality. Previous birth interval was a significant determinant of infant mortality in Nyanza Region. Mothers possessing long preceding birth intervals (>24 months) were 0.583 less likely to experience infant mortality in comparison to mothers with short preceding birth interval (< 24 months.) In Central Region preceding birth interval had insignificant effect on infant mortality. Birth order had insignificant effect on infant mortality both in Nyanza and Central Region. Source of drinking water had significant effect on

infant mortality in Nyanza Region. Mothers with safe source of drinking water were 0.622 less likely to experience infant mortality as to mothers with unsafe sources of drinking water. While in Central Region source of drinking water had insignificant effect on infant mortality. Type of toilet facility had insignificant effect on infant mortality both in Nyanza and Central Region. The variables included in bivariate analysis most of them conforms to expectation that is they have a negative effect on infant mortality.

Three comparable multivariate regression models were run for each region. Comparability was guaranteed by similarity of the variables used in each model for each region. The multivariate results for comparable model 1 show that maternal education had insignificant effect in Nyanza Region. In Central Region maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education. This finding concurs with a study done by Kamal (2012) that showed that mothers with secondary plus education experienced reduced levels of infant mortality. The findings by Danning Liu (2014) also showed that infants of mothers who possessed higher education experienced a decreased prospect of infant mortality.

In comparable model 2 results show that maternal education had insignificant effects on infant mortality in Nyanza region. In Central Region maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.417 less likely to experience infant mortality in comparison to mothers with primary and no education. Household wealth index had insignificant effect on infant mortality both in Nyanza and Central Regions.

In comparable model 3 results show that maternal education had insignificant effect on infant mortality in Nyanza. However, in Central Region maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were 0.364 less likely to experience infant mortality in comparison to mothers with primary and no education. Household wealth index had insignificant effect both in Nyanza and Central Region. Preceding birth interval significant effect on infant mortality. Mothers with long preceding birth interval (>24 months) were 0.611 less likely to experience infant mortality in comparison to mothers with short preceding birth interval (< 24 months) in Nyanza Region. This finding is in line with literature reviewed in this study. For instance, Miringu (2016) observed that mothers with previous birth interval of below twofold years were further inclined to experience infant deaths in comparison to mothers with

previous birth interval exceeding two years. Moreover, Mekonnen (2011) showed that long birth intervals reduces the chances of infant mortality and increasing previous birth intervals reduces the possibility of infant mortality. Source of drinking water had significant effect on infant mortality in Nyanza region. Mothers having safe sources of drinking water 0.670 less likely to experience infant mortality in comparison to mothers with unsafe sources of drinking water. In Central Region source of drinking water had insignificant effect on infant mortality. This finding concurs with Mutunga (2007) finding that protected sources of drinking water leads to decreased infant mortality levels. The multivariate results illustrate that preceding birth interval and source of drinking water were the only variables that significantly affected infant mortality in Nyanza Region. In Central Region maternal education was the single variable that had significant effect on infant mortality.

Further scrutiny of the multivariate regression models used in this study established that all the three multivariate analysis models included in Central Region were statistically significant. However, in Nyanza Region model 1 and 2 were statistically insignificant while model 3 was significant. The analysis established that the variables included in multivariate regression models for Nyanza region captured the effect of maternal education on infant mortality. Contrarily, in Central Region the variables included in multivariate regression models didn't capture the effect of maternal education on infant mortality.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS.

5.1. Introduction.

This part provides summary, conclusion and recommendations founded on the intents of this study.

5.2. Summary

This study concentrated on comparative analysis of the effect of maternal education on infant mortality in Nyanza and Central regions. The study aimed at finding out whether the patterns of infant mortality differed with maternal education, to determine the unadjusted and adjusted effect of maternal education on infant mortality in Nyanza and Central Regions. The variables utilized in this study were derived from Mosley and Chen conceptual model. Data analysis involved direct estimation of mortality using life table probability which assisted in analyzing the patterns of infant mortality in Nyanza and Central Region. Logistic regression analysis was employed and it helped in analyzing the unadjusted and adjusted effect of maternal level of education on infant mortality. Findings indicated that patterns of infant mortality differed with maternal education in both Nyanza and Central Region. The risk of infant death reduces with increase in maternal education in both study regions. Mothers possessing secondary plus education bore a lesser risk of infant death in comparison to mothers with primary and without education. In both regions mothers possessing secondary plus education had lesser probability of infant death in comparison to mothers possessing primary or no education. The IMR for Nyanza Region was 63, 55 and 40 deaths per 1000 live births for mothers without education, primary complete and secondary plus education congruently. The IMR for Central Region was 62 and 27 deaths per 1000 live births for mothers possessing primary complete and secondary plus education congruently.

Most variables incorporated in this study did not have significant effect on infant mortality in Nyanza and Central regions. The bivariate analysis results showed that in Nyanza region previous birth interval, household wealth index and source of drinking water were the only variables established to be statistically significant. While in Central region maternal education was the only variable that had significant effect on infant mortality. The multivariate outcomes showed that previous birth interval and source of drinking water had significant effect on infant mortality in

Nyanza region. Mothers with long previous birth interval (> 24 months) were 0.611 less likely to experience infant mortality in comparison to mothers with short preceding birth interval (< 24 months). Mothers with safe sources of drinking water were 0.670 less likely to experience infant deaths in comparison to mothers with unsafe sources of drinking water. In Central region maternal education had significant effect on infant mortality. Mothers with secondary plus education were 0.417, 0.417 and 0.364 less likely to experience infant mortality in comparison to mothers with primary and no education in model 1, 2 and 3 respectively.

5.3. Conclusion

As the results on patterns of infant mortality by maternal education depicts that patterns of infant mortality differed with maternal level of education in Nyanza and Central Regions. Mothers possessing secondary plus education bore a lesser probability of infant mortality as to mothers possessing primary or without education in Nyanza and Central regions. This indicates that increasing maternal level of education so that every mother attains at least secondary plus education could significantly help in reducing infant mortality in Nyanza and Central Region.

This study also established that in Nyanza Region previous birth interval was a significant determining factor of infant mortality. Mothers with long preceding birth interval (> 24 months) were more likely to experience infant deaths as to mothers possessing short preceding birth interval (< 24 months). Nyanza region has high infant mortality because most mothers have short preceding birth interval due to fertility replacement effect. This means that a mother in Nyanza region replaces every infant death. Source of drinking water was also a significant determining factor of infant mortality in Nyanza region. Mothers with safe source of drinking water were less likely to experience infant mortality as to mothers with unsafe source of drinking water. The high infant mortality in Nyanza region can also be credited to mothers being exposed to unsafe sources of drinking water. While in Central region maternal education had significant effect on infant mortality. Mothers possessing secondary plus education were less likely to experience infant deaths in comparison to mothers possessing primary and without education. In Central region the low infant mortality is attributed to most mothers having at least secondary education.

In conclusion the multivariate results indicated that previous birth interval and source of drinking water were the proximate variables that maternal education acts through to significantly reduce infant mortality in Nyanza Region. However, this study did not establish the proximate variables

maternal education acts through to significantly reduce infant mortality in Central Region. Distinctively this study could not find out reverse causality of preceding birth interval influencing child birth in Nyanza region.

5.4. Recommendations

The focus of this section is to provide recommendations founded on the results of this study for policy, programmes and further research.

5.4.1. Recommendations for Policy and Programmes

The study revealed that infant mortality generally drops with rise in maternal education in both Nyanza and Central Regions. This study therefore recommends policy makers to prioritize improvement of maternal education in Nyanza and Central Region. Innovative education programmes should put in place to inspire females to accomplish at least secondary education. To promote reduction in infant mortality, adult education programmes aimed at accommodating mothers who dropped out of school before attaining at least secondary should also be intensified in Nyanza and Central region.

In Nyanza Region, Family planning programmes should be intensified that encourage birth intervals of beyond 24 months since this study established that maternal education acts through it to reduce infant mortality. This will be able ensure that at least every child born in Nyanza region survives infancy. This study established that safe source of drinking water had significant effect on infant mortality in Nyanza region. Therefore it is imperative that water programmes aimed at ensuring that every household has admission to safe source of drinking water should be intensified. This should include putting in place programmes that enhance preventive measures such boiling or treating drinking water which to a great extent will ensure infant survival. In Central Region, programmes aimed at improving child survival should be intensified while making efforts to establish the mechanisms via which maternal education acts to significantly reduce infant mortality.

5.4.2. Recommendations for Further Research.

The variables incorporated in analysis were not able to capture the effect of maternal education on infant mortality in Central Region. The data used could not facilitate computation of crucial proximate variables such as immunization status as well as uptake of child welfare facilities of the dead children. Further studies should be undertaken to identify variables that could completely capture the effect of maternal education on infant mortality. Since it could not be established after infant death the interval a mother in Nyanza region took before giving birth to another child. Therefore, further researches are recommended to find out reverse causality of preceding birth interval influencing child birth in Nyanza region.

Most studies done on effect of maternal education on infant mortality were conducted at national and regional levels due to data limitations. This study recommends that further researches should be done at county level since health service provision was devolved to counties by the 2010 Constitution of Kenya. The 2014 KDHS sampling frame allows some limited county level analysis of demographic and health indicators; innovative efforts should be explored to compute proxy variables that can be constructed using this data set to study the effect of maternal education on infant mortality in the counties.

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