

**EFFECT OF MATERNAL AND
ENVIRONMENTAL FACTORS ON INFANT
MORTALITY IN KENYA**

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DECLARATION

This research project is my own original work and has not been presented to this or any other university for an award of a degree.

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DEDICATION

I would like to dedicate this research project to my dear husband Jared Onyango and my son Liam Jaoko for their invaluable support rendered to me during the course of my studies.

ACKNOWLEDGEMENT

First and foremost I thank God for the gift of good health that has helped me to successfully complete this research project. My heartfelt thanks go to my supervisors, Dr. Boniface K'Oyugi and Dr. Andrew Mutuku for their encouragement, suggestions, constructive criticism and comments during the time of writing this project.

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ABSTRACT

Infant mortality is a key indicator for any country's socio-economic and health status since it represents the current health condition of a people. The study set out to establish how maternal and environmental factors affect infant mortality in Kenya. Secondary data from the 2014 Kenya Demographic Health Survey was used to carry out this study, where a total of 7,128 live births formed the sample for this study out of which 275 were infant deaths. Descriptive statistics and Logistic regression were the main methods of data analysis.

Key findings from the multivariate logistic regression showed that region and birth order/preceding interval were significantly related to infant mortality in Kenya. Mothers of birth order 4+ and <24 preceding birth interval were more likely to experience infant deaths compared to mothers of birth order 4+ and ≥ 24 months preceding birth intervals. Mothers from Rift Valley region were less likely to experience infant deaths compared to mothers from Nairobi region, while those mothers from North Eastern regions were more likely to experience infant mortality compared to those from Nairobi region.

The main implication from these findings is to for the government and other stakeholders to come up with programmes to address the high risks associated with infant mortality in different regions as well as incorporate the benefits of longer birth intervals into the Maternal Child Health programmes (MCH).

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The risk of a live born child dying before celebrating their first birthday is referred to as infant mortality. It is a commonly used indicator for measuring the socio-economic and health condition of any nation. This is because survival of infants heavily depend on the socio-economic conditions of their environment (Madise et el, .2003), and therefore the level of infant mortality exhibits the level of current health condition of a nation and the ability of a society to addresses the needs of its people. It is also part of United Nations development index (UN, 2007) and therefore it's important to describe it for purposes of evaluation and outlining of health policies (Park, 2005).

Infant Mortality Rate varies based on changes in socioeconomic, geographic, biologic, demographic, cultural and environmental factors. These are some of the factors known to influence the Infant mortality (Mosley & Chen, 1984). Most of highest rates of infant mortality are still found in the Sub-Saharan Africa, where out of the 8.8 million under-five deaths globally in 2008 (UN, 2010) half came from this region and Kenya is a country in this region. Although infant mortality rates in Kenya have continued to decline, from more than 100 deaths per 1000 live births in 1969 to the current rate at 39 deaths per 1000 live births in 2014. These rates are still high compared to the already developed countries.

Kenya has put up several policies to aid in addressing the IMR like the Child Survival and Development Programme spearheaded by UNICEF, its main intention was to help in reduction of Infant, Child and Maternal deaths by supporting interventions of proven performance in water, sanitation, hygiene, nutrition and health and also by backing up and advancing result-based interventions in order to encourage hastened investment on health form the government on Kenya

(UNICEF, 2009). Other policies include the National Urban Development policy and the National Slum Upgrading and Prevention policies which are aimed at strengthening governance, development planning, economic sustainability, environmental care and security. This will help towards poverty reduction, and improving economic growth and will help Kenya realize its vision 2030 (Institute of surveyors, 2012).

Such Programmes are useful if Kenya is to improve living conditions for its people as improvement on socioeconomic factors, environmental factors and more campaigns towards maternal factors will generally improve the health status and further reduce the infant mortality. Thus study was aimed at gauging the effects of maternal and environmental factors on infant mortality in Kenya.

1.2 Problem statement

In Kenya infant mortality stands at 39 deaths per 1000 live births and is considered high compared to developed countries. Infant mortality analysis in Kenya and other developing countries have shown inverse relationship with maternal and environmental factors (Gyimah 2002, Kibet, 2010, Omedi & Wanjiru, 2014, K'Oyugi, 2000, Mutunga, 2004). These studies have shown that maternal factors like age of mother at birth of child, preceding birth interval and birth order to have a significant relationship. High risk of infant mortality is known to be high for younger mothers (< 20 years) and to older women (35+) this high risk among young mothers is attributed to complications during birth and the fact the mother is not experienced in raising an infant. On the other hand mother who are much older are likely to experience infant deaths and this is attributed to the fact that women who had had many pregnancies are physically drained, and suffer from depletion associated with pregnancy complications and child birth. For preceding intervals; shorter preceding birth intervals are related increased infant mortality, where quick succession of pregnancies can impact the mother's health negatively and in turn affect the unborn child. A mother with two small may not be able to pay attention to the two siblings and the child who is accorded less time and attention has higher chances of dying.

First births and higher order births (4+) are known to have high risks of infant mortality. For first births, this is attributed to the fact that the mothers are still young and mostly lack experience looking after the infant. For the high birth orders the aging of mothers, make their mammary glands lose the ability to produce enough milk for the infant which results to early weaning and thus the infant lacks the necessary nutrients from the mother's milk, this makes the infant more susceptible to infection which can lead to death.

Source of drinking water and type of toilet facility were the environmental factors mostly discussed in past studies which had an inverse relationship with infant mortality. Mothers from household whose main source of drinking water is piped or from a public tap had lower risks of infant mortality compared to those mothers from households where the source of water was an open well, rivers and lakes. Mothers from household with access to a toilet facility were less likely to experience infant deaths compared to mothers from households with no toilet facility

This study used the most recent (2014) Kenya Demographic and Health Survey to establish if maternal and environmental factors are still important factors that influence infant mortality in Kenya.

1.3 Research question

How do maternal and environmental factors influence Infant mortality in Kenya?

1.4 Objectives of the Study

The general objective was to examine the effects of maternal and environmental factors on infant mortality in Kenya.

The specific objectives were to:

- i. Determine the effect of maternal and environmental factors on infant mortality in Kenya.
- ii. Establish the effect of maternal and environmental factors on infant mortality in Kenya when you control for socio-economic factors.

1.5 Justification of the study

To improve human welfare and development, Kenya has to greatly reduce infant mortality. Current data indicate a general reduction on infant mortality in the country but the rates remain high as compared to those of developed countries. By examining the determinants of infant mortality, it will help in assessing the performance of effectiveness of policies and programs aimed at reducing infant mortality.

There is need to reassess the determinants of infant mortality with an aim of informing policies and programs, by doing so, the knowledge acquired will inform policy and program designers on what variables to focus on to further reduce infant mortality in Kenya.

The study focused on shedding more light on how maternal and environmental factors influence infant mortality. Once the factors are well understood and association is established the knowledge gained will be useful to policy makers as well as researchers as it will aid in coming up with better policies and programs in addressing the challenges.

1.6 Scope and Limitations of the Study

The study was centered on population at risk of dying: children aged 0-11 months and utilized the 2014 Kenya Demographic and Health Survey data. A national representative survey where a representative sample of 32,172 women aged between 15-49 years were eligible for interview where 31,079 were interviewed successfully yielding a response rate of 97% and the child file from the data was used to source for relevant information needed.

Some main limitations of this study were; as secondary data was used, the study did not consider all the proximate determinants of infant mortality defined in the conceptual framework since the data lacked some measures on, nutrient deficiency, injury and personal illness control as indicators on nutrition collect information available at specific time of the survey. Therefore the study focused on variables available from the survey.

Another major limitation of the data is under reporting of child death, especially those that occurred soon after birth. This is because recording is done retrospectively. To this end only live births in the last year prior to the survey were considered so as to reduce the recall bias.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discussed literature in relation to infant mortality particularly in Kenya. It reviewed literature from various scholars as well as major socio-economic, environmental and maternal factors that influence infant mortality in Kenya. Lastly this chapter discusses the conceptual and operational frameworks to be used as well as definition of key variables.

2.2 SOCIOECONOMIC DETERMINANTS

2.2.1 Maternal Education

Maternal education is one of the socio-economic variables known to have a reverse relationship with infant mortality. Maternal education is reflected better in child feeding and cares practices, late marriage and motherhood as well as proper utilization of prenatal care and immunization services of the infant. Hence, highest levels of infant mortality are recorded with mothers with no education than mothers with any other category of education (Mustafa & Odimegwu 2008).

Kibet, (1981) found that women's education and malaria were the main discriminating component of infant mortality at macro level, where higher levels of education lead to lower infant mortality and low level of education lead to higher infant mortality. Lower infant mortality has been reported among mothers with some education as compared to their counterparts with no education (Gubhaju, 1987, Kibet, 2010 and Mustafa & Odimegwu, 2008). Mothers who are educated are aware of maternal and child health care and are able to seek these services if their children are sick, they are also to make timely decisions on their own which can help in saving their children life

in case of emergency illnesses. Such mother's have better childcare skills and are more self confident, take up well paying jobs, marry later and are more exposed to media and more information with favorable impact on child survival (Suwal, 2001).

2.2.2 Household Wealth Index

Household wealth level affects infant survival through socio-economic, bio-demographic and household environmental interactions. Mother's from wealthy households can afford both antenatal and postnatal care services even in private hospital, such mothers can also deliver in hospital and with the help of skilled personnel (Omedi & Wanjiru, 2014), they also attributed the low hospital deliveries in rural setting was due to the long distance to health clinics which attracts a considerable high fares as well as high charges at the facilities. A wealthy family can afford these.

Bocquier & Gunther, (2012), Fotso(2007) observed a high infant mortality among women from wealthy families where instances of early weaning were common resulting in early infections which lowers the immune system and eventually lead to death.

Uddin & Kabir (2006) reported that in urban Bangladesh mothers who had no jobs experienced infant deaths at 77 deaths per 1000 live births in relation to their working counterparts who experienced infant deaths of only 45 deaths per 1000 live births, a possible explanation to this difference is because working mothers are able to cater for basic needs to their children. A study by Fotso (2011), in some sub-Saharan Africa countries found that mothers with no jobs and working mothers did not establish any difference in influencing infant mortality.

2.2.3 Type of Place of Residence

A study on neighborhood differentials in infant mortality conducted by Measurement, Learning and Evaluation in (Senegal, Nigeria and Kenya) in 2010, concluded that urban areas experienced high infant mortality as compared to the rural areas and attributed this increase to an increase in the slum

settlements in urban areas where poor socio-economic status lead to underprivileged health and living conditions especially for mothers and their children (MLE, 2010).

K'Oyugi (1982), concluded that infant mortality was higher in rural areas than in the urban areas. Lower mortality patterns in urban were attributed to better sanitation, short distances to health facilities and higher income in urban residents. This situation was however contradicted by Kittur (2014), when she made an observation that infant mortality was higher in urban areas and she attributed these findings to the emerging slums and poor living conditions in the slums.

2.2.4 Region

Misati, (2011) explains the existence of major regional variation on infant mortality in Kenya, where some regions occupied by some specific cultural groups as having infant mortality at higher rates than others. The regions in Kenya which are known to have high infant mortality are Nyanza and Western inhabited by the Luo and Luhya communities, located near Lake Victoria, Coast region is also known to have higher infant deaths since it's along the Indian oceans. Possible arguments for these levels of infant mortality in the Coast as well as Nyanza regions are the fact that the areas are malaria-endemic, including significantly high poverty levels. Central, Rift Valley and Nairobi provinces are known to have the lowest infant mortality (NCPD et al., 2009).

Regional differentials have been observed in Zambia, where Luapala, a province with poor environmental conditions and high incidences of malaria emerged the highest in infant mortality, while the Southern province, though rural, but with medium scale farming and large herds of cattle recorded the lowest rates (Madise, Banda & Benaya 2003).

2.3 MATERNAL FACTORS

2.3.1 Birth Order

According to Gyimah, (2002) high risk of mortality is known to be high among the first births, reduces for the second and third births and gradually increasing thereafter. Kibet, (2010) concluded that the increased risk of infant deaths among the first order births is attributed to the e young age of the mother, complications during birth and mother inexperience of the mother in looking at the infant. He went ahead to note that total children in a household will likely limit amount of time assigned to each child and especially if the child is sick.

High order births increase infant mortality, and this is attributed to the fact that women who have had more pregnancies will be physically drained and mostly where birth interval is shorter and pressure on household resources (Koenig et el, 1990). Educating families on the need for birth spacing would have a huge positive impact on bringing down infant deaths in the high fertile populations of Africa, (Becher et el., 2004). Sufficient birth spacing is beneficial to the well being of both the mother and the child.

Births to older mothers suffer higher risks of experiencing infant mortality; this is because such mothers suffer form, malnutrition, anemia and damage to their reproductive health. Ageing of mothers make their mammary glands to lose the ability to produce adequate milk which results to early weaning for infants (Omedi & Wanjiru, 2014), this study found higher risk of infant death among mothers aged 35 and above years and this was consistent with findings from other studies (e.g. Omedi, 2014).

2.3.2 Preceding Birth Interval

Preceding birth intervals which are shorter are related with an increase of risk of infant death. Fotso (2007) concluded that infants who are born with preceding interval of 36 months and higher are less likely to die in relation to those whose intervals of less than 18 months. Quick successions pregnancies can have a negative effect on the health of a mother; this can in turn affect the development of the unborn child affecting the immunity of the child exposing them to higher risks of death.

The duration of birth interval is important on infant survival, with shorter intervals reducing the chances of survival significantly. If a child is born in a span of less than two years after another child then the child is at a higher risk of dying than those siblings with intervals of two or more years (Mekonina, 2012).

2.3.3 Age of Mother at Birth of child

Maternal age is regarded as an assistant for a host of many factors including but not limited to level of education, size of family, awareness and practices associated with childcare and efficiency to look after a child (Mock et al., 1993). The patterns for mortality by mothers' age generally take a U-Shape, with higher mortality risks occurring to children who are born to very young mothers and to those children born to older mothers. A possible explanation for this is the fact that younger mothers are not very experienced in taking care of infants (Kibet, 2010). Most children born to very young mothers are more inclined to be underweight and malnourished and as a result they are more susceptible to diseases. For the children born to older mothers, the high risk of death could be as a result of depletion associated with pregnancy complications and repeated child births.

2.4 ENVIRONMENTAL FACTORS

2.4.1 Source of Drinking Water

The most frequent and far-reaching risks related with drinking water is contamination by sewage whether directly or indirectly. If food is cooked using drinking water which is already contaminated could lead to more cases of infection (WHO, 1984). According to Mutunga (2004), households that have access to safe drinking water, can access sanitation facilities and use low contaminating fuels for cooking tend to experience lower mortality rates. In his study on how environmental factors impact infant mortality and child mortality in rural Kenya (K'Oyugi, 2000) found that mothers from households whose main source of drinking water as piped water or a public tap were unlikely to experience infant mortality compared to those mothers from households who had open well, rivers and lakes as their main source of water.

2.4.2 Type of Toilet Facility

Buttenheim, (2008) observed that children who resided in household with at least a toilet facility were unlikely to fall sick compared to those from households with no toilet facility. Muganzi, (1984), shows that the use of pit latrine and earth floor house contributed to high infant deaths. He further found out that residing in a permanent house and making use of piped water were resulted to lower infant mortality. Effect of lack of sanitation on mortality is well documented (Davanzo 1983). In Kenya households with a flush toilet as the main toilet facility registered a 13 percent compared to those households whose main type of toilet facility was a pit latrine at 31 percent Mutunga, (2007). In a study done by Omariba concluded that households with no toilet facility had a 20 percent increased chance of experiencing infant mortality compared to households with a pit latrine as their main source of toilet facility.

2.5 Summary of Literature Review

From the literature reviewed there is an agreement that maternal and environmental factors do have an inverse relationship with infant mortality. Literature reviewed depicted that preceding birth intervals, birth order, age of mother at birth of child, source of drinking water and type of toilet facility are all linked to child survival.

For the socio-economic factors maternal level of education , Region, wealth index and type of place of residence were associated with infant mortality except for a few studies that showed different results in different regions..

For the wealth quintile different studies showed conflicting findings where some concluded that mothers of high wealth quintile experienced lower infant mortality as they are able to provide better care in terms of healthcare and nutrition (Uddin & Kabir, 2006) while other studies showed that mothers from high wealth quintile tend to wean their infants much earlier which might lead to infections as the infant's immunity system is not strong enough. This calls for further investigation on factors influencing infant mortality.

Availability of clean water and toilet facility showed consistent results throughout all the studies reviewed where infants born in household with piped water or public tap had a lower rate of infant mortality than those infants born in households using rivers, wells and lakes (K'Oyugi 2000).

2.6 Conceptual and Operational Frameworks

2.6.1 Conceptual Frame Work

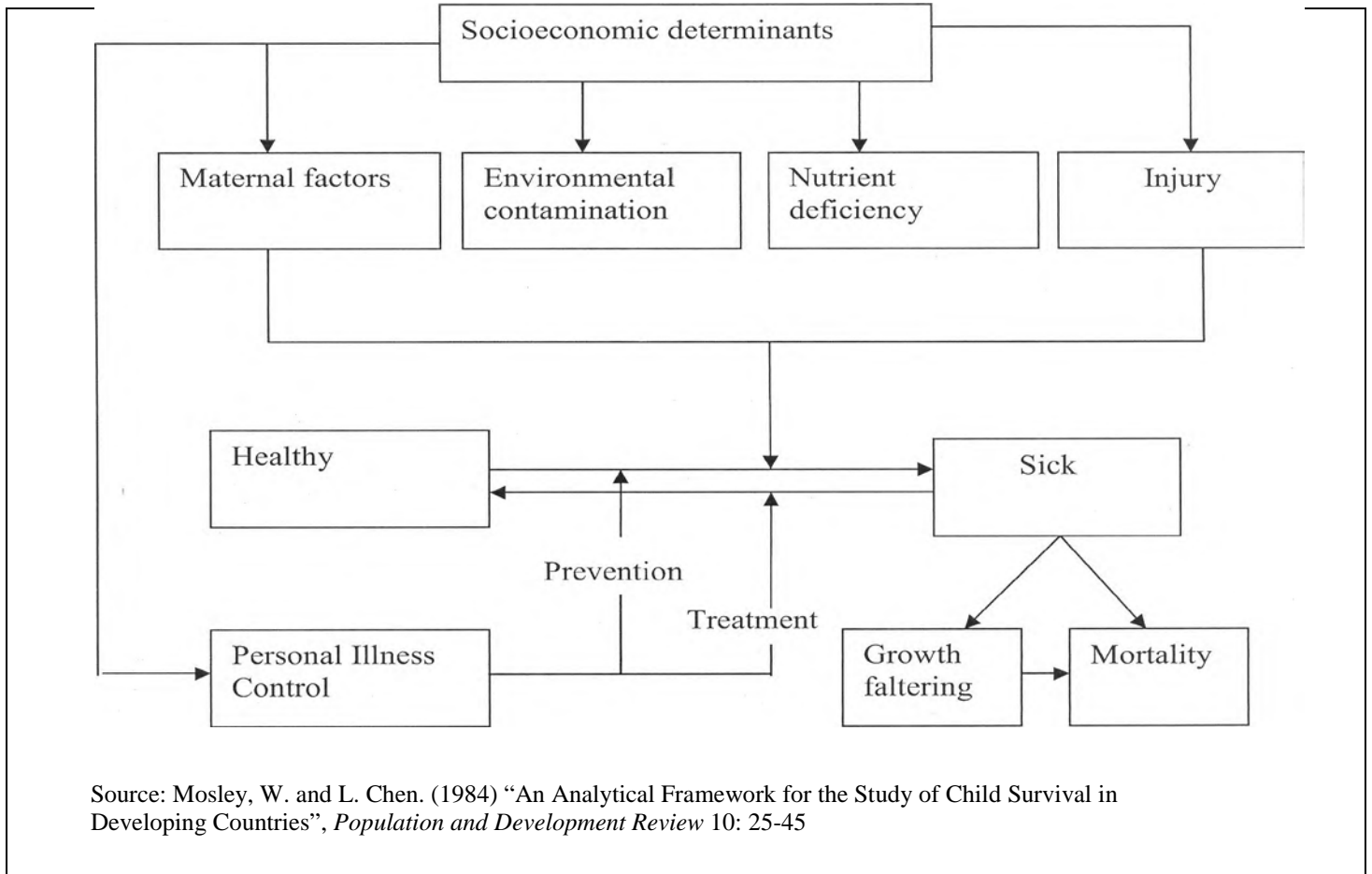
This study utilized the Mosley and Chen (1984) analytical framework to give direction on specifying the variables that influence mortality rate in Kenya. Mosley & Chen (1984) proposed a framework for exploring explanation of what influences child survival in most developing countries. This framework integrates together the social and biological variables. It assumes that economic as well as social determinants of child mortality must operate through a set of intermediate determinants in order to impact infant mortality. The effects of socio-economic variables are deemed indirect since they work through the bio-medical factors also known as the intervening variables (Mosley & Chen, 1984; Schultz 1984). The coming up with the intervening variables in order to the study child survival was based on several assumptions:

1. 97 percent or more infants are anticipated to live through the first five years of live in an ideal setting.
2. Less survival probabilities in any give society is due to socio-economic, environmental and biological forces.
3. All independent variables must work through some intermediate determinants after which they influence the chance of disease and the final result of disease process.
4. Nutrient deficiencies and some very specific diseases seen in any living population might be viewed as maternal indicators for the work of the immediate variables.
5. Wavering growth as well as ultimate death in children is the additive outcomes of many disease processes. Only in rare occasions is a child's death an outcome of one isolated disease.

The most fundamental thing to this model is being able to distinguish a set of immediate variables that have a direct effect on the chance of morbidity and mortality and all socio-economic determinants must operate through these variables in order to influence child survival. The proximate determinants are categorized into five groups, these are: the maternal factors which include age, parity, birth interval. Environmental factors which comprises of: air, food/water/fingers, skin/soil/inanimate objects and insect vectors. Nutrient deficiency made up of calories, protein, micronutrients, Injury which can be accidental or intentional and finally personal illness control comprising personal preventive measures and medical treatment.

Figure 1: Illustrates how all the groups of proximate determinants function on health dynamics of any population. Proximate determinants affect the speed of change of healthy individuals towards sickness. The personal illness control factors affect both the speed of illness through prevention and the pace of recovery through treatment. In the end either a full recuperation or permanent change reflected by an ever raising level of unending growth wavering which eventually leads to death.

Figure 1: Illustration of Conceptual Framework



2.6.2 Operational Framework

Due to some limitations on data to be used as discussed in the limitation section, some of individual factors outlined in the Mosley and Chen conceptual framework will not be included in the study. The factors that are not in the operational framework but are in the conceptual model are factors in the categories of nutrient deficiency, injury and personal illness control as this information for individual infants who died prior to the survey is not available.

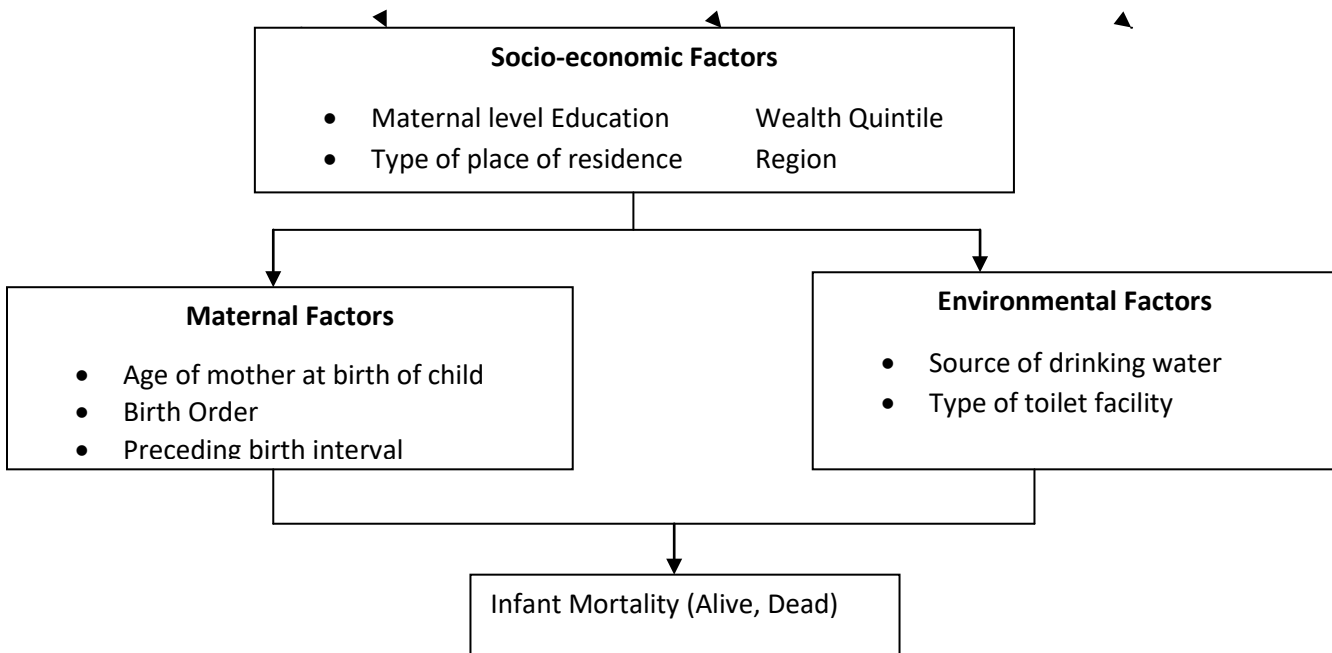
The variables selected to be included in the operational framework for the study are based on important factors identified from previous studies in developing countries and in particular in Kenya

as seen in the literature review. For socio-economic variables which will be considered in the operational framework are; maternal education, wealth index, type of place of residence and region.

Proximate variables consisted of maternal and environmental factors. Maternal factors also known as biological factors included; mother’s age at birth of child, birth order and preceding birth interval.

The environmental factors contained two variable namely the type of source of drinking water (Safe or unsafe) and type of toilet facility (with toilet facility and no facility). Lastly the outcome variable for the study is risk of death during infancy. The diagram below (Figure 2) represents the operations of the full operational framework.

Figure 2: Illustration of Operational Framework



Adapted from: Mosley, W. and L. Chen. (1984). Analytical Framework for the Study of Child Survival in Developing Countries.

2.7 Definitions of variables in the operational framework, their measurements and hypothesized relationship with outcome variable.

Dependent Variable: the risk of death during infancy defined as any age below one year (0-11 months) will be used as the outcome variable for this study. It will be measured as 0=Alive and 1=Dead.

2.7.1 Socio-economic Factors

Maternal Level of Education: this is the highest level of formal schooling attained by the mother. It will be measured as 0=No Education, 1=Primary and 2=Secondary+. The mother's education is intended to show level of knowledge for child care with a premise that the more educated a woman is the better the child care. The hypothesized relationship is that the risk of death is expected to decrease with the increase in the number of years attained in school.

Wealth Quintile: defined as a measure of households cumulative living standards. To be measured as 0=Low, 1=Middle, 2=High. The household wealth quintile is expected to show availability of resources in a household to better the living condition of a child. It is therefore expected in this study that infants born in households with low wealth quintile will show a relatively higher risk of infancy death.

Type of place of residence: the place of mother's residence at the time of the survey. Categorized as 0=Urban and 1=Rural. Mothers from the rural areas are not always informed or learned as well as those in urban areas. It is also difficult to get information on health issues in rural areas and means of transportation to health facility has been an issue. The expectation of the study is that mothers in rural areas are disadvantaged and therefore expected to have a relatively higher infant mortality.

Region: mothers region of residence at the time of the survey. The provinces are 0=Coast, 1=North Eastern, 2=Eastern, 3=Central, 4=Rift Valley, 5= Western, 6=Nyanza, 7=Nairobi. In Kenya infant mortality is mainly high in regions along the Lake Victoria and the Coastal belt, as these are Malaria endemic regions which are Nyanza, Western and Coastal regions respectively. Nyanza region also has a high HIV/AIDS prevalence compared to all other region and therefore the expectation of the study is that infants born to mothers from Nyanza region are expected to experience a higher infant mortality.

2.7.2 Maternal factors

Age of mother at birth of Index child: Mother's exact age at the time of birth. It will be measured in groups as: 0=< 20years, 1=20-34, 2=35+.the variable is intended to show the physiological strength of the mother. The expectation in this study is that the U shaped mortality pattern will be depicted where the young (under 20) and the old (35+ years) will have relatively higher infant deaths compared women in the reproductive years (20-34 years).

Birth Order/Preceding birth interval: refers to the order a child is born e.g. first, second etc and the time difference from one child's date of birth until the next child's date of birth. To be measured as 0=4+ and >=24 months, 1=2-3 and >=24 months, 2=2-3 and <24 months and 4+ and <24 months. The expectation of the study is that birth orders 2-3 and 4+ with < 24 months preceding intervals will show a relatively higher risk of death.

2.7.3 Environmental factors

Type of Toilet Facility: the type of toilet used to dispose human waste. To be measure as 0=Improved, 1=Un improved. This variable is expected to capture the hygienic condition of the household. It is therefore expected that infants born to households with a toilet facility will have relatively lower risks of dying.

Source of Drinking Water: the origin of drinking water for the household. To be measured as: 0= Safe Source, 1= Un-safe Source. The variable is also expected to measure the hygienic condition of the household. The expectation is that infants born to households with a safe source of drinking water will experience relatively lower risks of infant mortality.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The chapter gives a detailed picture for source of data and statistical methods used for data analysis in order to arrive at the necessary conclusion if maternal and environmental factors have any effect on infant mortality in Kenya.

3.2 Data Source

Data was drawn from the 2014 Kenya Demographic Health Survey (KDHS). The data was sourced from the Macro international Inc. website and was analyzed using the Statistical Package for Social Sciences version 23. The sample for the 2014 Kenya Health and Demographic Survey was drawn from the Fifth National sample survey and evaluation program (NASSEP V) Master sampling frame the most current one which is maintained by the Kenya National Bureau of Statistics and is used to conduct household based surveys throughout Kenya. The survey consisted of two sampling stages where 1612 (617 in Urban and 995 in Rural) clusters were selected during the first sampling stage. At the second stage 25 households were selected per cluster giving a sample size of 40,300 households. A total number of 39,679 households were selected and out of this 36,812 qualified for interviews, out of the eligible households 36,430 were interviewed successfully with a response rate of 99%.

A national survey in which a representative sample of 32,172 women of ages 15-49 years were eligible for interview and 31,079 were interviewed with a response rate of 97%. Segment population involved analysis of infants born one year preceding the survey. The sample size for children in this period was 7,128 in total which constituted 275 infants deaths.

3.3 Methods of data analysis

This section focused on available methods of analysis and which is was most preferred for this study. There exist many methods which could have been used for this study, examples of this methods are. Life tables, requires construction of life tables of all the covariates. The life table also assumes that the conditional probability of dying at a given age is same for all individuals and as such it is not very appropriate for this study.

Other methods are the indirect demographic techniques proposed by Brass and Trussell. Brass developed a procedure for converting proportions dead of children ever born- an important assumption made in the development of this method is that chance of a child dying is only a role of the child's age and not other factors like mothers age or the child birth order and as such the method could be used for this study.

Proportional hazards model proposed by Cox in 1972. It is one of the popular regression models in research. The model allows one to asses a relationship between individuals and survival time and one (univariate) or multiple (multivariate) explanatory variables. Additionally it allows an estimated risk of an event occurrence. The main assumption for the Cox analysis is the proportionality of the hazards. In the event of a violation of the proportionality of hazard assumption, the use of the Cox regression is incorrect. This study preferred the logistic regression model as it only focused in the sub sample of children who had experienced death before celebrating their first birthday.

3.3.1 Descriptive Statistics

In this study, descriptive statistics was used to describe the key background characteristics of the study. The key background characteristics were Maternal, Environmental and Socio-economic. Other than the descriptive statistics, cross tabs was used to run bivariate analysis to show whether there was significant relationship between maternal, environmental and socio-economic factors with infant mortality.

To test for significance, Pearson chi square was used and is computed as follows:

$$X^2 = \sum (O-E)^2 / E. \text{ Where: } \mathbf{O} = \text{observed frequencies and } \mathbf{E} = \text{Expected frequencies.}$$

The chi-square only gives the statistical significance association between the dependent variable and the independent variables and so in order to understand the relationship between the effect of maternal and environmental factors on infant mortality logistic regression was used.

3.3.2 Logistic Regression

This was the most preferred method of data analysis chosen for this study. The logistic regression model also known as Logit model or binary logistic regression was chosen for this study as the response variable was dichotomous and the predictor variables were categorical. It was used to calculate the chances an infant would survive given the existing environmental and maternal factors. Probability of outcome was measured by the odds of occurrence of an event.

The logistic regression function is shown as:
$$P = \frac{e^{a+bX}}{1+e^{a+bX}} \text{ Where:}$$

P = the probability of an event happening

E = natural logarithm, which is equal to 2.71828.....

α and b = the model coefficients

x = independent variable

Advantages associated with this method are flexibility and can be adopted easily for use and it is also convenient method for estimation of relative risk.

The method assumes, that the outcome variable should be normally distributed, sample size should be large enough and should be randomly drawn, it also assumes that each independent variable is same regardless of the effect of other variables unless there are interaction terms.

In order to establish the effect of maternal and environmental factors on infant mortality in Kenya, three models were estimated. Model one included maternal factors only and was meant to establish if maternal factors had any effects on infant mortality in Kenya. The second model was estimated to determine if environmental factors alone had any effect on infant mortality. The third model included all the factors (maternal, environmental and socio-economic) to establish if maternal and environmental factors had any effect on infant mortality when controlling for socio-economic factors.

To test the goodness of fit for these models, the likely hood ratio was used.

CHAPTER 4

FACTORS INFLUENCING INFANT MORTALITY

4.1 Introduction

The chapter has three sections; first section shows how the study population is distributed by different background characteristics, section two describes the differentials in infant mortality and finally the last section represents results from the multivariate analysis.

4.2 Background characteristics of study population

Table 4.1 demonstrates results by key background characteristics for the study population. Over the one year prior to the survey there were 7,128 live births in Kenya, where 275 of the infants died before celebrating their first birthday.

The results showed that most deaths were to women with at least primary level of education (55.6%), was lowest to mothers with secondary and higher level of education (19.6%) and mothers who had no education experienced deaths at (24.7%). The results further showed that women from households with low wealth experienced the highest deaths (66.2%) was lowest for the middle class women at (13.8%) and women from high wealth quintile experienced deaths at about (20%).

The results also revealed that most deaths occurred to mothers from Rift valley region (26.5%) and lowest in Nairobi at (2.9%) Nyanza and Eastern regions experienced the same proportion of deaths at (14.5%). Majority of infants deaths were from rural areas (72.7%) and (27.3%) were from urban areas.

Further, women aged between 20-34 years reported higher deaths (73.5%), while women aged 35+ reported the lowest infant deaths at (10.9%) while teenage mothers experienced infant deaths at (15.6%). A higher proportion of infant deaths were of 4+ & > 24 Months (52.4%) and were lowest for birth order 2-3/<24 months preceding birth interval (10.2%). The results also showed that most deaths occurred to mothers from households with an unimproved type of toilet facility (63.3%) while those who had access to an improved facility had (36.7%) while those women from homes with an unsafe source of drinking water had higher deaths at (68.4%) as compared to those women from homes with a safe source of drinking water who had the least deaths at (31.6%).

Table 4.1: Descriptive characteristics of the study population

Variable Name	Percent	Number
		n=7123
Child Alive		
No	3.9	275
Yes	96.1	6853
SOCIO-ECONOMIC FACTORS		
Maternal Education		
No Education	24.7	68
Primary	55.6	153
Secondary+	19.6	54
Wealth Index		
Low	66.2	182
Middle	13.8	38
High	20.0	55
Region		
Nairobi	2.9	8
Central	8.0	22
Coast	16.0	44
Eastern	14.5	40
Nyanza	14.5	40
Rift Valley	26.5	73
Western	9.8	27
North Eastern	7.6	21
Place of Residence		
Urban	27.3	75
Rural	72.7	200
MATERNAL FACTORS		
Mother's age at birth of child		
<20 Years	15.6	43
20-34 years	73.5	202
35+	10.9	30
Birth Order/Preceding Birth Interval		
4+ & ≥24 Months	52.4	144
2-3 & ≥24 Months	25.8	71
2-3 & <24 Months	10.2	28
4+ & <24 Months	11.6	32
ENVIRONMENTAL FACTORS		
Source of drinking water		
Safe Source	31.6	87
Un-safe Source	68.4	188
Type of toilet Facility		
Improved	36.7	101
Unimproved	63.3	174

4.3 Differentials of infant deaths in Kenya

Table 4.2 presents the results on differentials of infant mortality in Kenya by the different characteristics. From the findings birth order/preceding birth interval had an association with infant mortality. Mothers of birth order 4+ and less than two years preceding birth interval experienced the highest proportion of infant deaths at 5.9% followed by mothers of birth order 2-3 and less than two years preceding birth intervals whose proportion of deaths was 5.0 %. This signifies that short birth intervals were affiliated with infant mortality.

No significant relationship was established with maternal education, wealth quintile, place of residence, mother's age at birth of child, source of drinking water and type of toilet facility with infant mortality.

Table 4.2: Infant mortality differentials by selected explanatory variables

Variable Name	Infant Deaths	Infants alive
Maternal Education		
No Education	68 (3.8)	1730 (96.2)
Primary	153 (4.1)	3547 (95.9)
Secondary+	54 (3.3)	1576 (96.7)
$\chi^2=2.100$; $df=2$; $P=0.350$		
Wealth Index		
Low	182 (4.2)	4136 (95.8)
Middle	38 (3.4)	1070 (96.6)
High	55 (3.2)	1647 (96.8)
$\chi^2=3.832$; $df=2$; $P=0.147$		
Region		
Nairobi	8 (5.5)	137 (94.5)
Central	22 (6.0)	344 (94.0)
Coast	44 (4.6)	910 (95.4)
Eastern	40 (4.0)	950 (96.0)
Nyanza	40 (4.2)	909 (95.8)
Rift Valley	73 (3.0)	2388 (97.0)
Western	27 (4.1)	626 (95.9)
North Eastern	21 (3.4)	589 (96.6)
$\chi^2=13.222$; $df=7$; $P=0.067$		
Place of Residence		
Urban	75 (3.4)	2117 (96.6)
Rural	200 (4.1)	4736 (95.9)
$\chi^2=1.626$; $df=1$; $P=0.202$		
Mother's age at birth of child		
<20 Years	43 (4.0)	1026 (96.0)
20-34 years	202 (3.9)	5029 (96.1)
35+	30 (3.6)	798 (96.4)
$\chi^2=0.201$; $df=2$; $P=0.904$		
Birth Order/Preceding Birth Interval		
4+&>=24 Months	144 (3.7)	3751 (96.3)
2-3&>=24 Months	71 (3.3)	2061 (96.7)
2-3&<24 Months	28 (5.0)	534 (95.0)
4+&<24 Months	32 (5.9)	507 (94.1)
$\chi^2=10.069$; $df=3$; $P=0.018$		
Source of drinking water		
Safe Source	87 (3.6)	2297 (96.4)
Un-safe Source	188 (4.0)	4556 (96.0)
$\chi^2=0.421$; $df=1$; $P=0.560$		
Type of toilet Facility		
Improved	101 (3.8)	2525 (96.2)
Unimproved	174 (3.9)	4328 (96.1)
$\chi^2=0.002$; $df=1$; $P=0.968$		

4.4 Effects of Maternal and Environmental factors on infant mortality in Kenya

This chapter represents the multivariate logistic regression results. It consisted of three models where the first two models were run for only maternal and environmental factors in order to establish the gross effects and the main model was run for all factors to establish the net effect of maternal and environmental factors on infant mortality when controlling for socio-economic factors. The results were presented in tables 4.3, 4.4 and 4.5 respectively.

Table 4.3 show results for maternal factors in order to ascertain if they have any influence on infant mortality. As seen in the results preceding birth interval had a significant influence on infant mortality in Kenya. Mother's of birth order 4+ and < 24 months preceding birth interval were 1.7 times more likely to experience infant deaths as compared to mothers of birth order/preceding interval of 4+&>=24 months.

Table: 4.3. A model for Maternal determinants of Infant Mortality

Variables	Co-efficient(β_i)	S.E(β_i)	Exp(β_i)
Mother's age at birth of child			
<20 years (RC)			
20-34 years	-0.069	0.177	0.933
35+ years	-0.143	0.245	0.867
Birth order/Preceding interval			
4+ &>=24 Months (RC)			
2-3&>=24 Months	-0.107	0.152	0.899
2-3<24 Months	0.303	0.214	0.739
4+&<24 Months	0.511	0.205	1.667**

Note: *p-value<0.001; **p-value<0.01; *p-value<0.05**

Table 4.4 show the outcome for environmental variables in the absence of socio-economic variables in order to ascertain if they had any influence on infant mortality. As seen both the environmental factors did not have any influence on infant mortality.

Table: 4.4. A model for Environmental determinants of Infant Mortality

Variables	Co-efficient(β_i)	S.E(β_i)	Exp(β_i)
Type of source of drinking water			
Safe source (RC)			
Un-safe Source	-0.090	0.136	0.914
Type of toilet facility			
Improved (RC)			
Un-improved	0.016	0.131	0.984

Note: *p-value<0.001; **p-value<0.01; *p-value<0.05**

Third model was fitted in order to establish the overall influence of maternal and environmental factors on infant mortality in Kenya when controlling for other variables.

The results in Table 4.5 show that region is a significant determinant of infant mortality in Kenya, where mothers from Rift Valley region were 0.365 times less likely to experience infant deaths compared to those in Nairobi region. Mothers from North Eastern region were also 1.395 times more likely to experience infant mortality as compared to those in Nairobi region. These are interesting findings as other studies done in Kenya have shown otherwise where Nyanza, Western and Coast regions are known to have higher infant deaths as compared to other regions. Misati, (2011) explains that great regional differences exist in infant mortality in Kenya, where some regions inhibited by specific cultural groups have higher infant mortality levels than others.

Despite controlling for the socio-economic factors, maternal factors had an influence on infant mortality where birth order/preceding interval was found to be significantly associated to infant mortality where mothers of birth order 4+ and <24 months were 1.650 times more likely to experience infant mortality compared to mothers of birth order 4+ and a preceding interval of ≥ 24 months. This conforms to what most past studies have shown. These results were supported by the literature reviewed for this study where shorter preceding birth intervals, is highly associated with high risk of infant death. Fotso (2007) found that those infants born after a birth interval of 36 months and over were not likely to die compared to infants with a preceding interval of less than 24

months. Therefore the length of birth spacing plays a major role on survival of the index child, where short birth intervals considerably reduce the chances of survival and vice versa.

Table: 4.5. Model for determining the effects of maternal and environmental factors on Infant Mortality

Variables	Co-efficient(β_i)	S.E(β_i)	Exp(β_i)
Level of Education			
No education (RC)			
Primary	0.044	0.178	1.045
Secondary+	-0.081	0.233	0.922
Wealth Quintile			
Low(RC)			
Middle	-0.262	0.195	0.770
High	-0.378	0.220	0.685
Region			
Nairobi (RC)			
Central	-0.025	0.437	0.975
Coast	-0.574	0.421	0.654
Eastern	-0.675	0.422	0.509
Nyanza	-0.651	0.422	0.521
Rift Valley	-1.008	0.408	0.365**
Western	-0.619	0.442	0.539
North Eastern	0.931	0.465	1.394*
Type of Place of Residence			
Urban (RC)			
Rural	-0.134	0.165	1.143
Age of Mother at birth of child			
<20 years (RC)			
20-34 years	-0.071	0.179	0.932
35+ years	-0.203	0.248	0.817
Birth order/Preceding interval			
4+&>=24 Months (RC)			
2-3&>=24 Months	-0.104	0.153	0.902
2-3+&<24 Months	0.290	0.215	1.336
4+&<24 Months	0.501	0.208	1.650*
Type of source of drinking water			
Safe source (RC)			
Un-safe Source	0.025	0.152	1.026
Type of toilet facility			
Improved (RC)			
Un-improved	-0.178	0.149	0.837

Note: *p-value<0.001; **p-value<0.01; *p-value<0.05**

An association was established between infant mortality and maternal factors which was in line with past studies which have shown that infants who are born within a short interval (< 24 months) are likely to die in comparison to those infants born with a longer preceding interval (> 24 months). Therefore this study established that maternal factors do have an effect on infant mortality in Kenya and this is both when you control for other factors or run on its own.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The final chapter represents summary and conclusions which were arrived at with respect to how the study was carried out and recommendations also made with respect to the findings of the study.

5.2 Summary

The main intention of the research study was to assess the effects of maternal and environmental factors on infant mortality in Kenya. The aim was to establish if maternal and environmental factors had any effect on infant mortality in Kenya when controlling for socio-economic factors. To be able to achieve the objectives of the study, appropriate variables were selected and analyzed from the Kenya Demographic and Healthy Survey 2014, these variables included maternal education, wealth quintile, region, place of residence, mother's age at birth of child, the birth order, preceding birth interval, source of drinking water and type of toilet facility.

Mosley and Chen framework was used to conceptualize the study and for data analysis methods, descriptive statistics and logistic regression were used. The preliminary results showed the highest number of infant deaths were to women who only had a primary level of education (55.6%), were from households of low wealth quintile (66.2%), from rural settings (72.7%) and came from Rift-valley region (26.2%). For the maternal factors most deaths were for women aged 20-34 years (73.5%) and the birth order were of first births (26.5%). Women with households with no access to safe drinking experienced higher deaths (68.4%) and women from households with a pit latrine as the type of toilet facility experienced higher infant deaths (64.7%).

Most factors considered in this study were not found to have any significant association with infant mortality in Kenya. In the bivariate analysis preceding birth interval was significantly associated with infant mortality. The multivariate analysis showed both the region and birth order/preceding birth intervals had an inverse relationship with infant mortality in Kenya. The region of residence was found to be a significant determinant of infant mortality where mothers from Rift Valley were 0.365 less likely to experience infant mortality as compared to mothers from Nairobi region, while mothers from North Eastern region had 1.394 time more likely to experience infant deaths as compared to those from Nairobi province. High order births and shorter preceding birth intervals were found to increase the chances of death during infancy. Mothers of birth order 4+ and preceding interval of <24 months were 1.650 times more likely to experience infant mortality compared to women with a birth order and preceding interval of 4+ >= 24 months. The findings were still show that shorter birth intervals continue to be an important contributor to infant mortality in Kenya.

5.3 Conclusion

As observed, infant mortality was explained by mother's region where mother from Rift Valley had lower chances of experiencing infant mortality as compared to those for the Nairobi region. This can be explained that Nairobi region has many informal settlement and access to health care and sanitation is going down with time because of the poor status of people living in these settlements, while in regions like Rift Valley many women continue to seek health services from the hospitals. On the other hand the results showed that women from North Eastern region continue to experience high mortality rates compared to those in Nairobi and this can be attributed to lack of ease access to health facilities due to long walking distances as well as existence of cultural believes which prevents some mothers from visiting the health care centers. The results further that birth order/ preceding interval was a key determinant of infant mortality where mothers with birth order of 4+ and a short preceding

interval of less than two years suffered more deaths, and this can be explained by the fact that short birth interval is not adequate for both mother and child to have adjusted before having to deal with another child. In conclusion this study established that maternal factors have a negative effect on infant mortality in Kenya.

Unlike most studies this study did not establish any association between maternal education, wealth quintile, and place of residence, age of mother at birth of child, type of source of drinking water and type of toilet facility.

5.4 Recommendations

This section will provide recommendations based on the findings of the study both for research and policy.

5.4.1 Recommendations for policy and Programmes

Policy and programme makers should come up with Programmes that are context specific to region to address unique factors affecting infant mortality in different regions in Kenya and by doing so infant deaths can reduce greatly as the programs will focus on the areas affecting that particular region. Good practices can also be borrowed across the Regions as what worked for region can work for other regions as well.

As an overall strategy birth intervals can be integrated into the mother child health programme (MCH) so that mothers are educated on the benefits of longer birth intervals and dangers of short birth intervals.

5.4.2 Recommendations for further research

As observed, infant mortality was explained by mother's region of residence and birth order/preceding intervals. As most studies are national based; future research should be focused on regional level to identify the risks associated with infant mortality in different regions.

Qualitative studies should be carried to explore why infant mortality is higher in some region than in other regions as well as why most women continue to have children with very short birth intervals and from such information better programmes and policies to help in addressing the issue of high birth orders and very short birth intervals. Qualitative research is helpful as respondents give information on issues affecting them on the grassroots.

As the study showed no association with most socio-economic factors which is not the case for most studies carried out previously, further research can to be done at county level as there is available data by counties, in order to establish if these are still important factors that influence infant mortality in Kenya.

REFERENCES

- Becher, H. Jahn, A. Gbangou. Kynast-Wolf, G. & Kouyate, B. 2004. Risk factors of infant and Child Mortality in rural Burkina Faso: *Bulletin of the WHO*, 82(4)
- Bocquier, P., & Gunther, L. 2012. Is there an urban advantage in child survival in Sub-Saharan Africa? Evidence from 18 countries “*Population and Development review*”, New York.
- Buttenheim, A. M. 2008. The sanitation environment in urban slums: Implication of child health *Population and Environment*, 30. 26-47
- Da Vanzo, J., W.P. Butz & J.P. Habicht 1983. How biological and behavioral influences on mortality In Malaysia vary during the first year of life: *Population Studies*
- De Klerk, N.S., Poerwanto & M. Stevenson. 2003. Infant mortality and family welfare: Policy Implication for Indonesia public health policy and practice for Indonesia, population in Indonesia 2003: pp 45
- Desta Mekonina. 2012. Infant and Child mortality in Ethiopia, role of socio-economic, demographic And biological factors in the previous five year period 2000-2005: *Unpublished thesis Lund University, Department of Economic history Ethiopia, 2012*
- Ettarh, R & J. Kimani. 2012 “Determinants of under-five mortality in rural and urban Kenya”, Rural And remote health journal Africa, population health and research center. 2012: 1812 pp 2-4
- Fotso, J. C. 2007. Urban-rural differentials in child malnutrition: Trends and socio-economic correlates in Sub-Saharan Africa. *Health and place* 13 published by African population and Health research, (1): pp 205-223
- Fotso, J. C. 2011. Maternal and child health services for urban poor a case study from Nairobi, Kenya between 2006-2009: Published by African population and Health Research, Nairobi Vol 2
- Gubhaju, B., B. 1987. Urban-rural differentials in Infant and child mortality in Nepal *Contributions to Nepalese studies*, CNAS, Tribhuvan University, Vol 14 (2)
- Gyimah, S. O. 2002. Ethnicity and Infant mortality in Sub-Saharan Africa: The case of Kenya and South Africa. *African population studies*, vol 24.

- Hobcraft, J. 1993. Women's education, welfare and child survival: a review of the evidence
Health Transition Review: 3 (2)
- Irene Kittur. 2014. Factors influencing infant mortality in urban Kenya: *Un-published project, Population Studies and Research Institute, University of Nairobi, Kenya*
- K'Oyugi, B.O. 2000. The Impact of Environmental factors on infant and child mortality in Rural Kenya: In Oucho. J.O. Ocholla-Ayayo, ABC, Ayiemba E.H.O and Omwanda L.O (edits)
Population and Development in Kenya, Population Studies and Research Institute, University Of Nairobi.
- Kibet, M. S. (2010). Comparative Study of Infant and Child Mortality: The case of Kenya and South Africa: *African Population Studies, Volume 24.*
- Kibet, M.K.I. 1981 Differential Mortality in Kenya: Unpublished MSc Thesis, PSRI: University of Nairobi.
- Koenig, M. A., Phillips, J. F., Campbell, O. M., & D'Souza, S. 1990. Birth Intervals and Childhood Mortality in Rural Bangladesh: *Demography, Vol. 27, No. 2.*
- Kweyu, N. L. 2007. The effects of birth intervals on infant mortality in Kenya: A research Project at Population and research institute, University of Nairobi.
- Madise, N. J., Z. Matthews and B. Margetts. 1999. Heterogeneity in child nutritional status between Households: *A comparison of six sub-Saharan African Countries, Population Studies.*
- Madise, N. J. 2003. Infant Mortality in Zambia: Socio-economic and demographic Correlates. *Social biology 50: 148-166.*
- Misati, A.J. 2011. Determinants of child survival in Kenya: A comparative study Lambert Academic Publishing.
- Mosley, W. H., & Chen, L. 1984. An analytical framework for the study of child survival in developing countries: *Population and development review, 1984, pp 25-45.*
- Muganzi, Z. 2000. Factors affecting infant and child mortality in Kenya: In Oucho.J. O, Ocholla

- Ayayo, ABC, Ayiemba. E.H.O and Omwanda L.O (edits), *Population and Development in Kenya*, Population Studies and Research Institute, University of Nairobi.
- Mustafa, H. E & Odimegwu, C. 2008. Socioeconomics determinants of infant Mortality in Kenya: Analysis of Kenya DHS 2003: *Journal of Humanities & Social sciences*, Vol.2, issue 2.
- Mutunga, C.J. 2004. Environmental determinants of child mortality in Kenya: Kenya Institute for public policy Research and Analysis (KIPPRA), Nairobi, Kenya.
- Omariba, D. 2007. Determinants of infant and child Mortality in Kenya: an analysis controlling for frailty effects.
- Omedi Gilbert & Wanjiru Gichuhi. 2014. Determinants of Infant Mortality in Rural Kenya: *Research on Humanities and Social Sciences*, Vol.4, No. 28.
- Omedi, G. 2014. Factors Influencing Infant Mortality in Kenya and Tanzania: *Southern Social Science Journal*, Vol. 1, No. 1, 2014.
- Pablo Viguera Ester, Alberto Torres, Jose M. Freire, Valentin Hernandez & Angel Gil, (2011). Factors associated to infant mortality in Sub-Saharan Africa: *Journal of public health in Africa; volume 2:e27*.
- Park, K. 2005. Preventive Medicine in Obstetrics, Pediatrics and Geriatrics: Park's Text book of preventive and social medicine, (18th Edition) India.
- Pebley, R., & P.W. Stupp,. 1987. Reproductive patterns and child mortality in Guatemala: Guatemala inc. publishers, 24(1):43-60.
- Schell C.O, M. Reilly, H. Rosling, S. Peterson, and A. M. Ekström,.2007. Socioeconomic determinants of infant mortality: *A worldwide study of 152 low-, middle-, and high income countries*: Scandinavian Journal of Public Health.
- Suwal, J. V. 2001. The Main Determinants of Infant Mortality in Nepal: *Social Science and Medicine*, Volume 53.
- Uddin, G., & Kabir M. 2006. Factors associated with child health in urban areas of Bangladesh:

Working paper at the University of Jagannath, Department of Demography and statistics,
Dhaka, Bangladesh 2006:6-8.

United Nations 2007. Child mortality in developing countries socio-economic differentials:
Trends and Implications New York.

United Nations 2010. The Millennium Development Goals Report. New York:

UNICEF 2009. Child Survival and Development Program Kenya. National Development
And vision 2030. First medium-term plan (2008-2012).

WDI 2004. The World Bank online database

World Bank. 2001. Health and Environment: Background paper for the World Bank Environment
Strategy, Washington D.C.

Zibeon S. Muganzi. 1984. The effects of individual and contextual variables on infant mortality in
Kenya: Research project at PSRI: University of Nairobi.