LUND UNIVERSITY
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Master program in Economic Demography

Determinants of Infant Mortality in Kenya - Analysis of Kenya DHS 2003 and 2008/9

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Abstract: Infant mortality rate is considered as sensitive indicators of living standard and socio-economic conditions of a country. It remains a big challenge for the Kenyan Government due to the high infant mortality rates as she strives to achieve the Millennium Development Goals (MDGs). This paper examined and identified the important determinants of infant mortality in Kenya. The analysis will be based on the analytical framework by Mosley& Chen (1984) which take socio-economic, demographic as well biological factors into account. The logistic analysis will be used the micro level data from Kenya Demographic Survey 2003 and 2008/9. The infant mortality reduced during the periods between 2003 and 2008/9. The main results indicate that among the demographic factors mother's age at first child birth is the important determinant for infant mortality. Proximate determinants such as length of breastfeeding and prenatal care are associated strongly with infant mortality. The importance of socio-economic determinants such as father's occupation as well as region of residence in infant mortality is quite significant. It is only significantly that infants born to parents with a secondary or higher degree of education experience a lower risk of dying for the previous five year period before 2008/9.

Key words: infant mortality, Kenya, regional differences, demographic determinants, socio-economic determinants, proximate determinants

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1. Introduction

Infant mortality rate remains still a problem in many parts of the world attention. Especially the high level of infant mortality is recognized as worthy of serious concern in developing countries. Despite significant improvements have been achieved with the infant mortality rate, recording an average annual decline approximately 4 percent in 1960-1980 (Hill et al., 2001), Kenya experienced an upsurge in infant mortality since the early 1990's. The level of infant mortality rate rose from 59 deaths per 1,000 live births in 1989 to 78 deaths per 1,000 live births by 2003 (CBS, *et al.* 2004). After 2003, the infant mortality rate decreased year by year. The recent Kenya Demographic Survey 2008/9 showed the infant mortality declined by 32 percent from within a period of 5 to 6 years. It is estimated that 1 in every 19 children die before celebrating their first birthday (Republic of Kenya, 2009). 60 percent of infant deaths occur during the first month of life. Neonatal mortality is 32 deaths per 1,000 live births, while post neonatal mortality is 21 per 1,000 live births (KDHS, 2009).

The reduction between the periods of 2003-2008/9 has been a controversial issue and many researchers have tried to find out the determinants what impact the decline in infant mortality in Kenya. Some scholars focused on medical causes. Elsewhere, other researchers argue that and find out the majority of the reduction associated with biological and socio-economic factors. As for biological determinants, such as decreased levels of malaria and HIV infection rates related to this decline; while others believe that socio-economic factors such as eliminating poverty gradually could explain the decreasing phenomenon. Though infant mortality rate declined appreciably among all the provinces in Kenya, there is available evidence indicates that great regional variations in infant mortality exist. For instance, The Central province has the lowest infant mortality than the adjacent Rift Valley and Nairobi province. It is recorded that infant mortality rate is 95‰ in Nyanza province cause the challenges to improve the infant survival (Misati, 2011). At the district level, Homabay region has exceeding 200 infants dying before celebrating their first birthday compared with 50 died in Nyeri region. The vast gap among various provinces within Kenya, have drawn the attention of governments to intensify their efforts to improve child health and survival.

From the above discussion, a reduction of infant mortality is an important issue in Kenya. There has been a clear decrease in mortality trends in Kenya during 2003-2008/9. So the aim of the thesis is to investigate the causes for the reduction of infant mortality and identify the more important factors associated with the decrease of infant mortality. The paper applies the Mosley & Chen framework to guide the specification of variables that are likely to have underlie the observed infant mortality decrease in Kenya. Data from the 2003 and 2008/9 KDHS will be used, and logistic regression analysis used to examine the factors associated with infant mortality risks. Demographic factors of the "marital status of the mother", "mother's age at first child birth", "birth interval" plus proximate factors of the "source of drinking water", "type of toilet facility", "type of floor material", "duration

of breastfeeding", "prenatal care", were developed. Furthermore, these bio-demographic determinants incorporated socio-economic determinants including "maternal education level", "father's educational level", "father's occupation", "electricity", "region of residence" were developed. I will compare the estimate results of the model between 2003 and 2008/9 and distinguish which factors are more contribute to the decline level of infant mortality.

1.1 Aim and scope

As discussed earlier, together with the decline of infant mortality, poverty is the fundamental problem in Kenya. 58 percent of Kenya lives on less 2 $ a day resulted in more than half of the country's people are poor, and 7.5 million of those poor live in extreme poverty (africapdia.com). Since in the Kenyan society, there are a number of other changes that have associated with the decreasing trend in infant mortality. For example there has been a reversal in public health measures, especially immunization. In order to achieve a better understanding the connection between population health and the economy, it is vital to analyze the background factors and determinants of infant mortality.

The aim of the paper is to investigate the association between infant mortality and bio-demographic (proximate) and socio-economic factors in Kenya and distinguish which of these factors contribute the most to the reduction level of infant mortality during the period between 2003 and 2008/9 and identify the most important factors. Therefore, it shows that the government should give more attention to those key sectors which will have a greater impact on child survival in order to achieve the Millennium Development Goals (MDGs) target on infant mortality. According to Mosley & Chen (1984), a number of socio-economic, demographic and proximate variables are to be assessed for analysis which the paper is based on micro level data. The Kenya Demographic and Health Survey (KDHS, 2003 and 2008/9) will be used in this study.

1.2 Research Question

According to the previous studies and the theoretical model by Mosley & Chen (1984), a number of variables that most likely affect infant mortality levels will be identified in Kenya. A theoretical framework will be established for the statistical analysis. The following research question will be answered:

"What factors contribute the most to the reduction of infant mortality in Kenya in the period 2003 and 2008/9?"

From the statistical analysis, the determinants that have an impact on infant mortality in Kenya will be identified and tested, using Demographic and Health Survey Data. The research question can be answered.

1.3 Objectives

General Objective
The general objective of the paper is to identify the bio-demographic (proximate) and socio-economic factors that associated with the reduction in infant mortality in Kenya during the period of 2003-2008/9. Understanding the causes behind the decline is vital in designing high impact public health strategies for the acceleration of national and international public health goals such as the Millennium Development Goals (MDGs).

Specific objectives
1 To study the levels, trends and differentials in infant mortality during the periods between 2003 and 2008;

2 To study the variations in the fertility behavior during the periods between 2003 and 2008;

3 To study the effect of selected socio-economic and demographic as well as proximate variables on infant mortality and suggest viable strategies to reduce infant mortality in Kenya.

1.4 Outline of the Paper

The paper will start with an overview of the geographic, and demographic as well as economic settings of Kenya. In order to get the accurate discussion and conclusion, it is very important to know the completely background knowledge of the settings. Also, we can use the micro level data to obtain some knowledge on the aggregated level. The first chapter is about the briefly introduction. In this, the first part will describe the aim and scope. The second part will introduce the research question. The third part will list the objectives of the paper, including general and specific objectives. The fifth part will briefly describe general definitions. The second chapter describes the background of Kenya. In this, the first part will briefly describe the geographic setting. The second part will describe an overview of the demographic development of Kenya. The third part will focus on an overview of the economic development of Kenya since its independence. The last part of the background chapter will discuss regional differences in Kenya. The third chapter mainly focuses on the overview of previous research, including socio-economic, demographic and biological factors. Mosley & Chen's (1984) infant mortality theoretical framework will serve as the theoretical base. At the last part of the chapter will list several hypotheses that will be tested in the statistical analysis. The forth chapter describes the data, including possible data quality problems. The fifth chapter describes the statistical model used in the analysis. Giving the definition of the dependent and independent variables used in the analysis. The sixth chapter lists statistical analysis. In this, the first part will list the expectations from the empirical analysis. The second part will consist of

infant mortality for the previous five year period before 2003 statistical analysis and infant mortality for the previous five year period before 2008/9 statistical analysis. The seventh chapter will be a discussion of the results obtained from the analysis. The eighth chapter will be the conclusions. The ninth chapter will end with references.

1.5 Definitions

Infant mortality: It refers to the probability of a child dying before the first birthday. (KDHS, 2008/9)

Neonatal mortality (NN): It refers to the probability of dying within the first month of life. (KDHS, 2008/9)

Postneonatal mortality (PNN): It refers to the difference between infant and neonatal mortality. (KDHS, 2008/9)

Poverty: It refers to a set standard which is consistent over time and between countries. First introduced in 1990, the dollar a day poverty line measured absolute poverty by the standards of the world's poorest countries. The World Bank defined the new international poverty line as $1.25 a day for 2005 (equivalent to $1.00 a day in 1996 US prices), but have recently been updated to be $1.25 and $2.50 per day. (The World Bank)

Millennium Development Goals: The UN definition of MDG will be used: "It endorsed by governments at the United Nations in September 2000, aim to improve human well-being by reducing poverty, hunger, child and maternal mortality, ensuring education for all, controlling and managing diseases, tackling gender disparity, ensuring sustainable development and pursuing global partnerships."

2. Background

It is important to obtain the background knowledge about Kenya before initiating the empirical analysis. In order to fully understand the results from the statistical analysis, it is vital to obtain a full understanding of the setting for a thorough interpretation of the results.

2.1 Geographic setting

Kenya is located in Eastern Africa, with borders the Indian Ocean to the east, Somalia to the northeast, Ethiopia to the north, Southern Sudan to the northwest, Uganda to the west, and Tanzania to the south. The country is divided into 8 provinces (North Eastern, Eastern, Coast, Rift Valley, Central, Western, Nyanza and Nairobi) and 72 districts. All the provinces have large differences in terms of economic situation and living standards. Due to the differences among ethnic groups, the regional differences very

often. Obviously there are citizens from all over the country in the large cities with different ethnical backgrounds.

2.2 Demographic development

Table 1 - Basic demographic indicators

Table 1.1 Basic demographic indicators

Selected demographic indicators for Kenya, 1969, 1979, 1989, 1999, and 2009

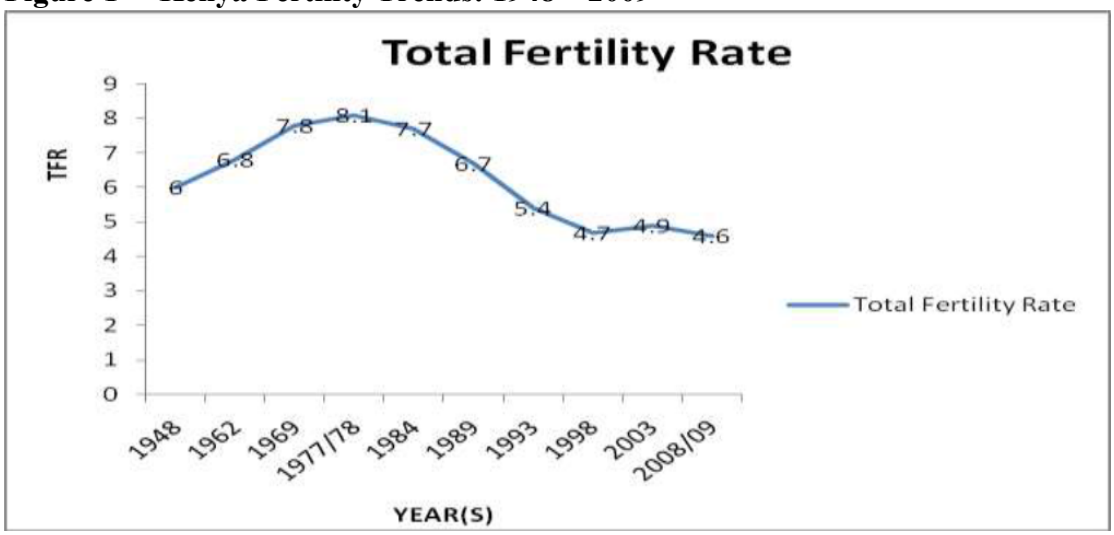
Indicator	1969	1979	1989	1999	2009
Population (millions)	10.9	16.2	23.2	28.7	39.4[a]
Density (pop./km²)	19.0	27.0	37.0	49.0	67.7[a]
Percent urban	9.9	15.1	18.1	19.4	21.0[a]
Crude birth rate	50.0	54.0	48.0	41.3	34.8[b]
Crude death rate	17.0	14.0	11.0	11.7	u
Inter-censal growth rate	3.3	3.8	3.4	2.9	2.8[a]
Total fertility rate	7.6	7.8	6.7	5.0	4.6[b]
Infant mortality rate (per 1,000 births)	119	88	66	77.3	52.0[b]
Life expectancy at birth	50	54	60	56.6	58.9[a]

[a] Revised projection figures
[b] KDHS results (see later chapters)
u = unknown
Source: CBS, 1970; CBS, 1981; CBS, 1994; CBS, 2002a

Source: Kenya Demographic and Health Survey 2008/9

As table 1 showed, the population of Kenya has continued to increase exponentially over time. Kenya was experiencing rapid population growth from its independence until the late 1990s. Kenya's population was 10.9 million in 1969, then tripled to almost 28.7 million by 1999 (Central Bureau of Statistics, 1994, 2001). At that time, economic growth was strong and the potentially harmful influence of high fertility rates and rapid population growth were alleviated. Previous census results showed that the annual population growth rate was declined from 3.4 percent per year in 1979-1989 periods to 2.9 percent per year during the 1989-1999 periods. Currently, the growth is estimated to be about 2.8 percent. Decline in population growth is a realization of the National Population Policy for Sustainable Development (National Commission on Population and Development, 2000). It's also the result to falling fertility levels over recent decades. Probably due to increased deaths from HIV / AIDS epidemic, the deterioration of health services, as well as widespread poverty (National Commission on Population and Development, 2000), the mortality rates rose from the 1980s. The crude birth rate increased from 50 births per 1,000 in 1969 to 54 births per 1,000 in 1979, but has since dropped to 48 births per 1,000 in 1989 and 41 births per 1,000 in 1999 respectively. The crude death rate increased from 11 deaths per 1,000 in 1979-1989 periods to 12 deaths per 1,000 in 1989-1999 periods. As a result of the high fertility and declining mortality in the past (the table 1 showed), the country is still characterized by a very youthful population structure.

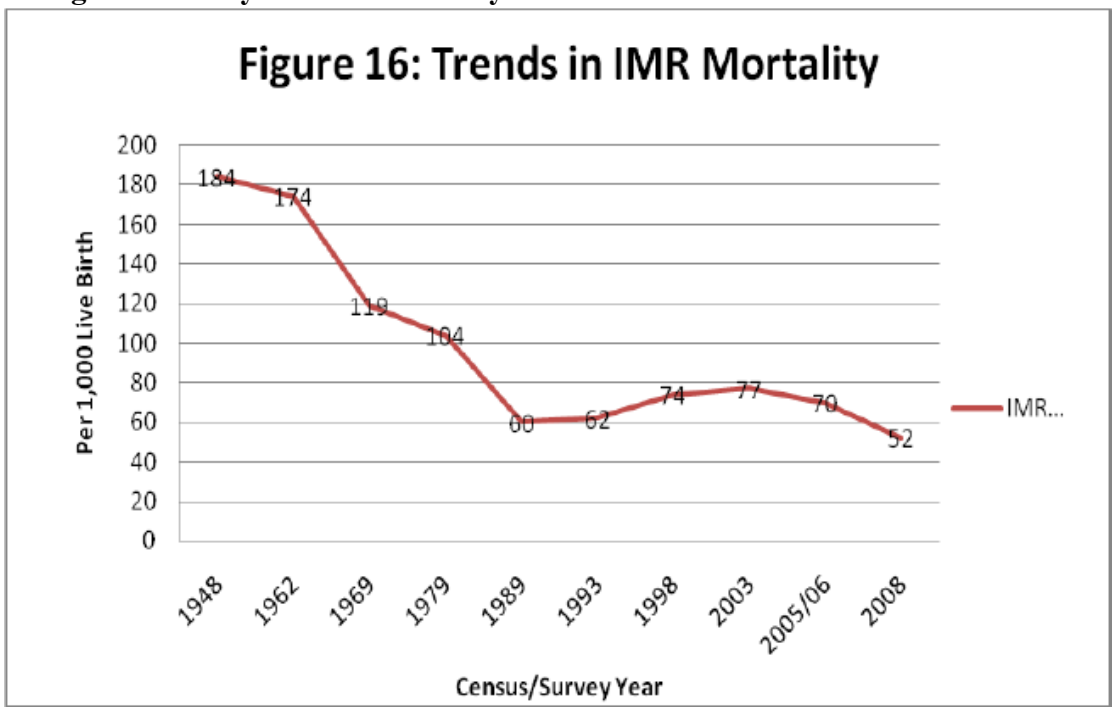
Figure 1 - Kenya Fertility Trends: 1948 - 2009



Source: KNBS-KFS, KDHS, Census Reports

From the figure 1, it shows the total fertility rate was stable around 8 until the 1980s, but then declined sharply from 8.1 per 1,000 in 1977/78 to 4.7 per 1,000 in 1998. The rapid fertility decline observed between 1978 and 1998 was as a result of substantial national and international support of the national FP program, including reinvigoration of the population policy. Then the total fertility rate increased marginally to 4.9 per 1,000 in 2003 and again declined slightly to 4.6 per 1,000 in 2008/2009.

Figure 2 - Kenya Infant Mortality Trends: 1948 - 2009



Source: KNBS-KFS, KDHS, Census Reports

The figure 2 presents infant mortality rate trends. It first declined rapidly from 119 deaths per 1,000 live births in 1969 to 88 deaths per 1,000 live births in 1979, and it declined again to 66 deaths per 1,000 live births in 1989. Nevertheless, the economic development stagnated due to both external and internal factors since the early 1990's. Living standards started to decline and the mortality trends of Kenya's children have unfortunately reflected the macroeconomic situation of the country (Hill, 2001), infant mortality rate increased to 77 deaths per 1,000 live births in 2003. Recent KDHS results indicate that it declined to 52 deaths per 1,000 in 2008/09.

2.3 Economic setting

The agricultural sector in Kenya contributes 25 percent of the Gross Domestic Product (GDP), while the manufacturing sector accounts for 13 percent of the GDP. In 2002, the main agricultural exports were coffee, tea and horticulture. The tourism industry has attributed much to improve the living standards of citizens. Kenya is a former British colony. In December 1963, it gained its independence. However, the GDP has declined from 7 percent to 2 percent after that. Many internal structural issues and external shocks have contributed to this weak performance, for example, the low commodity prices, and bad weather conditions hitting hard on the agricultural sector, as well as global recession and poor infrastructure. After 2002, the Kenyan economy began to recover. In 2007 reached the similar growth levels of the 1960s. However, due to the election in 2007 the economy growth was hit hard and soon began to decline. Due to the slow economic growth performance, it failed to keep pace with population growth, which contributed to a deterioration of the living standards and the overall welfare of the Kenyan people. At present, Kenyans are living below the absolute poverty line. It is estimated the number of poor people was 17 million in 2001. Since in 2003, the Kenyan government has launched the Economic Recovery Strategy for Wealth and Employment Creation so as to restore the economic growth, to generate employment opportunities and to decrease poverty levels (CBS, 2004).

2.4 Regional differences

Kenya is divided into 8 regions: North Eastern, Eastern, Coast, Rift Valley, Central, Western, Nyanza and Nairobi. There are great differences among these regions in terms of population, economy, natural resources and infrastructure. For example, a person born in the Central region can expect to live a 16 year longer than a person who born in Nyanza region (SID, 2004). The Kenyan provinces are different in many aspects. In order to obtain the better understanding that the similar inequalities might have an impact on infant mortality, the following section will mainly focus on a very brief description of the five most important regions.

Figure 3 - Map of Kenya

The Central province is an important region in central Kenya. This region is the ancestral home of the Kikuyu community. The central region is also home to many hard working small-holder farming communities and large agricultural estates.

The Eastern province is the second largest region in Kenya, which is mostly inhabited by the Bantu ethnic tribe Kamba. The region includes the Chalbi Desert, Mount Kenya, and the eastern half of Lake Turkana. The climate in the region is arid to semi-arid.

The Coast province is an important region since it was here the first white settlers entered the country. It is inhabited by the Mijikenda and Swahili, among others. The economy growth is mainly based on tourism and fishing (Mwakikagile, 2007).

The Nyanza province is located in the southwest part of Kenya and is inhabited by the Luos, Gusii, Kuria, Luyhas and Abasuba tribes. The region is endowed with abundant natural and human resources. The economy growth is mainly based on very light industry and cotton production. It is the poorest region in Kenya with poverty levels of 65 percent (SID, 2004).

The Nairobi province located on high latitude and tropical diseases such as malaria are rare. It differs a lot from the other provinces. The city of Nairobi is the main commercial center of the country. Nairobi has a well-developed infrastructure, including modern financial and communications system. The region is home to a verity of ethnic groups and social classes (Mwakikagile, 2007).

Regional differences in Kenya are manifested in wide forms. There are huge differences in terms of health outcomes in Kenya. KDHS 2008/9 presents the following mortality rates. It's important to minimize the infant mortality in regional disparities.

Table 2 - Mortality by provinces, per 1000 births 2008/9

Province	Neonatal Mortality (NN)	Postneonatal Mortality (PNN)	Infant Mortality ($_1q_0$)
Nairobi	48	12	60
Central	31	11	42
Coast	44	27	71
Eastern	31	8	39
Nyanza	39	56	95
Rift Valley	30	18	48
Western	24	41	65
North Eastern	33	24	57

Source: Kenya Demographic and Health Survey 2008/9

From the table 2, we can see variations in infant mortality exist across the provinces, with Nyanza province having the highest levels of infant mortality rates (95 deaths per 1,000), which is almost 2.5 times higher than Eastern province (39 deaths per 1,000). However, it is important to note the considerable declines in infant mortality rates in Nyanza province over the past five years. It has declined from 133 deaths per 1,000 since the 2003 KDHS to 95 deaths per 1,000. There also appears to have been a substantial decline in infant mortality rates for North Eastern province, which has declined from 91 deaths per 1,000 since the 2003 KDHS to 57 deaths per 1,000.

Besides, there are great differences in terms of educational attainment among the regions. The Gross Enrolment Ratio differs a lot between the regions. GER means the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. According to the Kenyan Ministry of Education, 2004, the central region has an enrollment rate of 96 percent whereas the North Eastern region has only 17 percent. According to Palloni (1991) study which estimated infant mortality rates by mothers education for districts in Kenya revealed that women with uneducated in poorer districts of South

Nyanza reported a higher mortality compared to the rate for the uneducated women in a better of Nyeri district, the uneducated mothers in Nyeri had lower infant mortality. There are also great differences in HIV prevalence rates among the regions. The HIV prevalence rate is 7 percent in Nairobi province and 13.9 percent in Nyanza province, compared with the rate is 3.5 percent in the Eastern province and 4.2 percent in the Coast province (KDHS, 2009). Also in terms of different health indicators, there are great disparities among the regions. Much more than half of all the births in Nyanza province or in the North Eastern province take place at home, compared with most births in Nairobi and in the Central region take place in the hospital or in a clinic. (SID, 2004)

It is also important for the overall economic development of a region to access to infrastructure. There are great differences in access to infrastructure among all the provinces in Kenya. From table 3, it shows the access of households to water and electricity by provinces in 2003. It is very unequal to access to water and electricity in Nairobi province, which the proportion of households with piped water in dwelling and electricity are greater than all other regions combined respectively. It's important to increase the proportion of people with access to good quality health care services.

Table 3 - Access to infrastructure by Province

Province	Piped water in dwelling	Electricity
Nairobi	**33**	**71**
Central	**12**	**19**
Coast	**8**	**19**
Eastern	**4**	**7**
North Eastern	**1**	**3**
Nyanza	**1**	**5**
Rift valley	**5**	**11**
Western	**1**	**2**

Source: SID, SIDA "Pulling apart facts and figures on inequality in Kenya" 2004

3. Theory

3.1 Building a Theoretical Framework

Infant mortality can be assessed and analyzed from many different starting points. In the literature, many different factors that directly or indirectly affect infant mortality have been emphasized. The survival of infants at birth and the subsequent months depends in a number of socio-economic, demographic and biological factors. Scholars have taken their starting point in the socio-economic and demographic as well as biological factors. In the half of 20th century, the debate focused on which extent the socio-economic and technological changes contribute to improve the health

status and mortality in developing countries (Menken, 1987). Caldwell (1979) took another starting point and instead emphasized the socio-economic factors, such as the importance of maternal education for the infant survival. He put up a theory that maternal education works through changing feeding and care practices, leading to better health seeking behavior and by changing the traditional familial relationships. Mortality and medical knowledge is not reflected in the socio-economic measures found by Preston (1975). Klaauw and Wang (2003) develop a flexible parametric framework for analyzing infant mortality. This framework is based on the widely used hazard rate models, which extend with two features. First, the model allows socio-economic and environmental characteristics to have different impacts on infant. Second, they allow for frailty at multiple levels, which can be associated with each other. Their model predicts that a significant number of infant deaths can be avoided by improving the women's education, providing access to electricity, sanitation facilities and reducing indoor air pollution. In particular, reducing indoor air pollution and increasing the educational level of women might have significant impacts on infant mortality. A more recent framework, Commission of Social Determinants of Health (WHO, 2008) was established to support countries and global health partners to address the social factors leading to ill health and inequities. The determinants are the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels. However, the social determinants of health are mostly responsible for health inequities - the unfair and avoidable differences in health status seen within and between countries, eliminate the poverty.

Mosley & Chen (1984) take the analysis in a further step and argue that social scientists tend to ignore the biological factors through which socio-economic factors that need to operate in order to influence mortality. They also criticized the medical research only focused on specific diseases or biological mechanisms. Instead, they created a framework for analysis combining both socio-economic and biomedical factors.

The theoretical framework by Mosley and Chen (1984) is often used as a theoretical basis and framework is based on several premises:

1 In an optimal setting, over 97% of newborn infants can be expected to survive through the first five years of life.

2 Reduction of the probability of surviving is due to the operation of economic, biological, social and environmental factors.

3 The socio-economic factors only operate through a number of proximate determinants (biomedical factors).

In the analytical framework, the health of infants would be affected by exogenous and endogenous factors by an underlying assumption. According to Schultz (1984), exogenous factors are mainly of socio-economic character, while the endogenous are as known as biomedical. The socio-economic factors are considered indirect affect infant mortality, since they play a role by operating through the biomedical determinants. The biomedical factors are often referred to the proximate determinants, because

they constitute the middle step through which the exogenous factors operate.

Mosley & Chen identified a set of 14 proximate determinants directly affect the morbidity and mortality among infant and children. All social and economic determinants must operate through these variables to influence child survival. These proximate factors can grouped into five categories: 1 Maternal factors; 2 Environmental contamination; 3 Nutrient deficiency; 4 Injury; 5 Personal illness control.

- *Maternal factors:* age; parity; birth interval.
- *Environmental contamination:* air; food/water/fingers; skin/soil/inanimate objects; insect vectors.
- *Nutrient deficiency:* calories; protein; micronutrients (vitamins and minerals).
- *Injury:* accidental; intentional.
- *Personal illness control:* personal preventive measure; medical treatment.

Each of the maternal factors (age, parity and birth interval) has been exert an independent influence on pregnancy outcome and infant survival through its effects on maternal health. Environmental contamination refers to the transmission of infectious agents to children. Air, food, water and insects are four categories representing the main routes whereby these agents are transmitted to the human host. Nutrient deficiency relates to the calories, protein and micronutrients intake. A child's nutritional intake depends on the mother during pregnancy and breastfeeding is very important. Injury involved physical injury, burns, and poisoning. Most accidental injuries are unintentional. However some are deliberately caused by the most extreme cases of infanticide. Personal illness control involves preventive measures to avoid disease. These include observing taboos, as well as immunization or malaria prophylaxis.

The framework includes socio-economic determinants are divided into three groups:

- *Individual level variables:* individual productivity (fathers, mothers); traditions/norms/attitudes.
- *Household level variables:* income/wealth.
- *Community level variables:* ecological setting; political economy; health system.

Three elements that determine individual productivity are referred to as skills, health and time. Skills are typically measured by educational level of fathers and mothers. For fathers, particularly in the urban areas, educational levels usually correlate strongly with occupation, and therefore with household income. Thus father’s education is an important determinant of the household’s assets. In many cases, health effects have strong relationship with father’s education due to the operations on the proximate determinants through the income effects. Father’s education may affect child survival by influencing the choice of consumption goods, including child care services. However, mother's education does not necessarily affect the child's health through family asset management. On the contrary, due to

the biological link between mother and child during pregnancy and breastfeeding, the health and nutritional conditions of the mother influence directly the child's health. Educated mothers have a practice on health care, such as hygiene, preventive health care, nutrition. For the purpose of having a healthy child, mother needs to take much time for different nursing practice, such as visiting the clinic, food preparation, bathing children and more knowledge. There is often a sharp division of labor between men and women in traditional societies, which tends to maximize the mother's time for the children. However, in many transitional societies, much of the mother's time is needed for income-generating activities and little time left to take the children (Birdsall, Greevey 1978). The consequence of mothers working outside the home depends largely on the overall economic situation of the family. For poor families, mothers work outside may lead to child neglect, and a wealthy family can hire a baby-sitter's care of children.

The second individual level variables in analytical framework are proposed
traditional / norms / attitudes that influence personal choices and health outcomes of the individuals. In most traditional societies the mother has full responsibility for child care result in she may have little control over allocation of resources to herself or her child (Safilios-Rothschild, 1980). Besides, most decisions in these areas are reserved for the elders. One key change this concept in traditional societies produced by maternal education is a shift. It is important for children's survival that the mother not only has the basic responsibility to care for children, but also has some power over the basic household purchases and health care practices. Another important factor is the child's values. The value of boys and girls is different from country or cultural according to Mosley & Chen (1984). Marriage expectations can be a major economic factor in child survival. Kenya is brought forward as an example where girls have a higher value due to the high cost of dowry needed to marry the girl. The third cultural determinant proposed is traditional food preferences may have a negative impact on child survival. Food preferences can assume importance in many developing countries, food taboos are practiced during pregnancy and breastfeeding, of course, has a negative effect on child survival.

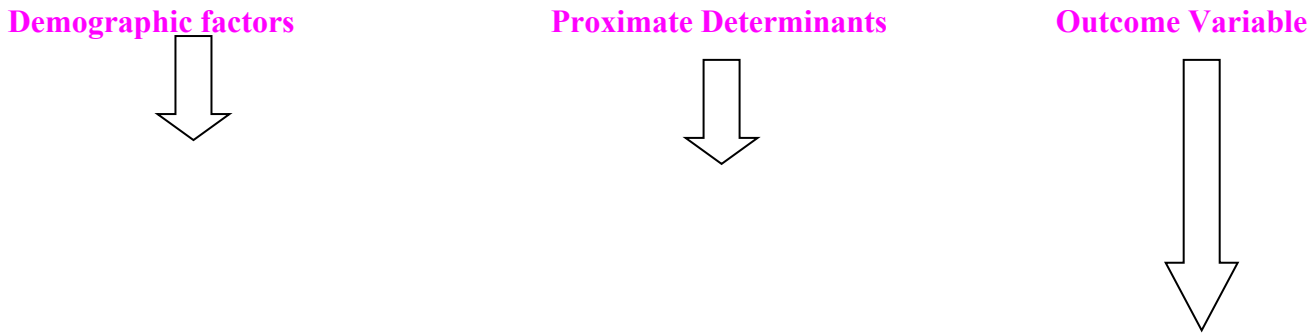
As for the household level variables, as mentioned by Mosley & Chen, are described as *"A variety of goods, services, and assets at the household level operate on child health and mortality through the proximate determinants."* Access to and use of health facilities and piped water are some of the mediating factors for majority affect the child's health. The size and quality of the house are important too. Poor ventilation and overcrowded housing is deemed to adversely affect children's health. Other goods and services made with preventive care, such as showers and soap-related merchandise. According to Mosley & Chen, children growing up in household with such good experience may have a lower risk of dying.

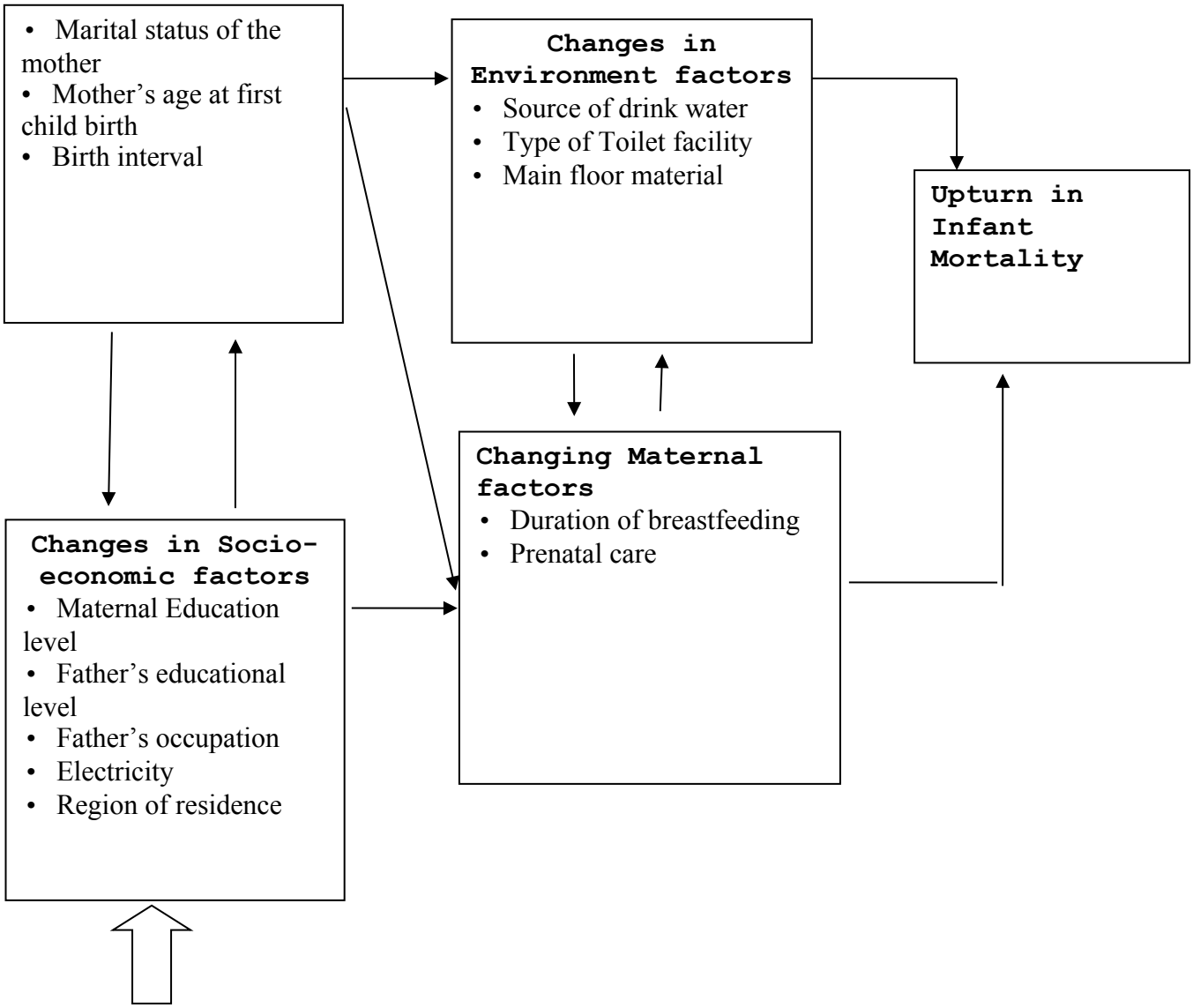
Framework for socio-economic variables of the third group is made at the community level variables. It includes the ecological, political and health system variables that might determine the child health outcomes. The ecological factors include climate, soil, rainfall, temperature, altitude and

seasonality, these variables can have a strong impact on child survival by affecting not only the quantity and variety of food crops produced, the availability and quality of water, but also the availability of income-generating work for the parents. The political factors can operate to influence child survival including organization of production, physical infrastructure, political institutions. The quality of infrastructure such as better toilet facilities, better quality housing floor materials and less contaminated water have been found to have statistically significant negative association with infant death (Koyugi, 1992).

The mechanism through which different determinants operate to affect infant and child mortality are complex due to synergism of social, economic and biological process. Various conceptual model / theoretical framework have been developed by different authors on the study of child survival (Mosley and Chen, 1984; Schultz, 1985; Jain, 1985). Among the various works of the theoretical frame, the proximate determinant frame work developed by Mosley & Chen is the most widely used model. Finally, the Mosley & Chen framework and its variants is the most widely used framework for studying mortality changes. Below is the conceptual framework I adopted in guiding this paper.

Table 4 - The Operational Framework for Studying Infant Mortality in Kenya





3.2 Previous research

3.2.1 Socio-economic determinants

Several researchers using data from African countries had established that the educational attainment of parents has negative effects on infant mortality. Caldwell (1979) reported that the mother's education reducing the child mortality. He proposed a theory that mother's education works through changing feeding and care practices, leading to changes in traditional family relationship and better medical practices. Kibet (1981) investigated factors influencing infant mortality at the macro-level using districts level data. He found out that infant mortality is significant related to education. The study concluded that the mortality differentials among

regions in Kenya were partly as a result of the existing educational differentials among the regions. However, in his study on the "impacts of household and community level environmental factors on infant and child mortality in rural Kenyan", Koyugi (1992) observed that maternal education of under nine years had insignificant protective effects on infant mortality. Devlieger (2005) showed mysterious conclusions that effect of father's educational level on child survival is weaker in sub-Saharan Africa. Tulasidhar (1993) used data of censuses showed the mortality differential by maternal education. Adetunji (1995) examined the Demographic Healthy Survey 1986-1987 using birth history data from 2,635 women aged 15-49. The study showed that infant mortality is higher in those born to mothers with secondary education compared to uneducated mothers. Studies by Hobcraft, McDonald and Rustein (1984) and Mosley (1984) shows that in Kenya, the increase infant mortality associated with a low level of maternal education is greater in the poor regions of the country. Economists have tended to emphasize that maternal education operates through the allocation of material time to market and non- market activities. By increasing women's education and strengthening potential returns from work can stimulate labor force participation. In return, the working mother has less time to take care of child but increase the family's economic resources, which might have beneficial effects on child health. A generalized liner models used to associate socio-economic variables with the neonatal, post-neonatal and infant mortality rates found that father's occupation and education were associated with both neonatal and post-neonatal mortality (Hobcraft J.N., et al., 1984).

3.2.2 Demographic determinants

Results of the review researches show that demographic factors such as age at birth, parity, and birth interval have a significant relationship with infant mortality. Especially significant is the birth interval which infant is born within two years of another child, both children are at greater risk of dying (Chidambaram V.C. et al., 1985). The infant health is affected by the mother's age at birth. The high infant mortality occurs women who below 20 years old due to biological immaturity and inability to care for their children as well as economic instability or lack of experience of motherhood. If child bearing is limited to the best ages of 20 to 34, then not only maternal mortality, but also infant mortality can be reduced to the lowest possible levels (Hemant Tiwari, 1989). The analysis of Gujarat NFHS (1992-1993) data demonstrated that the demographic variables like mother's first age at birth and previous birth interval are directly associated with infant deaths (Patel R.M., 2000). According to UN statistics, nearly 40% of all children under five deaths occur in the first month of life. Two thirds of all death in the first month occurs in the first week and two thirds of those within the first 24 hours of life. Mutunga (2004) found that child survival was found better for those who were of birth order 2-3, birth interval more than 2 years, not outcomes of multiple births. A Tanzanian study had shown demographic factors such as short birth interval (less than 2 years), teenage pregnancies (<20 years) and previous child death were all significantly associated with increased infant mortality. A study on the

correlation between infant mortality and socioeconomic, demographic, cultural factors conducted in 11 villages in East Godavari (developed) and 21 villages in Medak (undeveloped) districts of Andhra showed that maternal age, birth order, birth interval, age, and sex of the child were important demographic determinants of infant mortality. Poor chances of survival were given to births at a young mother with a first birth. Only in Medak increased birth interval contributed to lower infant mortality (Sandhya S, 1991). Some researchers have stated that those women who have children in rather quick succession (shorter birth intervals) also experience higher infant mortality. However, there seems to be a lack of consensus in taking infant mortality level as the most important indicator not only for assessing the quality of public health services but also for assessing the all development status of population. In addition to this, some studies also suggest that environmental factors play a crucial role in determining early childhood mortality levels, which, besides infant mortality, also reflect the overall health status of the population. Incidentally, in comparison to the later gage, the gaps between levels of mortality during infancy and early childhood are widest across developed and developing nations (Lahiri S. and Ram U., 2006).

3.2.3 Proximate determinants

"West African societies" studied by Harrington's (1974) views an infant's chances of survival as the outcome of a series of factors governing exposure to diseases and those encompassing the course and outcomes of diseases among them, he notes, the type of dwellings which mainly affects mortality through the elements of exposure. Farah and Preston (1982) finds living in a house which made from mud in Sudan raises significantly the infant's mortality by a statistically 6% in the capital and 7% at the national level. A study on the relative role of public health program in influencing infant mortality in Kenya used selected proximate variables. The study has used data mainly from the 1993 Kenya Demographic and Health Surveys, logistic analysis has revealed that survival through infancy is dependent on certain proximate variables like maternal condition, prenatal care, infant feeding practices, malnutrition and environmental sanitation. Multivariate analysis has revealed the important role of proximate factors in the reduction of infant mortality. Finally, the direct, indirect and total effect of various independent variables on the dependent variable though path analysis were identified. These findings suggest that it is the effective utilization of the available public health services that has resulted in reducing infant mortality in the country (Das N.P., 1996). According to Mosley & Chen (1984) the environment factor has a great impact on child survival. It will be faster for the spread of disease in an unhealthy environment such as water and toilet facilities are of very importance for the analysis of infant mortality. Espo (2002) used logistic regression to assess associations between morbidity and various linear or dichotomous environmental predictor variables. The results showed that source of drinking water and sanitation facilities were strong predictors of infant mortality.

3.4 Hypothesis

Regarding a theoretical model and review previous research in the field combined with the information regarding Kenya, a few more hypotheses based on the available data will be considered and tested in the empirical analysis:

Demographic factors:
• Infants born to mothers that are married experience a lower risk of dying than women who are not married
• Infants born to very young mothers (<19 years) experience a higher risk of dying.
• Infants born in a shorter birth interval (<24 months) experience a higher risk of dying.

Socio-economic factors:
• Infants born to parents with a higher degree of education experience a lower risk of dying.
• Infants born to fathers with a higher degree of occupation experience a lower risk of dying.
• Infants born into households with electricity experience a lower risk of dying.
• Infants born in the Nyanza regions experience a higher risk of dying.

Proximate factors:
• Infants born in household with taped water, flush toilet experience a lower risk of dying.
• Infants born in household with earth floor experience a higher risk of dying.
• Infants that are breastfed more than six months experience a lower risk of dying.
• Infants born to mothers that have received prenatal care, experience a lower risk of dying.

4. Data

I briefly summarize the data to be used in the empirical analyses. The data from the Kenya Demographic and Health Surveys 2003 and 2008/9 will be used for this study. The data set consists of a national representative sample of household level data. The two surveys comprising women age 15-49 and men age 15-59. In the 2003 Kenya Demographic and Health Survey 9,865 households were selected, 8,195 women and 3,578 were interviewed. For the 2008/9, 9,936 households were selected, 8,444 women and 3,910 men were interviewed. The KDHS data provides socio-economic information about the mother and her household, such maternal education level, the household's ownership of selected material assets, and where the household lives. The two surveys contain the detailed information about women aged 15-49, coving topics such as education, fertility levels, marriage, sexual activity, fertility preferences, awareness and use of family planning

methods, breastfeeding practices, nutritional status etc. All qualified women are asked about their birth history, providing information about the date of birth, survival status and, if dead, date of death of each infant reported by a woman. The birth history provides information about demographic characteristics of the child, such as sex, age of mother at the time of the birth, birth order of the child, and preceding birth interval. The data to be used in the empirical analysis is mainly derived from the woman's information. The two surveys record information about health variables for births (to interviewed, surviving women) in defined periods prior to the survey.

4.1 Possible data quality problems

As mentioned earlier, this study use the birth history data of the respondents (mothers) from KDHS. The KDHS 2003 data was evaluated by the WHO (2008) and a frequent underestimation of events was found. Differences in sample implementation lead to underestimation of fertility in both sample surveys. In addition, some problems such as omission of child births, it can be omitted for either deliberately or by accident (KDHS, 2008/9). Very often are not all birth of a woman properly reported, neither are all children that have died.

5. Methods

5.1 Statistical Model

In this analysis the dependent variable is binary of nature since there are two different outcomes, a child either survives the first year, or dies. Thus, a logistic regression model is applied for the statistical analysis. It was used in the study to estimate the likelihood of infant survival in view of the prevailing socio-economic and demographic as well as biological factors in the mortality regions. It is used to determine the relationship between selected independent variables and infant death. The p value selected is 0.05. In any observed significance which was less than the p value, it was concluded that there is an association between the dependence and independent variables, while that larger than the p value of 0.05 was taken as indicating no association between the variables. STATA directly calculates odds ratios and the odds ratio is the change in odds for a unit change in the predictor. That is, when the odds ratio is less than 1, increasing values of the variable correspond to decreasing odds of the events occurrence (infant death). When the odds ratio is greater than 1, increasing values of the variable means increasing likelihood of the occurrence.

The equation predicts the probability p of an outcome from a set of independent variables. P always has a value between 0 and 1. The logistic regression model predicts logit(P) as:

$$\text{Logit}(p) = \log(p/1\text{-}p)$$
$$\text{logit}(P) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_pX_p$$

logit(P): is the probability of infant death and p is dichotomous that have a value 0 or 1
$b_0 \ldots b_p$: is the coefficient of the independent variables
$X_1 \ldots X_p$: refer to the socio-economic, demographic, biomedical factors of infant mortality

Control variables are introduced in order to assess the impact of the various factors on the risk of infant mortality. The model for the empirical analyses is classified to two parts. The first basic model consists of bio-demographic variables for the year 2003 and 2008/9 separately. The second model incorporates socio-economic variables with proximate variables.

5.2 Definition of variables

Selected variables from the KDHS dataset are used to establish a model and socio-economic, proximate and demographic variables can be found in the dataset. From the back drop of the theoretical framework the following variables are created:

5.2.1 Dependent variable

The information on children and childbearing was collected in the Women's questionnaire of the KDHS surveys. First, there is information on the respondents (mothers) to sum childbearing experience. Information such as how many children were ever born, how many of both sexes, the number that has died, can be found. Furthermore, there is more detailed information for all birth, such as, month and year of birth, current age (or age at death) and the child's gender. The dependent variable is the probability of dying between the child's birth and he/she first birth day. As mentioned above the dependent variable is dichotomous, noted as 1 if the occurrence of the infant death and noted as 0 if death has not occurred. The total number of live births considered for this study were 4,495 and 6,612 with 358 (7.96 percent) and 342 (5.18 percent) of infant deaths occurred during the preceding five years of the study periods (1999-2003 and 2004 -2008) respectively.

5.2.2 Independent variables

The independent variables are described below. According to Mosley & Chen (1984), I divided into three categories of socio-economic, demographic and proximate determinants.

Current Marital Status: This variable refers to whether a woman is married. The variable is categorized into two categories: not married (0), married (1)

Mother's age at first child birth: This variable refers to the age in years of the mother at the time her first birth occurred. The variable is categorized into two categories: <19 years (1), >19 years (0)

Birth interval: This variable refers to the length in months of the preceding birth before the index child. The variable is categorized into two categories: <24 months (1), >24 months (0)

Maternal education level: This variable refers to the highest educational level attained by the mother. The variable is categorized into two categories: primary or less (0), secondary or higher (1)

Father's educational level: This variable refers to the highest educational level attained by the father. The variable is categorized into two categories: primary or less (0), secondary or higher (1)

Father's occupation: This variable refers to work status category of the father at the time of the survey. The variable is categorized into two categories: blue collar (0), white collar (1)

Electricity: The variable is categorized into two categories: no (0), yes (1)

Region of residence: This variable refers to also a good measurement of income. The variable is categorized into two categories: Nyanza (R), Central (1), Coast (2), Eastern (3), Nairobi (4), N. East (5), R. Valley (6), Western (7)

Source of drinking water: This variable is defined as the source of water for drinking in the sampled household. The variable is categorized into two categories: other (0), tap (1)

Type of housing floor material: This variable indicating the main materials used for constructing the floor of the house. The variable is categorized into two categories: other (0), earth (1)

Type of toilet facility: This variable refers to the household dispose human excreta. Like water source and floor materials, this means capture disease causing agents and a proxy for economic status of the household. The variable is categorized into two categories: other (0), flush (1)

Duration of breastfeeding: The variable refers to nutrition intake. Children are to be breastfed the first six months of their life as a minimum, and other kinds of feeding practices are discouraged (WHO). The variable is categorized into two categories: <6 months (0), >6 months (1)

Prenatal care: The variable refers to the regular medical and nursing care recommended for women during pregnancy. The variable is categorized into two categories: no (0), yes (1)

These are some of the variables that were found to have changed the most during the 2003-2008/9 and hence were likely to be associated with the decline in infant mortality.

Table 5 - Changes in infant Mortality Rates by selected covariates (KDHS, 2003 - 2008/9)

Changes in infant Mortality Rates by selected covariates (KDHS, 2003 - 2008/9)		
Variable	**1999-2003 (%)**	**2004-2008/9 (%)**
Current Marital Status		
Not married (0)	17.2	25.1
Married (1)	82.8	74.9
Mother's age at first child birth		
<19 years (0)	21.0	19.3
>19 years (1)	79.0	80.7
Birth interval		
<24 months (0)	19.9	23.1
>24 months (1)	80.1	76.9
Maternal education level		
Primary or less (0)	81.6	26.5
Secondary or higher (1)	18.4	73.5
Father's educational level		
Primary or less (0)	66.9	65.7
Secondary or higher (1)	33.1	34.3
Father's occupation		
Blue collar (0)	78.0	76.2
Whiter collar (1)	22.0	23.8
Electricity		
No (0)	90.3	84.1
Yes (1)	9.7	15.9
Region		
Nyanza (R)	18.1	15.8
Central (1)	15.3	11.3
Coast (2)	9.4	11.8
Eastern (3)	13.1	11.8
Nairobi (4)	10.0	9.3
N. East (5)	2.6	7.6
R. Valley (6)	15.2	19.1
Western (7)	16.3	13.3
Source of drinking water		
Other (0)	63.7	72.6
Tap (1)	36.3	27.4
Type of housing floor material		
Other (0)	28.7	32.6
Earth (1)	71.3	67.4
Type of toilet facility		
Other (0)	90.7	90.9
Flush (1)	9.3	9.1
Duration of breastfeeding		
<6 months (0)	46.3	46.2
>6 months (1)	53.7	53.8
Prenatal care		
No (0)	48.4	48.0
Yes (1)	51.6	52.0
Source: Kenya National Bureau of Statistics, KDHS 2003-2008/9 Data.		

6. Statistical Analysis

In this section the statistical analysis will be conducted in order to be able to answer the research question set up in the introduction. The dataset at hand is extensive with numerous variables and observations. As mentioned earlier the aim of this study is to investigate the impact of socio-economic and bio-demographic (proximate) determinants on the risk infant mortality of children born in the previous five years period of 2003 and 2008/9. The empirical analysis will be divided into two parts. First the basic model contains of most of the proximate (bio-demographic) variables for the year 2003 and 2008/9 separately. The second model adds socio-economic variables with proximate variables.

• Model (a): Infant mortality basic model + proximate variables + survey year
Infant mortality= marital status, mother's age at first birth, birth interval, source of drinking water, type of toilet facility, type of floor material, duration of breastfeeding, prenatal care

This will be followed by an analysis of the basic model together with the socioeconomic variables.

• Model (b): Infant mortality basic model + proximate variables + socio-economic variables + survey year.
Infant mortality= marital status, mother's age at first birth, birth interval, source of drinking water, type of toilet facility, type of floor material, duration of breastfeeding, prenatal care, maternal education level, father's educational level, father's occupation, electricity, region of residence

6.1 Expectations

The estimations for how each of the variables will affect the dependent variables will be listed here. Table 6 provides an overview of the expected odds ratios for each variable.

Table 6 – Expected odds ratios for each variable

Expected odds ratios for each variable								
Variable	**Sign**	**Rational**						
1. Marital status	-	Infants born to mothers that are married experience a lower risk of dying						
2. Mother's age at 1st birth	+	Infants born to very young mothers (<19 years) experience a higher risk of dying						
3. Birth interval	+	Infants born in a shorter birth interval (<24 months) experience a higher risk of dying						
4. Drinking water	-	Infants experience a lower risk of dying due to water from the tap decrease the spread of bacteria						
5. Floor	+	Infants living in a house with earth floor experience a higher risk of dying due to the spread of bacteria						
6. Toilet	-	Infants experience a lower risk of dying due to flush toilet decreases spread of bacteria						
7. Breastfeeding	-	Infants that are breastfed more than six months experience a lower risk of dying						
8. Prenatal care	-	Infants born to mothers that have received prenatal care, experience a lower risk of dying						
9. Maternal education	-	Infants born to mothers with a higher degree of education experience a lower risk of dying						
10. Father's education	-	Infants born to fathers with a higher degree of education experience a lower risk of dying						
11. Father's occupation	-	Infants born to fathers with a higher degree of occupation experience a lower risk of dying						
12. Electricity	+	Infants born into households with no electricity experience a higher risk of dying						
13. Region	+	Infants born in the Nyanza regions experience a higher risk of dying						

6.2 Statistical analysis

In this section, the statistical results of the logistic regression models will be conducted in order to answer the research question set up in the introduction. The first model for infant mortality includes only the bio-demographic determinants for 2003 and 2008/9 separately. This set up the significant proximate determinants of infant mortality. The second model for infant mortality adds control of socio-economic variables. The regression results for all models are shown in table 7 to 8 followed by the brief discussion of the results.

Table 7 - *Results from the Logistic analysis, a - Infant Mortality (2003)*

Results from the Logistic analysis, a - Infant Mortality (2003)				
No.	**Variable**	**Category**	**Odds Ratio**	**P - value**
A.	***Basic Model+proximate variables***			
1	Marital status	Not Married	1.00	-
		Married	0.99	0.941
2	Mother's age at fist child birth	>19	1.00	-
		<19	1.28	0.011*
3	Birth interval	>24 months	1.00	-
		<24 months	1.03	0.069
4	Source of drinking water	Other	1.00	-
		Tap	0.84	0.139
5	Source of toilet facility	Other	1.00	-
		Flush	0.77	0.175
6	Source of floor material	Other	1.00	-
		Earth	1.10	0.344
7	Duration of breastfeeding	Less than six months	1.00	-
		More than six months	0.45	0.000*
8	Prenatal care	No	1.00	-
		Yes	0.71	0.000*
Pseudo R2: 0.0198				
B.	***Basic + proximate variables + socioeconomic variables***			
1	Marital status	Not Married	1.00	-
		Married	1.12	0.638
2	Mother's age at first child birth	>19	1.00	-
		<19	1.42	0.025*
3	Birth interval	>24 months	1.00	-
		<24 months	1.22	0.166
4	Source of drinking water	Other	1.00	-
		Tap	0.80	0.105
5	Source of toilet facility	Other	1.00	-
		Flush	0.74	0.223
6	Source of floor material	Other	1.00	-
		Earth	1.18	0.367
7	Duration of breastfeeding	Less than six months	1.00	-
		More than six months	0.33	0.000*
8	Prenatal care	No	1.00	-
		Yes	0.69	0.004*
9	Maternal education level	Primary or less	1.00	-
		Secondary or higher	0.91	0.683
10	Father's educational level	Primary or less	1.00	-
		Secondary or higher	0.95	0.970
11	Father's occupation	Blue collar	1.00	-
		White collar	0.79	0.024*
12	Electricity	Yes	1.00	-
		No	0.90	0.699
13	Region of residence	Nyanza	1.00	-
		Central	0.38	0.000*
		Coast	0.88	0.468
		Eastern	0.34	0.000*
		Nairobi	0.69	0.142
		North Eastern	0.86	0.218
		Rift Valley	0.69	0.123
		Western	0.30	0.000*
Pseudo R2: 0.0454				
* **Significant relationship** P - value <0.05				

6.2.1 Infant mortality for the previous five year period before 2003 statistical analysis

Table 6 above shows the results of logistic regression analysis for the 2003. Starting out with the basic model, the demographic variables in the basic model concerned with “mother’s age at first child birth” shows a significant effect on infant mortality. Infants born with mothers who are younger than 19 years old at the first birth experience were associated with a 42 percent increased risk of dying. The variable “marital status” and “birth interval” showed no significant relationship. Turning to the proximate determinants, the results show that effects are significant for breastfeeding and prenatal care. Using less than 6 months as a reference, infants that has been breastfed more than six months are associated with a 67 percent decreased risk of dying. At the same time, there is a similar relationship with the variable “prenatal care”. Infants born to a mother that has received prenatal care before giving birth have a reduced risk (about 31 percent) of surviving. Contrary to what was hypothesized, the results indicated that the variables “source of drinking water”, “type of housing floor material”, “type of toile facility” have no significant effect on infant death.

The socio-economic variables show some significant associations. Turning to “maternal education level” and “father’s educational level”, these two variables are insignificant with the infant mortality. In addition, it indicates that there is a significant relationship between “father’s occupation” and infant mortality. The results show that children belonging to fathers with white collar had a reduced risk (about 21 percent) of surviving compared to belonging to fathers with blue collar. While it was not found the variable “electricity” has significant effect on the risk of infant death. There is a significant relationship between infant mortality and region of residence. All Kenyan regions in the regression were compared to the Nyanza region, which was described as a region with a lot of poverty in the background section. Children born in some other Kenyan regions experience a lower likelihood of dying compared to a child in the Nyanza region. For instance, infants born in the Central region experience a reducing 62 probability of dying compared to those infants born in Nyanza. At the same time, infants from Eastern region experience a reducing 66 probability of dying. The Western region also showed significant association which is about 70 percent less likely to die. It means infants born in these three regions experience a decreased ratio of dying compared with the reference region Nyanza.

Table 7 - *Results from the Logistic analysis, a - Infant Mortality (2008/9)*

Results from the Logistic analysis, a - Infant Mortality (2008/9)				
No.	**Variable**	**Category**	**Odds Ratio**	**P - value**
A.	***Basic Model+proximate variables***			
1	Marital status	Not Married	1.00	-
		Married	1.02	0.827
2	Mother's age at first child birth	>19	1.00	-
		<19	1.38	0.001*
3	Birth interval	>24 months	1.00	-
		<24 months	1.01	0.259
4	Source of drinking water	Other	1.00	-
		Tap	0.08	0.073
5	Source of toilet facility	Other	1.00	-
		Flush	0.75	0.071
6	Source of floor material	Other	1.00	-
		Earth	1.16	0.146
7	Duration of breastfeeding	Less than six months	1.00	-
		More than six months	0.59	0.000*
8	Prenatal care	No	1.00	-
		Yes	0.76	0.001*
Pseudo R2: 0.0283				
B.	***Basic + proximate variables + socioeconomic variables***			
1	Marital status	Not Married	1.00	-
		Married	1.12	0.638
2	Mother's age at first child birth	>19	1.00	-
		<19	1.27	0.049*
3	Birth interval	>24 months	1.00	-
		<24 months	1.30	0.176
4	Source of drinking water	Other	1.00	-
		Tap	0.84	0.194
5	Source of toilet facility	Other	1.00	-
		Flush	0.67	0.126
6	Source of floor material	Other	1.00	-
		Earth	1.22	0.171
7	Duration of breastfeeding	Less than six months	1.00	-
		More than six months	0.32	0.000*
8	Prenatal care	No	1.00	-
		Yes	0.70	0.002*
9	Maternal education level	Primary or less	1.00	-
		Secondary or higher	0.88	0.042*
10	Father's educational level	Primary or less	1.00	-
		Secondary or higher	0.73	0.025*
11	Father's occupation	Blue collar	1.00	-
		White collar	0.78	0.048*
12	Electricity	Yes	1.00	-
		No	0.99	0.999
13	Region of residence	Nyanza	1.00	-
		Central	0.31	0.006*
		Coast	0.67	0.914
		Eastern	0.39	0.001*
		Nairobi	0.60	0.101
		North Eastern	0.73	0.056
		Rift Valley	0.33	0.002*
		Western	0.78	0.011*
Pseudo R2: 0.0428				
*** Significant relationship** P - value <0.05				

6.2.2 Infant mortality for the previous five year period before 2008/9 statistical analysis

Table 7 above shows the results of logistic regression analysis for the 2008/9. The results are quite similar with 2003. In the infant mortality basic model that controlled the proximate determinants as shown in table, the variable "mother's age at first child birth" was negatively associated with infant mortality rate. Infants born with mothers who are younger than 19 years old at the first birth experience were increased by about 27 percent risk of dying. The variable "marital status" and "birth interval" also showed no significant relationship. Breastfeeding is a power full factor that decrease infant mortality in the case of Kenya, the result shows that who have been breastfed more than six months are lower the risk of dying at the infant age period by approximately 68 percent relative to children who breastfed less than 6 moths. This explains in the case of Kenya, breastfeeding is prolonged practice and a strong and important factor for child survival. At the same time, there is a similar relationship with the variable "prenatal care". Infants born to a mother that has received prenatal care before giving birth reduced the risk of infant mortality by 30 percent. The results opposed the expectation with respect to the previous literatures that the variables "source of drinking water", "type of housing floor material", "type of toile facility" have significant effect on infant death.

Turning to "maternal education level", the result is different with 2003. It was significant with the infant mortality. Infants born with mothers have secondary education or higher level have a significantly lower the risk of infant mortality relative to those mothers who have attained no education or primary education. The relative risk is 0.88. On the other hand, it indicates that there is a significant relationship between "father's educational level" and infant mortality. The odds ratio indicates that children born with fathers have secondary education or higher level have a lower the risk of infant mortality by about 27 percent, relative to those fathers who have attained no education or primary education. Besides, the variable "father's occupation" also showed a significant relationship, the results show that children belonging to fathers with white collar had a lower risk of infant mortality relative to those fathers with blue collar, which reduced the risk of infant mortality by about 22 percent. While it was not found the variable "electricity" has significant effect on the risk of infant death as well. With regard to "region of residence" variable, there showed a significant relationship. Infants born in the Central region experience a reducing 69 probability of dying compared to those infants born in Nyanza. At the same time, infants from Eastern region reduced by 61 probability of dying. The Rift Valley region and Western region also showed significant association which reduced infant mortality by 67 percent, 22 percent respectively. It means infants born in these regions experience a decreased ratio of dying compared with the reference region Nyanza.

7. Discussion

This study has examined infant mortality in Kenya in 2003 and 2008/9, a number of interesting results have been reached. The aim of this paper was to investigate the bio-demographic (proximate) and socio-economic factors impact on infant mortality. Based on the previous research in the field and an analytical model by Mosley & Chen (1984) a number of variables that most likely affect mortality levels in Kenya were identified and tested, the following conclusions can be made:

7.1 Socio-economic factors

A number of socio-economic determinants turned out to be important determinants of infant mortality in Kenya.

The variable "maternal education level" and "father's educational level" were underlying assumption: the higher level of education, the better achievement of childcare practices. It could intend to capture knowledge level of childcare. The results of this study support the hypothesis "Infants born to parents with a higher degree of education experience a decreased risk of dying". However, these two variables only significantly correlated with infant mortality for previous five period of 2008/9. The variable "father's occupation" was underlying assumption: the higher level of occupation, the better level of living standard in the household. It could intend to capture the effects of resources available for child health. The results of this study support the hypothesis "Infants born to fathers with a higher degree of occupation experience a lower risk of dying" for both previous five years period of 2003 and 2008/9. The higher incomes lead to higher standard of living and thus relatively lower the risk of infant death. A child born in a family in the higher income segments could decrease the likelihood of dying. In addition, the results of this study support the hypothesis "Infants born in some other Kenyan regions experience a lower likelihood of dying compared to a child in the Nyanza region" for both previous five years period of 2003 and 2008/9.

7.2 Demographic factors

A few demographic variables were of importance in the theory section. The age of the mother at first child birth was emphasized and a child born to a very young mother was expected to have a decreased chance of dying (Bongaarts 1987,). The variable mother's age at first child birth is significantly associated with infant death for both previous five years period of 2003 and 2008/9. However, the variable marital status of the mother and birth interval was found no have significantly effect on infant deaths. It was further pointed out that shorter birth intervals increase the risk of infant mortality. This concurs with theory, that when birth intervals are short, breastfeeding mothers terminated within a few months after birth, leading to poor child health.

7.3 Proximate (biomedical) factors

A great number of proximate determinants were analyzed in this study. Environmental contamination is according the theoretical model by Mosley & Chen (1984) an important determinant of infant mortality. A hygienic water source and toilet facility will enhance the child's chances of survival (Mosley &Chen, 1984). However, the variables "source of drinking water", "type of housing floor material" and "type of toile facility" had no significant effect on infant death. The variables "duration of breastfeeding" and "prenatal care" were found have effect on infant mortality for both previous five years period of 2003 and 2008/9.

The following is a list of the hypotheses outlined against the backdrop of the theoretical model.

• No significant relationship between marital status of mothers and infant mortality.

• It is significantly that children born to very young mothers experience a higher risk of dying.

• No significant relationship between birth interval and infant mortality.

• It is significantly that children born in the Nyanza regions experience a higher risk of dying.

• It is only significantly that children born to parents with a secondary or higher degree of education experience a lower risk of dying in 2008/9.

• It is significantly that children born to father with a white collar degree of occupation experience a lower risk of dying.

• No significant relationship between electricity and infant mortality.

• No significant relationship between clean water, mud floor, flush toilet and infant mortality.

• It is significantly that children breastfed more than six months experience a lower risk of dying.

• It is significantly that children born to mothers that have received prenatal care, experience a lower risk of dying.

8. Conclusions

This study has examined the determinants of infant mortality in Kenya 2003 and 2008/9. From previous research in the field and an analytical model by Mosley & Chen (1984) a number of variables that most likely affect mortality levels in Kenya were identified. A logistic regression was

made and a conclusion can be reached.

It is possible to conclude that socio-economic factor is a very important determinant of infant mortality in the Kenyan setting. The important socio-economic determinant was the occupation of the fathers. From the above discussion, it is clear that the successful implementation of the major challenges facing the domestic child survival project is the existence of wide regional differences in infant mortality. Based on the findings above, public health advocates have recommended multi-sector interventions to address the challenges of infant mortality, targeting specific areas to reduce infant mortality will be more useful and productive. To compensate for the existing huge differences on infant mortality between the various regions of the country, a number of conclusions are made:

The findings show that the parents' education level is an important determinant of infant mortality. The study suggests that encourage mothers and father to increase their education level up to at least secondary levels. It is recommended that there is need for the government to boost parents' education. Although the free primary education and free day secondary tuition possibility has been achieved in the country, then is need for full implementation of free education for girls in high school, which will allow access to knowledge as future moms foundation for future career development and general capabilities. In addition, due to the findings of this study support the occupational categories associated with higher income leads to higher standards of living, thus reducing the risk of infant death in the paper, the government should implement to reduce current levels of poverty and enabling policies to strengthen men's financial and occupational status. The study also suggest that infant mortality widely varied between regions in Kenya due to unequal distribution of socio-economic and health infrastructures.

According to infant mortality model, the finding suggests that infant mortality can be reduced substantially by increasing the mother's age at first birth. Breastfeeding is also an important significant factor for infant mortality. So, there is an urgent need for policy makers to promote family planning to improve the length of breastfeeding. This will improve birth intervals and reduce the incidence of higher birth orders at short birth intervals. The prenatal care should focus and identify such cases and provide those good health care service and guidance. However, other proximate variables diminished their impact and environmental factors lack their impact on infant mortality.

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