HOUSEHOLD ENVIRONMENTAL FACTORS AND CHILD MORTALITY IN KENYA

By

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DECLARATION

This project is my original work and to the best of my knowledge has not been presented for a degree in any other university.

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DEDICATION

I dedicate this work to my loving mother Laurenzia Njagi for encouraging me to pursue this degree and paying for my studies. Your moral and financial support led to successful completion of this degree. To my late dad; your words give me the strength to achieve my goals. My sisters and only brother, thank you for being there for me.

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To my classmates who shared with me their ideas, am very grateful for your support.

And finally, I thank God for without him nothing much is possible.

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ABSTRACT

This study examines the effect of household environment factors on child mortality in Kenya using the KDHS 2003 data. The household environmental variables analysed include toilet facility, source of water, type of cooking fuel and number of under five children. The controls variables used in the study are maternal education, type of place of residence, sex of the child, age of the mother, birth order and preceding birth interval.

The study is conceptualized using the Mosley and Chen framework on child mortality. Descriptive statistics and logistic regression are the main methods of analysis used in this study. The major findings of this study is that; of the household environment factors source of water, number of under five children in a household and type of cooking fuel emerged as predictors of child mortality.

Recommendations..emanating from this study include; the need to scale up programmes and accelerate the intervention strategies especially those associated with improvement of source of water, reduction of fertility and use of cleaner fuels so as to reduce the risk factors associated with child, mortality. Since child mortality has been seen to vary by type of place of residence it would be necessary to study the differentials by regions, additionally it would be paramount to study other pathways through which household environment factors act to influence child mortality in Kenya.

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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

Child mortality, commonly on the agenda of public health and international development agencies, has received renewed attention as a part of the United Nation's Millennium Development Goals (Mutunga 2004). Sen (1998) in a study on mortality as an Indicator of Economic Success and Failure, stated that mortality and its converse indicator, longevity or life expectancy, are among the most important measures of well-being and development in poor countries.

Estimates show that 10.1 million children died before their fifth birthday, mostly from preventable causes. Approximately 10 million infants and children under five years of age die each year, with large variations in under-five mortality rates, across regions and countries (Espo, 2002) in a study of infant Mortality and its Underlying Determinants in Rural Malawi. Baker (1999) while studying

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differentials in Malawi reported that childhood mortality rates have declined all over the world in the last fifty-five years. Between the mid 1940's and early 1970's, child death rates even in the developing countries reduced significantly much of these gains were achieved through interventions targeted at communicable diseases (diarrhea, respiratory infections, malaria, measles and other immunisable childhood infections).However these health gains were short lived. In the mid 1970's the worldwide progress was not maintained and infant mortality rates rose especially in Africa because disease oriented vertical programmes were not effective alone. Maternal, environmental, behavioral and socio-economic factors were recognized as additional important determinants of infant survival. According to UNICEF 1999, c.f Mutunga (2004), the decline in child mortality in Africa has been slower since 1980 than in the 1960s and 1970s. Of the thirty countries with the world's highest child mortality rates, twenty-seven are in sub-Saharan Africa.

Environmental risk factors account for about one-fifth of the total burden of disease in low income countries according to recent estimates by World Bank (2001) in the background paper for the World Bank environment strategy. WHO (2002) in the world health report on reducing risks and promoting healthy life reports that among the 10 identified leading mortality risks in high-mortality developing countries, unsafe water, sanitation and hygiene ranked second, while indoor smoke from solid fuels ranked fourth. About 3% of these deaths (1.7 million) are attributable to environmental risk factors and child deaths account for about 90% of the total.

This study focuses on household environmental factors and child mortality in Kenya such as source of water, type of cooking fuel, sanitation facility, type of roofing material housing and overcrowding. Using the 2003 KDHS this study attempts to explain the effects of the household environmental factors (controlling for confounding factors) on child mortality in Kenya. The main hypothesis of this study is that environmental risk factors influence child mortality in Kenya.

1.2 Problem statement

Nearly 99% of the 10.9 million children under the age of five years who died in 2000 were from developing countries. This amounts to at least 29000 deaths per day (UNICEF 2005)/of these deaths 41% occurred in sub-Saharan Africa(UNICEF 2005,black ,Morris &Bryce 2003).More than half of all deaths of young children are due to communicable diseases such as diarrhea^easles^neoumonia,malaria and HIV/ Aids ,all of which are preventable and treatable(Black et al 2003). While other areas of the world have experienced declining rates of childhood mortality over the last years, Sub Saharan Africa, for the most part, still maintains relatively high rates. It has been recently noted that 18 of the 20 countries across the world with the highest childhood mortality rates were in sub-Saharan Africa (UN, 1995 c.f Omariba 2005). In Kenya mortality has been declining since late 1940s, under-five mortality was 220 in the year 1958-62 period, this declined to 89 in 1984-1989 period. Later Kenya experienced reversals in the downward trend starting in 1986.Both infant and under five mortality increased by 24% and 25% in the period 1988 -1998 (Omariba 2005).Child mortality has continued to rise in the recent years increasing from 111 - 120 per 1000 births in the period 1998 - 2004 .

The table below shows infant and child mortality in Kenya

Table 1 Trends of infant and child mortality in Kenya.

Year	1989	1993	1998	2003	2004
Under 5 mortality rate (per 1000 births)	89	96	111	115	120
IMR (PER 1000 births)	60	62	74	77	79

Sources: CBS et al 2004 &UNICEF 2006.

Studies have shown that environment factors such as overcrowding, inadequate arrangements for excreta and waste disposal, poor ventilation, dampness, and numerous other housing problems remain threats to the health of low - income groups .Thus its important to prioritize which interventions are to be implemented, to determine the effectiveness of disease-specific interventions and to monitor trends in disease burden. This has been experienced in Kenya, Brazil and South Africa (Abrahams, 2006; Mutunga, 2004; Maria R et al, 2004).

This study therefore seeks to answer the question: To what extent do household environmental factors influence child mortality in Kenya?

1.3 Objectives of the study

The general objective of this study is to establish the effects of household environmental factors on child mortality in Kenya.

1.4 Specific objectives

1. To establish the effects of type of toilet facility and on child mortality.
2. To establish the effects of source of water on child mortality.
3. To determine effects of type of cooking fuel on child mortality.
4. To determine effects of number of under five children on child mortality.

1.5 Justification

Child mortality as well as environment sustainability has gained a lot of attention as MDG 4 and 7 respectively. According to the United Nations MDG report (2007); child survival rates are showing slow improvements and are worst in sub-Saharan Africa as compared to the rest of the world at 166 per 1000 live births. Improvement-^ basic sanitation and access to water is considered a major factor in meeting the MDG target. According to the state of world's children 2006, Kenya was ranked 37 in under 5 mortality in 2004 out of 192 countries.

Monitoring of trends in infant and child mortality is important since it provides a basis for assessing the performance of health programmes over time. What's more it serves as a platform for the government and its international development partners to set new goals in meeting the health need of the society (Omariba 2005). Child mortality remains an important public health issue;

Identification of specific household factors for predicting child mortality in Kenya can provide useful information to planners to look for definitive predictors to use in targeting high risk groups and determining new entry points for interventions.

1.6 Scope and limitation

This study intends to highlight the extent and causes of deaths of children in Kenya specifically looking at the influence of household environment factors.

The data used in this study is from the KDHS carried in 2003 among a representative sample of 8195 women of reproductive age in Kenya. This study will only use children who were between 12 months old and 59 months old, who had died or were still surviving, whose sample is 4666 children with 441 deaths. Several DHS show evidence of downward bias in reporting child deaths (Jacoby &Wang 2003) that is the longer the recall period the more likely the possibility of the respondents to misreport the cases. Thus the completeness with which births and deaths are reported is what determines the quality of mortality estimates from the retrospective study which is the case of KDHS.However did not affect results of the study since the inspection of mortality data in KDHS 2003 reveals no evidence of selective underreporting or misreporting of age at death that would significantly compromise the quality (CBS et al 2004).Nevertheless this study evaluates the quality of data by focusing on omission of dead children, heaping of children's ages,sex ratio at birth and reporting of age among women

The variable on number of under five children is unlikely to bring out the expected results due to the high proportions of deaths in households comprising of fewer than three under five children.

CHAPTER 2

REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter reviews various literatures on factors associated with child mortality. It especially points at household environment factors. Presentation of conceptual framework and operational framework will follow, and then hypotheses and definition of key variables will be discussed. Reviews of this literature will cite what is already known about child mortality as well as spell out the gaps from different studies.

2.2 Review of literature on household environment factors

Maria R et al (2004), while studying household overcrowding upon respiratory health of young children in Brazil, pointed that in the developing countries, where urbanization has been rapid in recent years with a lack of intervention in the housing market, a large proportion of the population is still living in conditions similar in many aspects to those of the nineteenth century citizens of London. In this study Maria et al found that after controlling for potential confounders, no evidence of an association between number of persons sharing the child's bedroom and lower respiratory disease was identified when all cases were compared with their controls. However, when two categories of cases were distinguished (infections, asthma) and each category compared separately with their controls, crowding appeared to be associated with a 60% reduction in the incidence of Asthma but with 2 V2-fold increase in the incidence of lower respiratory tract infections.

Wang (2003) used the Ethiopia 2000 DHS to examine the environmental determinants of child mortality. Running three hazard models to examine three age specific mortality rates: neonatal, infant and under five by access to basic environmental services. Results show that there is strong statistical association between child mortality and poor environmental conditions.

In developing countries, indoor air pollution is the most lethal killer after malnutrition, unsafe sex and lack of safe water and adequate sanitation. Sub-Saharan Africa and South East Asia are particularly affected, with 396,000 and 483,000 annual deaths, respectively (World Bank 2001) in the background paper for the World Bank environment strategy.

In Sub Saharan Africa, around 80% of the rural communities depend on biomass fuels for their domestic energy. In all the Countries of East Africa, the majority of the populations live in the rural and peri-urban areas where poverty is rampant leading to extensive use of biomass as source of energy. Exposure to IAP from the combustion of solid fuels is a predisposing factor contributing to morbidity and mortality in developing countries and the worst levels of exposure are closely associated with the poorest households (Rukunga 2004), in a report on indoor air pollution in east Africa.

According to Gymiah 2002 c.f Kiragu, E (2006), residence in a house with piped water was associated with a 30% reduction in the risk of infants deaths compared to that in a house source of drinking water was a river or stream.

Eva (2006) in a comparative study of infant and child mortality determinants in Kenya and Ghana, found that in Kenya highest risk was exhibited by those who draw their water from wells which can be contaminated due to a variety of factors like fetching and storage. Although their was no statistical significance, women who fetched their water from stream ,rivers or lakes and other category also seemed to exhibit high childhood deaths.

According to the MDG report (2007) an estimated 1.6 billion people will need access to improved sanitation over the period 2005-2015 to meet the MDG target. Though most of the world regions are on track, all developing regions have made insufficient progress towards the target. In SSA, the absolute number of people without access to sanitation actually increased .The repercussions of poor hygiene, health, economic, social open defecation and lack of access to safe water, is that they contribute to about 88 per cent of the deaths due to diarrhoeal diseases more than 1.5 million in children under age five.

According to the state of world children 2006, 62% of people in Kenya have access to improved drinking water while 48% were using adequate sanitation facilities but still Kenya was ranked 37 in under five mortality out of the 192 countries *listed. This reflects on the impact of water, sanitation, diseases and* other causes of deaths on infant's mortality and mortality rates for 1 and 4 years of age. Infectious diarrhea is probably the largest contributor to the disease burden from water, sanitation and hygiene. Disease burden from diarrhoeal disease in children younger than five can be up to 240 times higher in developing countries than in developed countries (UNFPA 2006). Indoor air pollution from cooking and heating with solid fuels, including wood, dung and coal on open fires or traditional stoves, is responsible for at least 1.5 million deaths every year worldwide. Such pollution causes acute lower respiratory infections in children under five years of age and chronic obstructive pulmonary disease in adults.

Liquefied petroleum gas, biogas and other cleaner fuels represent the healthiest alternative, WHO reports. Switching from a traditional to an improved stove substantially reduces indoor smoke. On average, 100 million more homes using these modern fuels for cooking would lead to 473 million fewer people being exposed to harmful indoor air pollution and 282,000 fewer deaths from respiratory diseases per year This has shown that every year, indoor air pollution is responsible for nearly one million deaths in children under five years of age. Reducing exposure to indoor air pollution will make a significant contribution to reducing child morbidity and mortality. Exposure of the developing embryo to indoor air pollution may contribute to perinatal mortality and low birth weight, a major risk factor for a variety of diseases during childhood (WHO 2002). Studies in sub - Saharan Africa have shown repeatedly that the prevalence of some childhood illnesses varies considerably by season (Koram et al, 2003; Bairds et al 2002).A study carried out in Ghana revealed that seasonality is an influential factor in determining life chances of children (Kubaje et al 2006).Children born during the heavy rains experienced mortality in the first months of life, this is due to elevated risk following rainfall and the increased presence of vectors. During rainy seasons mosquitoes are able to breed due to pools of water and thus children are more prone to catching malaria.

In developing countries 28% of deaths in children under 5 years of age are associated with acute respiratory infections (ARI). The sources of deaths and particulates are either outdoor or indoor. Indoor exposures are of greater concern because concentrations are often much higher and greater when time is spent indoors by vulnerable population sub-groups including young children (USAID 1997), congressional presentation on child survival and infectious diseases - especially in cold/rainy seasons.

It's thus expected they will inhale a lot of fuels while indoors and especially for households that are over crowded. Therefore it becomes also important to study the effect of overcrowding on child mortality, most studies have explored the area of child mortality causes in Kenya using different analytical methods but the effect of overcrowding among other environmental variables as a cause of child mortality in Kenya is relatively unknown.

Misati (2003) while stressing the importance of public health in a comparative study of determinants of child survival in Kenya, using the 1998 KDHS attributed the high mortality levels among children in Africa to poor environment status. She suggested the campaign against disease through availability of piped water and environmental sanitation such as water and sewerage disposal. Mutunga (2004) while studying environment determinants of child mortality in Kenya using the KDHS 2003 found that households using high polluting fuels experience high mortality. Households with access to safe water and had significantly lower mortality rates. These findings were consistent with Hala (2002) and Jacoby &Wang (2003). In his study he found that household size was negatively related to child mortality, he used household size to refer to number of people residing in a household considering it as a socio-economic variable. Kiptui (2001), in a study of the effects of maternal education of infant and child mortality in rural Kenya, found that water affects health in four ways. Water can carry pathogens which when ingested in sufficient quantity can disease infect the drinker and cause microbiological disease (e.g. cholera and typhoid) water may also carry toxic substances such as industrial wastes. Secondly water is important for cleanliness especially for flushing away faeces and urine. Hand washing, domestically and in personal hygiene reciuces the incidence of diarrhoeal disease, skin disease such as yaws, eye infectious among others thirdly water can be a link for disease that depend on transmission by animals or insects that depend some or all their lives in water. Malaria which is transmitted by mosquitoes is a prominent example. Diarrhoeal disease is often consequences of unclean water.

Richard G & Dean T (1991), conducted a longitudinal study in Machakos Kenya, and the results were that household probability of having a child under five die increases proportionate to the number of other under five children that the mother has. If the number increases 1 through 2 so does the probability of death. The increase was more than proportionate, 60 to 85 percent when the number of children under five increases two to 3.The probability of a child under five dying increased with the number of children under five present in household.

Similarly, Ballard TJ &Neumann CG (1995) in a one year follow up study of the association between household crowding and acute respiratory infections; found that children with more than 5 siblings living in the household were at increased risk of disease in Kenya. No association was observed in this study when crowding was measured by the number of children sharing a bed.

2.3 Review of literature on control factors

Social and economic conditions such as poverty, malnutrition, lack of education and sanitation, overcrowding and environmental degradation are key underlying contributors to child mortality. Changing the social and economic conditions that allow infectious diseases to flourish and spread, such as poverty, malnutrition, lack of education, lack of sanitation, overcrowding and environmental degradation can help improve child mortality. The overcrowding, poor housing and lack of adequate sanitation make these areas ideal staging areas for epidemics of child killers like diarrhea, measles and acute respiratory infections.

A study by Omariba (2005) on changing childhood mortality conditions in Kenya, found that secondary or higher education was associated with a 42% reduction in risk of child mortality. The mother's level of education is strongly linked to child survival. Higher levels of educational attainment are generally associated with lower mortality rates, since education exposes mothers to information about better nutrition, use of contraceptives to space births, and knowledge about childhood illnesses and treatment. Larger differences have been found to exist between the mortality of children of women who have attained secondary education and above and those with primary level of education or less, this is according to Mutunga 2004 in a study of environment determinants of child mortality. Type of place of residence was has been found not having significant influence on childhood deaths in Kenya in a comparative study of determinants of infant and child mortality in Kenya (Kiragu 2006). Rural- urban mortality differentials have been seen as reflecting the differences in social and economic conditions between rural and urban areas of a given country, but the observed gross effect of place of residence on infant mortality is more a function of household environmental conditions (Ikamari 1996).

Kubaje et al (2006), in a study on environmental and socio-demographic risk factors of child hood mortality in Ghana, he demonstrated that sex of the child is a strong predictor of mortality. He further indicated that in the first month and after the first year of life, the risk of death among boys is much higher than that of girls. He further demonstrated that age of mother was a significant factor of mortality when other factors are controlled for.

Studies have shown that spacing of births can reduce infant and child mortality. Childhood mortality rate has been seen to decline as the birth interval increases. Similiary it has been found that there is high probability of dying if mothers are of high birth order.

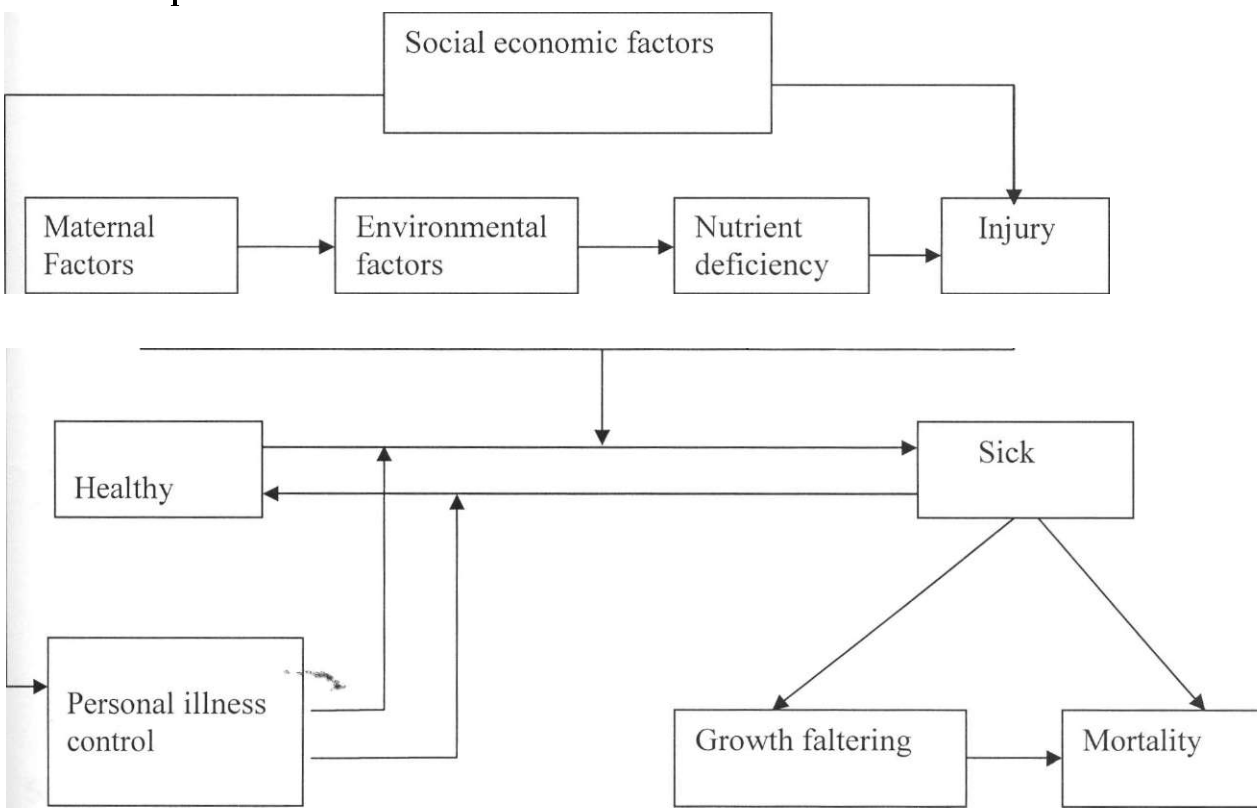
2.4 Summary of literature

A lot of literature exists about child mortality, and different factors have been pointed out as influencing child mortality. Different studies have shown that toilet facility, number of under five children, access to safe water, type of cooking fuel, mother's education, type of roofing material, type of place of residence.sex of the child and age of the mother are factors that are associated with child mortality.

However there have.Jbeen inconsistencies in overcrowding as a possible risk factor for child mortality. Different studies have used different indicators for overcrowding, some studies have used number of persons residing in a household, number of under five children in a household, number of persons sharing the child (under study) bedroom and also number of residents versus number of rooms .All these different measures have resulted to different conclusions, some have rejected overcrowding as a possible risk factor whereas others have seen it as a risk factor on child mortality and this makes the effects of overcrowding on child mortality relatively unknown.

Presence of toilet facility has been found to be associated with infant and child mortality; however Ikamari (1996) stated that the effects of household environment have been found greater after than during infancy.

2.5 Conceptual Framework

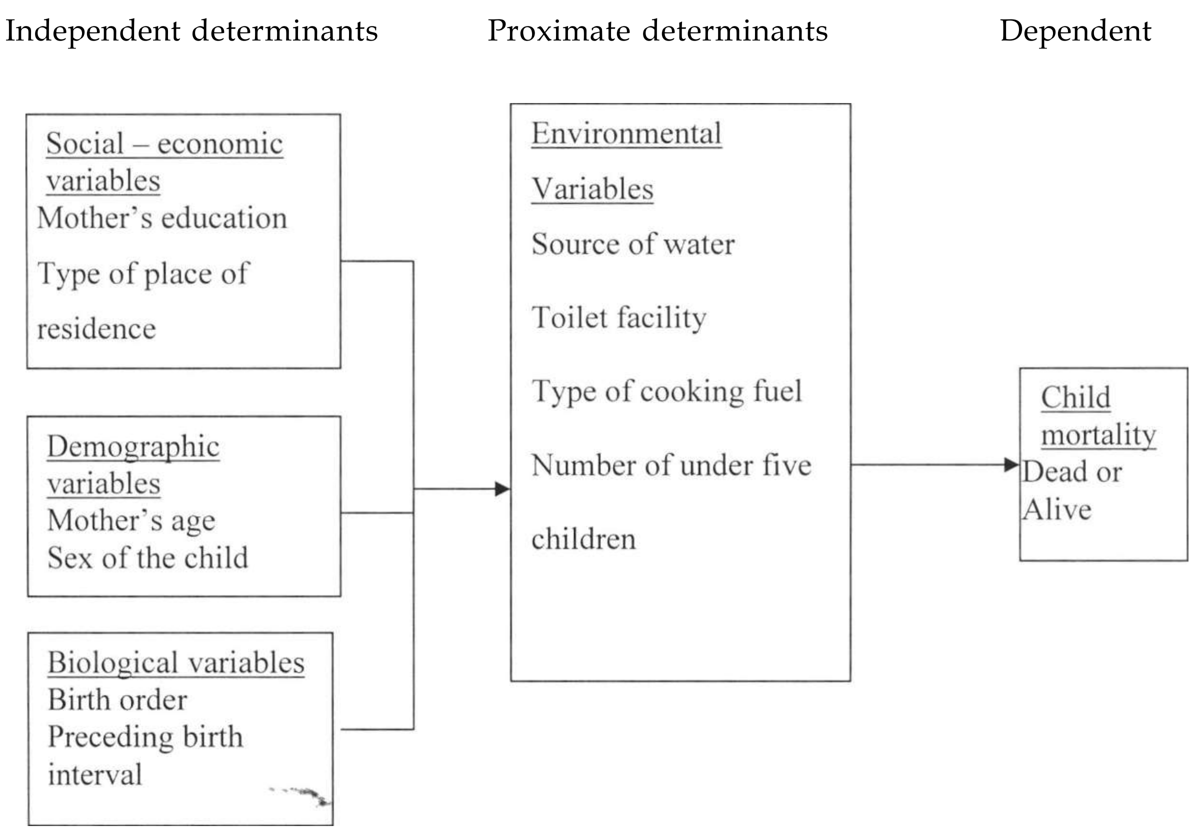


Source: Mosley & Chen (1984)

Mosley and Chen (1984) proposed a framework that assesses the determinants where the effects on social and economic factors on mortality are estimated through a common set of intermediate variables (Hill 2003). The framework links the individual child health for this with the underlying socio-economic factors.

The approach is based on the premise that all social and economic determinants of child mortality operate through a common set of biological mechanisms or proximate determinants to exert an impact on mortality.

2.6 Operational framework



Source: Mosley & Chen (1984)

2.7 Conceptual hypothesis

1. That household environmental factors are likely to influence child mortality.

2.8 Operational hypotheses

1) That households with unsafe source of water are more likely to experience high child mortality.
2) That children from households with toilet facility are less likely to die compared to those from households without facilities.
3) That households with few numbers of under five children are likely to have low child mortality with reference to those with higher number of under five children.
4) That households using high polluting fuel are likely to experience high child mortality compared to those using low polluting fuels.

2.9 Variables and their measurement

This section discusses the dependent variables of interest in this study, proximate determinants as well as the control variables to be used in analyses.

Dependent variable

Child mortality is the probability of dying between first birthday and the fifth birthday. This is the main dependent variable and it measures whether or not the index child died during a specified age under consideration. This variable is categorized into dead and living children.

Independent variables

1. Source of water

A variable denoting source of water is constructed from the mothers' response question on type of source of drinking water. This variable will have two categories safe and unsafe water. The assumption being that safe or clean water is that which is piped, whereas households using unpiped water have assess to unsafe water.

2. Toilet facility

This variable is used to denote whether or not household has a toilet facility. This is constructed from the mothers' response question on the type of toilet facility available in the household. This variable has two categories No toilet facility and presence of toilet facility. This variable measures poor and good sanitation facilities at the households. Households with no toilet facility are assumed to have poor sanitation whereas those that have toilet facility have

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good sanitation.

3. Type of cooking fuel

This is used to measure exposure to pollution in the household, households using electricity and LPG/Natural gas are assumed as using less polluting fuels whereas those households using charcoal, coal, firewood, dung and other type of fuels are said to use high polluting fuels. This variable is categorized into two denoting high polluting fuels and low polluting fuels.

4. Number of under five children

This variable is used as a measure for overcrowding. A variable denoting number of under five children is constructed and will have two categories that is less than 3 under five children and four and more number of under five children.

Control variables

1. Type of place of residence

This variable will denote type of place of mother's residence and is in two categories that is rural and urban.

2. Mother's education

This variable will Mother's education will refer to the education level of the child's mother that is no education, primary, primary completed and secondary plus.

3. Age of the mother

This variable show the current age of the mother .It is categorized into three that is mother's aged 15-24 years,25-34 years and 35 and above years are put together to create one category.

4. Sex of the child

This refers to the specific sex of the child categorized into male and female.

5. Birth order of the child

This is divided into four categories that is first birth order, second birth order, third birth order and all other are classified as birth order 4 and above.

6. Preceding birth interval

This refers to the time duration between the previous birth and the study birth. This is divided into three categories less than one year, two years and at least three births.

CHAPTER 3

DATA AND METHODS

3.1 Introduction

This chapter will present description of the source of data used in the study and the analytical methods utilized that lead to the conclusions on household risk factors and child mortality.

3.2 Source of data

This study utilizes data from the 2003 KDHS, the KDHS collected information through a cross sectional survey on fertility, mortality, socio-economic conditions, health issues and environmental issues. Data was collected from a representative sample of 8195 women aged 15-49 years and 3578 men aged 15-54 years. The sample data in this study is 4666 children born in the five years preceding the survey who are between 12 - 59 months old which comprises of 441 deaths. The data for mortality estimates was collected in the birth history of the women interviewed. Women gave information on date of birth of every child born, and if the child is dead the age at which the child died is given.

KDHS also collected information on child health outcomes (mortality & incidence of illnesses) access to basic services (drinking water, sanitation, fuels for cooking and heating, electricity access, health service, infrastructure) women's (respondents) demographic, social and economic characteristics; household assets.

3.3 Data analysis

In this section, methods of data analysis that is descriptive statistics and logistic regression are discussed as well as their justification. Descriptive statistics are discussed first and secondly logistic regression as the main analysis of the study, which will result in drawing the main conclusions.

3.3.1 Descriptive statistics

Frequencies are used to analyze the characteristics or distribution of the study population by background variables of study. Cross tabulations is used to show association between different study variables and child mortality.

3.3.2 Logistic regression

This study uses Logistic regression to estimate the odds ratio for each of the independent variables; on the dependent variable (child mortality).This will be appropriate in this study since the dependent variable is dichotomous that is dead or alive and thus probability is it must range between 0 and 1.

Logistic regression is an efficient way to introduce the necessary controls when the dependent variable is a dichotomous one and the explanatory variable are categorical as in the case of this study (Little, 1978:23-25 c.f Misati 2003). Bivariate analysis is used to examine the effect of each independent variable on the dependent and then later multivariate logistic model is fitted to examine the effect of household environment on child mortality.

The logistic regression equation may be expressed as follows

logit(p) = ln{p/(l-p)}

= a + Pi^{x}l^{+} h^{x}2 + P3V" + ____________ + Pmxn + Gl

Where p = the probability that the event will occur

In = Natural logarithm

1-p =The probability that death will not occur,

a = A f or the intercept of the model

Pi to P_n are logistic coefficients

^{x}i to $^{x}{}_{n}$ are dichotomous or interval explanatory variables (categorical variables are expressed as a series of dichotomized variable) and G is a binomially distributed error term.

Analysis in this study are expected to show that access to safe water, overcrowding, type of cooking fuel and toilet facility are associated with the risks of child mortality, even after controlling for the effects of socio-economic factors.

CHAPTER 4

CHARACTERISTICS OF STUDY POPULATIONS AND DATA QUALITY

4.1 Introduction

This chapter discusses the characteristics of the study population by household environmental factors and social-economic factors. Also distribution of children dead and alive by variables of study is discussed. Data quality issues also are discussed by pointing out the expected quality issues and how they are discounted.

4.2 Background characteristics of study population

Table 4.1 shows the summaries of the distribution of study population by various background characteristics. Of the sample of births used for analysis 10% died before attaining their fifth birthday whereas 90% survived up to the fifth birthday.

Of the sample population over 27% of births were from households that had access to safe water whereas nearly three quarter of the study births was from households that had unsafe source of water. About 26% of the sample births were from households with no toilet facility whereas 74 percent were from households with at least some form of toilet facility.

A small proportion 4%, of the study births resided in households that had more than four children who were under five, whereas 96% had three or less under five children in the household.

Additionally of the study population, 3% of the births were from households using low polluting fuels while 97% births were from households using high polluting fuels.

Of the sample population over 26% of the births were from mothers resident in urban areas but whereas 74%.were resident in rural areas. Of the study births 21% were born to mothers with no education, 58% were born to mothers with primary education, and a 22% were born to mothers who had secondary plus level of education.

Nearly half of the study births were from mother's aged between 25 to 34 years, 31% were from mother's aged between 15 to 24 years whereas 20% were born were from mother's aged 35 years and above. Of the study births 51 % were male births whereas 49% were female births.

Of the study births 25% were of birth order 1, 20% were births of order 2, 16% were births of order 3 and finally 40% were births of order 4 and above.

Additionally of the study births 27% were born in less than 1 year after a previous birth, 45% were born 2 years after a previous birth whereas 28% had were born 3 and above years after a previous birth.

Table 2 Background characteristics of the study population.

Variable	Frequency (n)	% distribution
Survival status		
Dead	441	9.5
Alive	4225	90.5
Water source		
Safe water	1273	27.3
Unsafe water	3393	72.7
Toilet Facility		
Access to toilet	3441	73.7
No facility	1225	26.3
Number of children		
<=3 children	4482	96.1
4+children	184	3.9
Type of cooking fuel		
Low polluting fuels	156	3.3
High polluting	4510	96.7
Type of place of residence		
Urban	3472	25.6
Rural	1194	74.4
Mother's education level		
None	959	20.6
Primary	2692	57.5
Secondary+	1015	21.8
Mother's age		
15-24 years	1431	30.7
25-34years	2312	49.5
35+	923	19.8
Sex of child		
Male	2375	50.9
Female	2291	49.1
Biological factors		
Birth order "v		
1	1166	25
2	914	19.6
3	739	15.8
4+	1319	28.3
Preceding birth interval		
<1 year	1269	27.2
2-3 years	2078	44.5
3+years	1319	28.3
Total	**4666**	

4.3 Differentials of child mortality by study covariates

Table 4.2 below summaries the proportion of children dead by the study covariates. In this table children dead are cross classified with the key household environment variables, socio-economic variables, demographic variables and biological variables to give proportion of children dead by covariates.

The results indicate that there was association between source of water and child mortality. Children born from households with unsafe water experienced higher deaths as compared to those children from households with safe water. This association was significant at 3% level.

Additionally, results show an association between number of under five children and child mortality. Children from households with 3 or less number of under five children experienced higher number of child deaths compared to those that had 4+ numbers of children in the household. This association between number of under five children and child mortality was significant at 3% level.

Results indicate that there was association between mother's education and child mortality. Mother's with primary education experienced the highest number of child deaths followed by those with no education and finally those with secondary plus had the least number of deaths. This association was strongly significant at 0% level.

There was a significant association between mothers age and child mortality, results show that 4% of deaths occurred to mothers aged between 25 -34 years whereas 3% occurred to mothers aged 15 -24 years and fewer deaths occurred to mother's aged 35+ years. This association was significant at 1% level.

Sex of the child had a strong association with child mortality; results show that 5% were deaths occurred to male whereas 4% occurred to females. This association was significant at 2% level.

Table 3 Proportions of children dead and alive by background characteristics

Variable		% Alive	% Dead
Water source			
Safe water		25.1	2.2
Unsafe water		65.4	7.3
X^2= 4.710	df = 1	sig 0.030	
Toilet Facility			
Access to toilet		67	6.8
No facility		23.6	2.7
X^2= 1.100	df = 1	sig 0.294	
Number of children			
<=3 children		86.8	9.3
4+children		3.8	.2
X^2= 4.654	df = 1	sig 0.031	
Type of cooking fuel			
Low polluting fuels		3.2	.2
High polluting		87.4	9.3
X^2= 3.525	df = *1*	sig 0.06	
Type of place of residence			
Urban		23.2	2.4
Rural		67.3	7.1
X^2= 0.107	df = 1	sig 0.744	
Mother's education level			
None		18.2	2.4
Primary		52	5.7
Secondary+		20.4	1.4
X^2= 17.370	df = 2	sig 0.00	
Mother's age			
15-24 years		27.7	3
25-34years		45.3	4.2
35+		17.5	2.3
X^2 = 7.56	df = 2	sig 0.012	
Sex of child-*^			
Male		45.6	5.3
Female		45.0	4.1
X^2 = 5.5	df = 1	sig 0.019	
Birth order			
1		22.7	2.3
2		17.6	2
3		14.5	1.4
4+		35.8	3.8
X^2 = 35.8	df = 3	sig .709	
Preceding birth interval			
<1 year		24.8	2.4
2 years		39.9	4.7
3+years		25.9	2.4
X^2 = 4.483	df = 2	sig 0.106	
Total		**4666**	

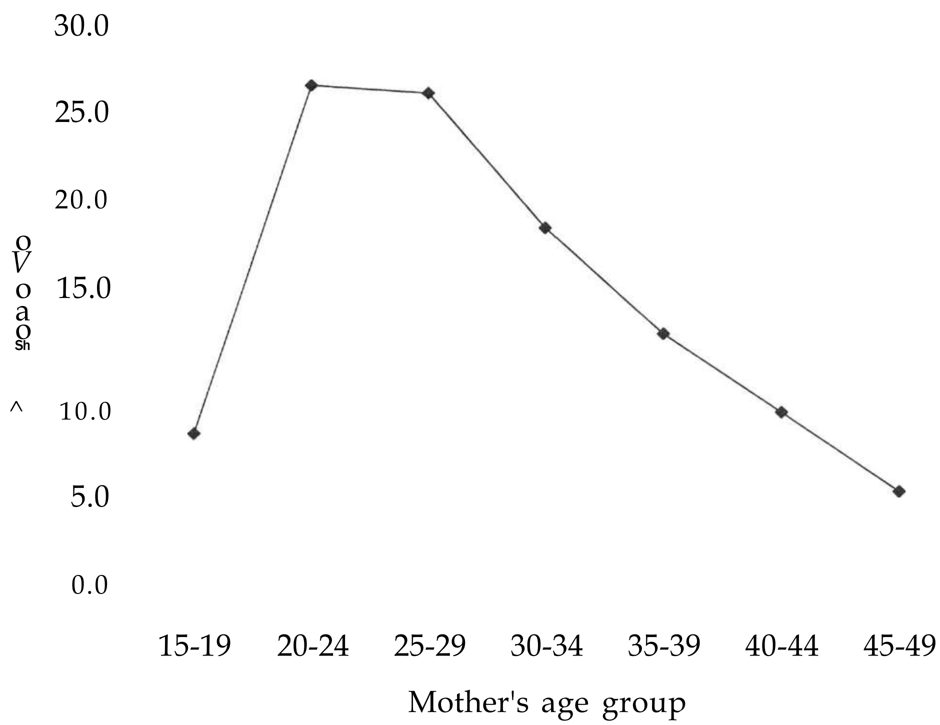
4.4 Data quality

This section discusses data quality issues and how they are addressed in this study. According to the KDHS 2003, the quality of mortality estimates calculated from retrospective birth histories depends upon the completeness with which births and deaths are reported and recorded. Potentially the most serious data quality problem is the selective omission from the birth histories of births who did not survive, which can lead to underestimation of mortality rates. Other potential problems include displacement of birth dates, which may cause a distortion of mortality trends, and misreporting of the age at death, which may distort the age pattern of mortality. When selective omission of childhood deaths occurs, it is usually most severe for deaths in early infancy. If early neonatal deaths are selectively underreported, the result is an unusually low ratio of deaths occurring within seven days to all neonatal deaths, and an unusually low ratio of neonatal to infant deaths. Underreporting of early infant deaths is most comrttonly observed for births that occurred long before the survey; hence it is useful to examine the ratios over time.

4.4.1 Omission of dead children

This is detected by studying the proportion of children dead by age group of the mothers, without omissions of dead children; dead children should increase proportionately with age of mother as long as child mortality has not been increasing. This is because children of older mothers have had longer exposure to risk of death. They also have most likely had higher mortality risk than children of relatively younger mothers. This pattern may be broken for mother aged 15-19 since their children usually have a higher risk of dying (Hobcraft, 1992).

Figure 1 Proportions of children dead by age group of the mother



From the figure above there is an indication of omission of deaths by mothers in the older age groups. This because the proportions of children dead is decreasing with the age of the mother instead of increasing with the mothers age. This shows that mothers in the older age groups easily forget their children who died earlier as compared to young mothers.

4.4.2 Heaping of children's ages

Recall problems may produce errors in the reporting of children's ages. Extent of age heaping is assessed by examining the percentage distribution of all living children by current single years of age and percentage distribution of all dead children by their age at death in months. Age heaping at 12 months posses a problem because it can affect estimates of both infant and childhood mortality since 12 months is the cut off point (Ikamari 1996).

Figure 2 Distribution of living children by current single year

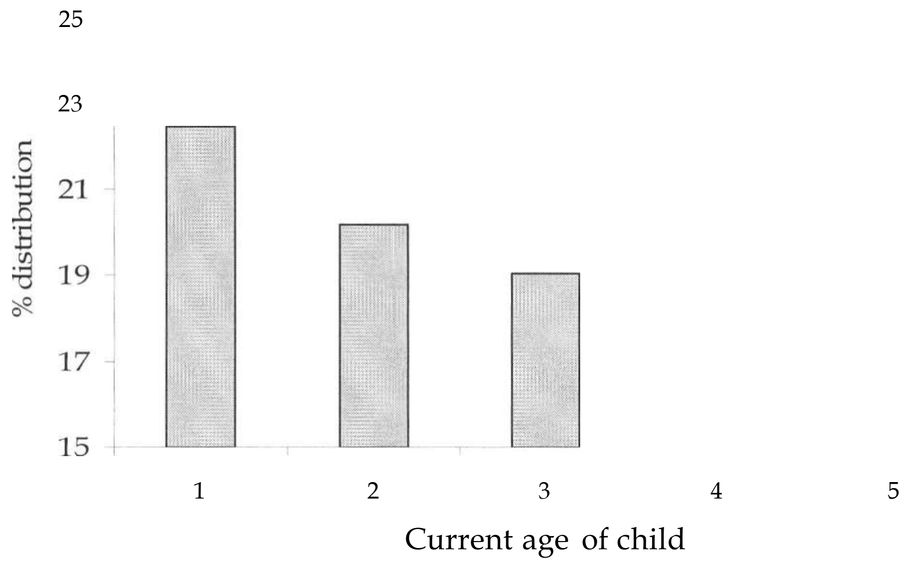
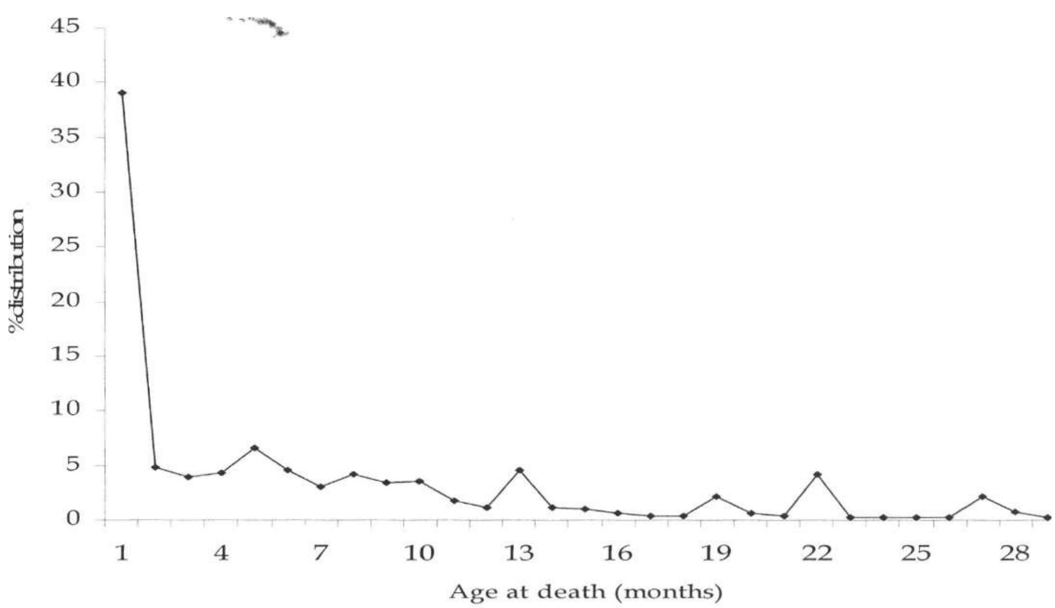


Figure 3 Distribution of children by age at death (months)



Figures 4.1 and 4.2 above shows distribution of living children by current single year and children dead by their age at death reported in months respectively. No evidence of age heaping is seen that would compromise the data

4.4.3 Sex ratio at birth

Sex ratio at birth is affected by underreporting/ under enumeration of the total number of children born at a particular period, this can result into underreporting of deaths.

The extent of under enumeration can be observed by computing the percentage distribution and sex ratio of single ages for those aged between 0 and 4 years. This is done by dividing the number of male births by the number of female births. A sex ratio that is larger than 100 shows an over reporting of male births while one that is smaller than 100 shows an over reporting of female births (Kiragu 2006).

Table 4.3 below indicates that sex ratio between age 0 and 4 years was 102; it's thus fair to say that male births were slightly over reported but that would not strongly compromise the quality of data.

Table 4 Sex ratios of children under five years

Age of children(Months)	Total sample of births	Total Male births	Total female births	Sex ratios
0-11	1283	640	643	99.9
12-23	1211	607	604	100
24-35	1139	585	554	105
36-47	1224	633	591	107
48-59	1092	550	542	101
Total	5949	3015	2934	102

4.4.4 Reporting of age among women

Variables that are computed on the basis of the mother's reported age affects results of analysis of infant and child mortality if reported poorly. Mothers who misreport their age are also likely to misreport their maternity history (Ikamari 1996).The most common type of error is digit preference of 0 and 5 which is as a result of respondents not recalling their exact age. The extent of age misreporting especially age heaping is considered by percentage distribution of all women by their current single years of age.

Gross misreporting can be detected by analyzing the 5 year distribution of respondents. With no serious age misreporting proportion of women in successive age groups is expected to decrease monotonically with increasing age. This takes place in conditions of stable fertility, declining mortality and closed migration .Age misreporting can result in the transfer of women into wrong age group distort the expected pattern of distribution of mean number of children ever bortv, mean number of children dead and proportion of dead children by age of mother (Ikamari 1996).

Figure 4.3 shows that there was no gross misreporting that would affect the data this because proportions of respondents (mothers) is decreasing with increase in age as is expected.

Figure 4 Distribution of respondents in 5 year age groups

30

25

20

V 15
I

^ 10

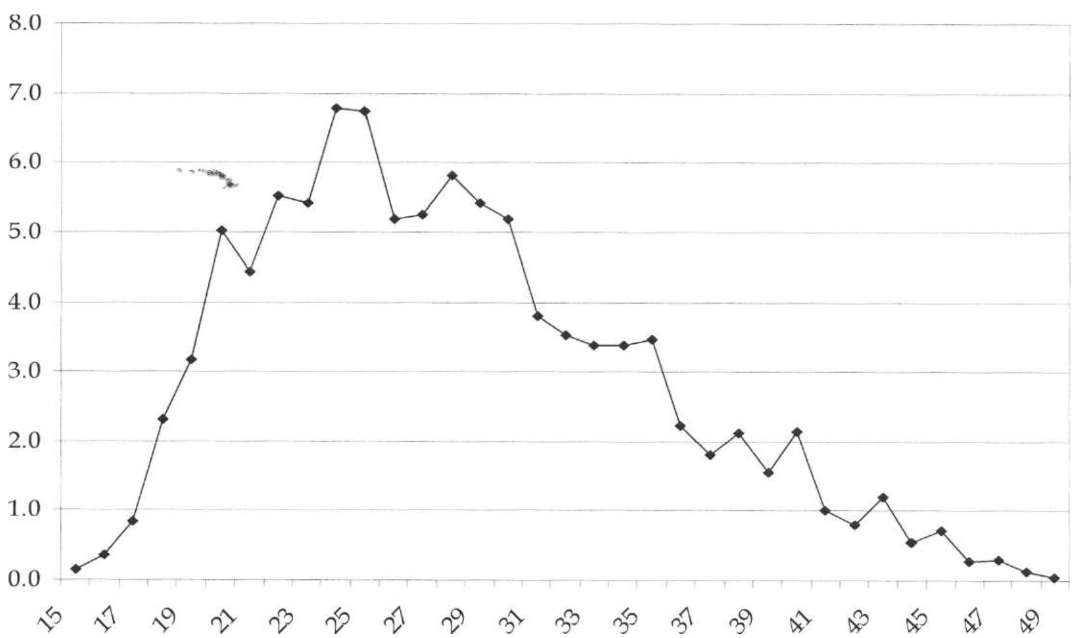
5

0 15-19 20-24 25-29 30-34 35-39 40-44 45-49

5 year age groups

In addition Figure 4.4 below, digit preference of 0 and 5 is observed. However the digit preference is minimal so as to compromise the quality of data.

Figure 5 Distribution of mother's age in single years



4.5 Summary of data quality.

This chapter has reviewed quality of data with respect to omission of dead children, heaping of children's age, sex ratio at birth and reporting of age among women. No evidence of errors was found that would compromise the data such as to affect the analysis.

CHAPTER 5

HOUSEHOLD ENVIRONMENT FACTORS AND CHILD MORTALITY IN KENYA

5.1 Introduction

This chapter examines the results of the analysis that are associated with child mortality controlling for other confounding factors. This will be achieved through the bivariate and multivariate analysis and the results of the analysis discussed.

5.2 Bivariate Logistic regression

This section discusses bivariate logistic regression analysis and findings with regard to household environmental factors anci the control variables. Bivariate models were run, to give the gross effect of each explanatory variable on dependent variable (child mortality). The results of the bivariate analysis are summarized in Table 5.

The study established that there was a significant relationship between source of water and child mortality. Children from households whose source of water was unsafe were 29% more likely to experience the risk of child death compared to those from households whose source of water was safe. This relationship was significant at 5% confidence level.

The results further indicate that number of under 5 children in a household was a significant factor influencing child mortality. Children born from households with 4 or more number of under five children were 52% less likely to experience child death as compared to children born from households with three or less number of under five children. This relationship was significant at 5% confidence level.

Moreover the results also show that type of cooking fuels was a significant predictor of child mortality. Households that use high polluting fuels for cooking had 96% more likely to experience child deaths as compared to those households that use low polluting fuels for cooking. This relationship is significant at 5% confidence level.

Further more results show that education is a significant predictor of child mortality. Children"*born to mothers with primary education were 16% less likely to die compared to those with no education. Children born to mothers with secondary plus education were 49% less likely to die compared to those born to mothers with no education, these relationships were statistically significant at confidence levels of 10% and 1% respectively.

Results further indicate that there was a significant relationship between mother's age and child mortality. Mothers aged 35 and above years were 38%

less likely to experience child deaths compared to mothers aged 15-24 years. This relationship was significant at 1% confidence level.

Additionally, results indicated that sex of child has a significant relationship with child mortality. Children whose gender is female were 21% less likely to die compared to their male counter parts, this relationship is significant at 5% confidence level.

Results further indicate that there was significant relationship between preceding birth interval and child mortality. Children born 2 years after the previous birth were 19% more likely to experience the risk of death relative to those born after one or less than one year. Children born 3 years after the previous birth were 6% less likely to experience child mortality compared to those born after less than 1 year after the previous birth. This relationship was significant at 10%'

This study did not find toilet facility, type of place of residence and birth order significant factors influencing child mortality.

Table 5 Bivariate results.

Bivariate Model

Covariate	**Coefficient (P)**	**Std error (S.E)**	**Odds ratio (exp P)**
Household environment factors			
Source of water			
Safe water [R]			
Unsafe water	0.256	0.118	*1* 292**
Toilet facility			
Presence of toilet [R]			
Absence of toilet	0.117	0.111	1.124
Number of under 5 children			
<= 3 under 5 children [R]			
4+ under 5 children	-0.728	0.345	0.483**
Type of cooking gas			
Low polluting fuels [R]			
High polluting fuels	0.674	0.366	1.962***
Socio-economic factors			
Type of place of residence			
Urban [R]			
Rural	0.038	0.117	1.038
Maternal education			
None [R]			
Primary	.177	0.120	0.838*
Secondary+	0.665	0.164	0.514***
Demographic factors			
Mother's age			
15-24 years[R]			
25-34 years	.142	.117	.868
35+years	206	.136	.615***
Sex of child			
Male			
Female	.237	.101	.789**
Biological factors			
Birth order			
1[R]			
2	.104	.149	1.110
3	-.091	.166	.913
4+	.038	.128	1.038
Preceding birth interval			
<1 year[R]			
2 years	176	.122	1.193*
3+years	-.062	.140	.940*

*****p<0.01; **p<0.05; *p<0.1**

[R] is the Reference category

5.3 Multivariate logistic regression

This section discusses multivariate results with regard to household environment variables and control variables .Two models are run to establish the effect of household environment, social economic, demographic and biological variables on child mortality. The results of the analysis are summarized in table 6 below.

Model 1 includes all the household environment factors and this includes; source of water, toilet facility, number of under five children and type of cooking fuel.

The results indicate that source of water is a significant determinant of child mortality; children born from households whose source of water was unsafe are 21 % more likely to die as compared to those from households whose source of water is safe. The odds ratios of source of water increases as socio economic, demographic and biological variables are added in model 2.These findings are consistent with Mutunga 2004 and Kiragu 2006, that unsafe water increases the risk of child mortality.

The results also indicate that number of under five children was a significant factor of child mortality. Children from households that had 4 or more number of under five children were 51% less likely to experience child mortality as compared to households with 3 or less number of under five children. When the socio-economic variables, demographic factors and biological factors are added in model 2 the effect of number of under 5 children on child mortality is reduced. This relationship was significant at 5% confidence level.

Type of cooking fuel was a statistically significant determinant of child mortality in model 1. Results indicate that children from households using high polluting fuels were 74% more likely to experience children deaths as compared to those children from households using low polluting fuels. This relationship was significant at 10% confidence level. However this effect disappears when other variables are introduced in the model.

Mother's education was an important factor influencing child mortality as indicated in model 2. Mothers who had primary education were 17% less likely to experience child deaths as compared to those mothers who have no education, this relationship is significant at 10% whereas mothers with secondary plus education were 47% less likely to experience child deaths relative to those mother's with no education. This relationship is significant at 1% level.

Table 6 Effects of household environment on child mortality in Kenya. Multivariate Model

Covariates	Model 1	Model 2
Household environment factors		
Source of water		
Safe water [R]		
Unsafe water	1.211(.124)*	1.238(139)*
Toilet facility		
Presence of toilet[R]		
Absence of toilet	1.045(0.115)	.880(133)
Number of under 5 children		
<=3 under 5 children [R]		
4+ under 5 children	.490(.346) **	,460(.348)**
Type of cooking fuel		
Low polluting fuels [R]		
High polluting fuels	1.736(.374)*	1.431 (.384)
Socio-economic factors		
Type of place of residence		
Urban [R]		
Rural		.810(135)
Maternal education		
None [R]		
Primary		.834(139)*
Secondary +		.527(187)***
Demographic factors		
Mothers' age		
15-24 years[R]		
25-34 years		.923(136)*
35+years		1.282(163)*
Sex of child		
Male[R]		
Female		.786(101)***
Biological factors		
Birth order		
1 R		
2		1.101(150)
3		.922(167)
4+		1.025(129)
Preceding birth interval		
<1 year[R]		
2 years		1.111(143)*
3+years		.852(168)*

*****p<0.01; **p<0.05; *p<0.1**
[R] is the Reference category; In brackets are the standard errors.

Additionally mother's age was a significant factor influencing child mortality. Children of mothers aged 35 and above years are 28% more likely to experience deaths as compared to those of mothers aged 15 -24 years. However children of mothers aged 25- 34 years are 8% less likely to experience child mortality compared to those of mothers aged 15-24 years. This relationship was significant at 10% level.

Further, results indicate that sex of the child was a significant factor of child mortality. Females were 21% less likely to die compared to males. This relationship was significant at 1% level. Evidence in biomedical literature suggests that, except where there is gender discrimination in favour of boys, the risk of death is generally higher for boys (WHO 2003).

Results of the study show that preceding birth interval was an important predictor of child rrtortality. Children born 2 years after the previous births were 11% more likely to experience child deaths relative to those born less than 1 year after the previous birth. Children born 3 and more years after the previous births were 15% less likely to experience child mortality compared to those born less than 1 year after previous birth.

However the study results show that toilet facility, type of place of residence and birth order were not significant factors associated with child mortality.

5.4 Discussions of results

Having a safe source of water, as opposed to unsafe source of water lowered the risk of death even when other factors are included in the model. This is because unsafe source of water exposes children to disease causing microbicides and thus they are vulnerable to infections.

Number of under five children in a household which was used as a measure for overcrowding was a significant predictor factor of child mortality; however the results were not as hypothesized, that is households with high numbers of under five children are more likely to experience mortality compared to those that have fewer number of under five children. This could possibly be attributed to the high proportions of deaths in households comprising of fewer than three under five children.

Type of cooking fuel was only a significant predictor of child mortality in absence of socio-economic, demographic and biological factors. This is consistent with other studies that children born in households using high polluting fuels as their main source of cooking fuel have higher mortality rates as compared to those using low polluting fuels. Higher incidence of respiratory infections which are responsible for child deaths is expected in households which use "dirty" fuels as opposed to those using clean cooking fuels.

As expected mother's education emerged as a strong predictor of child mortality. Children of mothers with secondary and above education have lower chances of dying between their first and fifth birthday compared with those whose mothers have no education. This could be because uneducated mothers are not knowledgeable on childhood illness as well as hygiene.

Mother's age and sex of the child emerged as significant factors influencing child mortality. Mother's age could have been significant because young mothers are not likely to be experienced in childcare compared to older mothers.

Preceding birth interval was seen as predictor factor of child mortality. Other studies have shown spacing births at least three years apart can reduce infant mortality. In general, childhooci mortality rate declines as the birth interval increases. Survey results show that children born less than two years apart are almost twice as likely to die as children born three years apart.

It was evident from the results that toilet facility, type of place of residence and birth order had no significant effect on child mortality.

5.5 Summary

This chapter explored household environment factors by using logistic regression analysis. Bivariate analysis was conducted to determine the effect of each explanatory variable on the dependent variable. Whereas multivariate model was fitted to determine the effect of household environment when other variables are introduced.

Bivariate results indicated that source of water, type of cooking fuel, number of under five children, maternal education level, mother's age , sex of the child and preceding birth interval were all significant predictors of child mortality.

The multivariate results indicated that source of water, type of cooking fuel and number of under five children are household predictor factors associated with mortality of children aged between 12 months and 59 months.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This section discusses the summary of the research findings, conclusion and recommendations for policy makers and for further research. These recommendations are made on the basis of the findings.

6.2 Summary

This study set out to examine household environment factors and child mortality in Kenya. Specifically, the study sought to examine the relationship between household environment factors and child mortality when controlling for other confounding factors. Child mortality was the dependent variable and was defined as the children aged between 12 and 59 months born five years preceding the survey.

The data for the study was extracted from 2003 KDHS. The study population consisted of a sub-sample of 4666 children aged between 12 and 59 months born five months preceding the survey comprising of 441 deaths. Data quality was assessed by examining omission of dead children, heaping,and women age reporting.

Chapter 1 introduced the study by giving the problem statement, scope, limitation and justification; chapter two discussed the literature on child mortality but more specifically on household environment factors and their relation to child mortality. Conceptual and operational frameworks were also discussed.

Chapter four discussed characteristics of the study population as well as data quality. Cross tabulations was used to get association between child mortality and different study variables.

In chapter five bivariate and multivariate logistic regression models were fitted Bivariate analysis indicated that there was a significant relationship between source of water, number of under 5 children in a household and type of cooking fuels. Higher risks of mortality were associated to children born in households using unsafe water and high polluting fuels. Similarly higher risks of mortality were associated to children borne to less educated mothers. Younger mothers and male children were associated with high level of child mortality. Child mentality rates declines as the birth interval increases.

The effect of household environment was established by fitting 4 multivariate logistic models. Model 1 included only the household environment factors, model 2 introduced the socio economic factors, model three introduced demographic factors and finally model four included biological variables.

6.3 Conclusions

From the study findings it's fair to conclude that source of water is a predictor of child death when controlling for other confounding factors. Number of under five children in a household was a significant predictor of child mortality as well. Type of cooking fuel was a significant predictor of child mortality thou its significant effect is reduced when other variables are introduced. Mother's education is a strong predictor of child mortality. Mother's age and sex of child are predictor factors of child mortality. Preceding birth interval is also a significant predictor factor associated to child mortality. These results are consisted with other study results that have been previously done. The effects of household environment on child mortality have also been established in other studies.

6.4 Recommendations

This section discusses the recommendations emanating from the study both for policy and further research. This will be discussed in light to the study findings and conclusions.

6.4.1 Implications for policy

This study indicates that household environment factors are found to have significant impact on child mortality. Therefore there is need to scale up intervention strategies directed to providing safer source of water, cleaner cooking fuels and also checks on fertility which translates to the number of children in a household. This will be aimed at reducing child mortality, and ensure that national health service strategic plan (NHSSP) target on reducing child mortality from 114 deaths per 1000 births in 2004/2005 by 2010 is achieved. This will eventually result in accelerating achievements of MDG's particularly in Kenya.

6.4.2 Recommendations for further research

Given that child mortality varies by type of place of residence as well as by region, it would also be necessary to examine how child mortality is influenced by household environmental factors at these levels. Future studies should also endeavor to establish pathways through which household environment are likely to influence child mortality.

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APPENDIXES

Table 7 Multivariate model 1

	B	S.E.	Wald	df	SIR.	Exp(B)
UNSAFE WATER(l)	.191	.124	2.373	1	.123	1.211
ABSENCE OF TOILET(l)	.044	.115	.147	1	.702	1.045
4+ UNDER CHILDREN(l)	-.713	.346	4.258	1	.039	.490
HIGH POLLUTINGF UELS(l)	.552	.374	2.172	1	.141	1.736
Constant	-2.931	.363	65.040	1	.000	.053

a Variable(s) entered on step 1: WATER, TOILET, CHILDREN, FUEL.

Table 8 Multivariate Model 2

	B	S.E.	Wald	df	SiR.	Exp(B)
UNSAFE WATER(l)	.213	.139	2.367	1	.124	1.238
ABSENCE OF TOILET(l)	-.127	.133	.918	1	.338	.880
4+ OF CHILDREN(l)	-.776	.348	4.980	1	.026	.460
HIGH POLLUTING FUEL(l)	.358	.384	.870	1	.351	1.431
NONE			12.633	2	.002	
PRIMARY(l)	-.182	.139	1.720	1	.190	.834
SECOND ARY(2)	-.641	.187	11.712	1	.001	.527
RURAL (1)	-.210	.135	2.421	1	.120	.810
15-24 YEARS			6.251	2	.044	
25-34 YEARS(l)	-.080	.136	.351	1	.554	.923
35+ YEARS(2)	.249	.163	2.318	1	.128	1.282
FEMALE(l)	-.241	.101	5.655	1	.017	.786
BIRTH INRERVAL 1 YR			4.481	2	.106	
BIRTH INTERVAL 2YRS(1)	.105	.143	.542	1	.462	1.111
BIRTH INTERVAL 3YRS(2)	-.161	.168	.918	1	.338	.852
BIRTH ORDER 1			1.094	3	.778	
BIRTH ORDER 2(1)	.096	.150	.410	1	.522	1.101
BIRTH ORDER 3(2)	-.081	.167	.234	1	.628	.922
BIRTH ORDER 4+(3)	.024	.129	.035	1	.851	1.025
Constant	-2.254	.416	29.379	1	.000	.105

a Variable(s) entered on step 1: WATER, TOILET, CHILDREN, FUEL, EDUC, VI02, AGE2, B4, BIRTH, BIRTHO.