RISK FACTORS ASSOCIATED WITH UNDER-FIVE DIARRHOEA IN KENYA

BY

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DECLARATION

I declare that this research project is my own original work. It is being submitted for the degree of Master of Arts in Population Studies at the University of Nairobi. To the best of my knowledge, it has not been submitted before in part or in full for any degree or examination at this or any other university:

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ABSTRACT

Diarrhoeal diseases are still the major cause of morbidity and mortality among children in many developing countries, including Kenya. There is a general agreement that the cause of child mortality and morbidity in developing countries is multi-factorial. This study was carried out to examine die effects of socio-economic, environmental and socio-demographic factors that were associated with childhood diarrhoea in Kenya using the KDHS 2008/09 data. A total of 5481 children under the age of five were captured in the two week period preceding the survey. Information on the households' socio-economic, environmental and behavioural characteristics was collected using structured, pre-tested questionnaire.

The findings of this study showed that the overall two-week period incidence of diarrhoea in under-fives was 17.1 percent. Significant variation was observed in incidences of diarrhoea between children in households with an improved toilet facility and those with non-improved toilet facility and in children whose mothers were below eighteen years and those beyond 35 years. Children in the age group 12-23 and those living in households with more than five members were highly affected especially for western province. Children who were well nourished experienced less diarrhoea incidences than those who were malnourished. A logistic regression analysis showed that children living in households with an improved toilet facility had 1.3 times higher odds of having diarrhoea than those living in households with a non-improved toilet facility. The odds of having diarrhoea in children who lived in households where there were six or more members was 1.3 times higher than the odds in children who iived in households where five or less people. Also, children living in Western province had two times higher odds of having diarrhoea than those in Nairobi province. Children who were malnourished had more than one and a half times higher odds of having diarrhoea than those who were well nourished.

From the study it is concluded that the incidence of diarrhoea in under-five children is very high, especially in children who reside in western province and who are younger than two years of age. Crowding, nutrition and poor environmental conditions are associated with the occurrence of diarrtioea in children. Even though these problems may be alleviated by sustainable socio-economic development through integrated effort of different sectors in the long run, recommendations are forwarded considering short-term solutions.

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CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

In some of the poorest countries of the world, one in five children fail to reach their fifth birthday, mainly owing to infectious diseases related to the environment (WHO 2001). Infectious and parasitic diseases (communicable diseases) account for 14 million deaths per year and are the world's leading killers of children. These diseases, which have intimate links to environmental conditions and poverty, affect the lives of poor people disproportionately and pose a serious threat to health and economic development.

According to millennium development goals report of 2011, the highest levels of under-five mortality continue to be found in sub-Saharan Africa. Estimates show that at least one in eight children die before the age of five (129 deaths per 1000 live births) which is nearly twice the average in developing regions and around 18 times the average in developed regions (UN 2011). In Eastern and Southern Africa region, the observed average annual rate of reduction (AARR) in the under-five mortality rate (U5MR) for 1990-2006 period was 1.4 percent which is viewed as insufficient to attain MDG 4 and would require an AARR of 9.6 percent between 2007 to 2015 if MDG 4 is to be achieved by countries in this region (UNICEF, 2008). The situation is Kenya is no different. Although there has been a decline in under-five mortality, Kenya is still very far from the country's MDG target of targets 33 deaths per 100 live births. The 2008-09 KDHS estimates that the under-five mortality for Kenya is at 74 deaths per 1000 live births, which is more than double the set out target with only three years to go.

Each year, an estimated 2.5 billion cases of diarrhoea occur among children under five years of age (UNICEF/WHO 2009). Estimates suggest that overall incidence has remained relatively stable with more than half of the cases occurring in Africa and South Asia where in most cases it results in death or other severe outcomes including malnutrition (UNICEF/WHO 2009). Globally, pneumonia and diarrhoea are responsible for an estimated 40 per cent of all child deaths. Fifteen percent of all deaths in children

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Efforts to reduce incidences of diarrhoea, to prevent and treat its complication and to improve its case management through oral rehydration therapy in Kenya have been focused through the policy statements on Control of Diarrhoea Diseases (CDD) formulated in 1993 (GoK, 2010). The policy set numeric targets to be achieved through mass media (IEC) on health issues, promoting breast feeding and proper weaning practices, by improving environmental sanitation, by enlarging access to clean environment and safe drinking water and establishing health units specifically for ORT.

According to the 2008-09 KDHS, more than one-third of Kenyan households get their drinking water from a non-improved source, mainly surface water from lakes, streams, and riv ers with wide disparities between urban and rural areas; only 6 percent of urban households use non-improved sources for drinking water compared to 46 percent in rural areas. Nationally, 41 percent of the population still depends on surface water; over 2 4 million children are water-deprived (GoK & IJNICFF, 2010)

The KDHS report also indicates that less than one-quarter of households use an improv ed toilet facility that is not shared, with urban households only slightly more likely than rural households to have an improved toilet facility; 30 percent and 20 percent, respectively (GoK, 2010). The most common type of toilet facility in rural areas is an open pit latrine or one without a slab (47 percent of rural households), while in urban areas toilet facilities are mainly shared with other households (52 percent). Ov erall, 12 percent of households have no toilet facility at all; they are almost exclusively rural, accounting for 16 percent of rural households. Despite the disparities in service provision between rural and urban areas, there is only a small variation in diarrhoea incidences between rural and urban areas (GoK, 2010); depicting that the causes are not merely sanitation related bui mediated through other variables.

1.2 Problem Statement

In Kenya, despite much efforts and successes in the management of diarrhoea, the disease has remained among the top five causes of mortality and morbidity, particularly among infants and children below five years. Diarrhoea is the third most common cause of mortality and morbidity in the country with a case fatality of 21 percent(GoK, 2010);

Kenya is among the fifteen countries that account for over 75 percent of all deaths from diarrhoea among children under-five years of age annually.

According to the Kenya Demographic and Health Surveys, diarrhoea cases consistently remained constant since 1998. The reported figures stood at 17 percent, 16 percent and 17 percent in 1998, 2003 and 2008 respectively(GoK, 2004; GoK, 2010). This imply that the absolute cases of diarrhoea had increased given that the population had grown over the same period and highlighting the need for detailed analysis of risk factors associated with diarrhoea to better prevent its occurrence.

Within the same period (1998-2008/09), rate of diarrhoea! illness was highest in children aged between 6-23 months with a peak period of between 6-11 months (GoK, 2010). There was only a small variation in the incidences of diarrhoea by sex, residence, and wealth quartile despite the major disparities in sanitation and water provision; pointing to a complex interaction between the risk factors associated with diarrhoea.

In most developing countries (Kenya included), most diarrhoea episodes; even the much life threatening cases, are never reported to the health system (Cairncross, Boisson. Bostoen, Curtis, Fung and Schmidt, 2010). The 2008-09 KDHS for instances, indicated that less than half (49 percent) of children with diarrhoea in the two weeks preceding the survey were taken to a health facility for treatment, although this was a marked increase from the 30 percent recorded in the 2003. This depicts that the health care system/treatment alone cannot eradicate deaths due to diarrhoea and more emphasis should be put on alleviating the occurrence of diarrhoea itself. Except some descriptive reports by the Kenya National Bureau of Statistics, limited systematic univariate or multivariate analysis of the factors that influence the occurrence of diarrhoeal morbidity and mortality among young children in Kenya exists today especially for the children below two years who have the highest risk of contracting the disease. This study therefore sought to explore the risk factors associated with childhood diarrhoea as a major cause of childhood morbidity and mortality in Kenya.

1.3 Research Question

i. What are the risk factors associated with under-five diarrhoea in Kenya?

1.4 Objectives of the Study

The general objective of this study was to explore risk factors associated with the risk of diarrhoea in Kenya for children below five years.

1.3.1 Specific Objectives

i To assess the socio-economic risk factors associated with under-five diarrhoea in Kenya.

li. To assess the demographic risk factors associated with under-five diarrhoea in Kenya.

iii. To assess the environmental risk factors associated with under-five diarrhoea in Kenya.

1.5 Justification

The success of any health policy or health care intervention depends upon the correct understanding of socio-economic, environmental and cultural factors which determine the occurrence of diseases and deaths. Morbidity information is mostly derived from clinics and hospitals. Yet, incidences of diarrhoea obtained from hospitals represent only a small proportion of all illnesses as many cases do not seek medical attention (GoK, 2010; GoK, 2004). Thus, hospital records may not be appropriate for estimating incidence of diarrhoea and are too sketchy to be used for program developments. This research was first attempt to obtain population-based morbidity data and the underlying causes from a nation-wide survey.

The focus on children below five years; who are at the highest risk of contracting disease, aimed at influencing policy and programs by addressing a population in which the findings of the study would bring about major changes in morbidity and mortality due to diarrhoea.

1.6 Scope and Limitation of the Study

The Study focused on a population associated with the highest risk of diarrhoea; children aged between 0-59 months. The sample was drawn from the 2008-09 Kenya Demographic and Health Survey (KDHS). The study population (children between 0-59

months old) yielded a total of 5481 children below the age of five; 17 percent of whom had diarrhoea infection in the two weeks period prior to the survey. This study therefore focussed on the 5481 children between 0-59 months old to explore the risk factors associated with diarrhoea.

The siudy was limited by a number of factors related to the nature of DHS data. First, DHS data do not allow one to attribute child morbidity to specific causes of death, hence the study cannot show how the risk factors contribute to mortality directly but rather to morbidity. Secondly, DHS did not define diarrhoea; the data obtained were solely based on the subjective assessment of the respondent which may present a problem because mother's reports of their children's symptom can be affected seriously by socio-economic and cultural factors. Where diarrhoea is common, mothers may not show a high degree of concern for all episodes of the condition unless there is a symptom of severity such as bloody stools, vomiting, fever, diarrhoea of increased duration, a change in colour of the stool or a sudden increase in frequency. This means that in such scenarios, early episodes of diarrhoea might have been underreported and the accuracy and completeness of reporting for diarrhoea might have varied considerably between socio-economic groups. Thirdly, although established to have a great impact on diarrhoea on many studies, data on hand-washing behaviour and practises were lacking form the KDHS. Tukei (1974) proposes that washing hand could lessen diarrhoea disease and if not practiced could increase cases. Several specific hygiene behaviours are hypothesized to be relevant for diarrheal disease risk. Washing hands after defecation with soap or ash produces less contamination than washing with water only, although rinsing with contaminated water can re-contaminate hands (Hoque, 2003). A comprehensive review of handwashing interv entions suggests a reduction in diarrhea risk of 42-48 percent associated with washing hands with soap, although the reviewers express concerns that poor methodology and publication bias may skew this estimate upwards (Caimcross et al., 2010).

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Child survival interventions were launched by the United Nations Children's Fund (UNICEF) and WHO in the 1980s after the world economic meltdown. The current focus of the development community in relation lo child survival is Millennium Development Goal 4 (MDG 4), which aims to reduce the global rate of under-five mortality by two thirds between 1990 and 2015. Eighty percent of illness and death in developing world is water related. Infectious diarrhoea is the largest contributor to the disease burden from water, sanitation and hygiene. Diarrhoea and malaria are the largest causes of mortality in children under five years of age (Li Liu, 2012),

This chapter reviewed theories and literature related to the risk factors associated with diarrhoea in children below five years It provided the conceptual model, the operational framework and the hypotheses for the study.

2.2 Theoretical Background

Diarrhoea is defined as having loose or watery stools at least three times per day, or more frequently than normal for an individual (UNICEF/WHO, 2009). Acute diarrhoea can lead to significant fluid loss and dehydration which may result in death or other severe consequences if fluids are not replaced at the first sign of diarrhoea Rotavirus is the leading cause of acute diarrhoea and is responsible for about 40 per cent of all hospital admissions due to diarrhoea among children under five worldwide (UNICEF/WHO, 2009).

Most pathogens that cause diarrhoea share a similar mode of transmission; from the stool of one person to the mouth of another (faecal-oral transmission) Pathogens may take different routes while travelling between individuals, for instance through ingestion of water during drinking, food borne transmission of faecal-oral pathogens as a result of poor hygiene.

Actual exposure to diarrhoea pathogens occurs at the household or individual level although information on both the exposure and risk is only available at the community or

family and community practices. Smith and Haddad (2000) built on UNICEF's framework for analysing the determinants of child health and conceptualized two important routes for transmission of diseases (diarrhoea) to young children: the behaviours of the child and caregivers (mothers) and the health environment including social organization and values (WHO, 1992). They argued that child care practices and hygiene behaviours (both at the household and community level) can either facilitate or interrupt feacal-oral transmission routes. Alberini, Eskelaand. Krupnick and Mcgranahan (19%) categorizes factors linked with the incidence and seventy of diarrhoea into two; economic/behavioural and engineering/infrastructure both of which are strongly intertwined Economic/behavioural factors focus on household behaviours, relationship between appropriate interventions and the resources and preferences of the households. Resources available to the family and the community determine the access to which women have maternal and child health care services while cultural set up influences health seeking behav iour as explained in the Mosley and Chen analytical framework for child survival. The engineering perspective on the other hand, emphasizes more strongly on the need to provide households with a plentiful and reliable supply of uncontaminated water and adequate sanitation services (Alberini et a1, 1996).

It is widely recognized that exposure to diarrhoea pathogens in developing countries is conditioned by such factors as socio-economic factors, household sanitary conditions, nieghbouihood basic sanitation infrastructure, and child related or care related vanables (e.g. hygiene behavior, anthropometric nutritional status, breastfeeding or intestinal parasitic infections) (Teran, 1991, Diame, 1990; Timaeus and Lush, 1995; Ryland and Raggers. 1998; Stallmgs, 2(X)4, Genser, Strina, Teles, Prado and Barreto, 2006). However, ascertaining exposure to contamination has proved to be very challenging due to variability of contamination in space and time and the number of contamination routes (Alberini et al., 1996), creating the need for context specific studies which forms the basis of this research.

2.3 Literature Review

Several studies hav e been done on diarrhoea incidences and prevalence in several parts of the world especially in Asia, Sub-Saharan Africa and South America where the

disease is still a leading cause of mortality and morbidity particularly among children below five years.

Most of the studies have investigated longitudinal factors associated with childhood diarrhoea though very few studies have investigated the dynamic features and hierarchical interrelationships among the potential risk factors (Genser et ai . 2006) Most of the studies have generalised findings for all the children below five years with only a few dealing with a particular age group. Authors have justified such studies by noting that some of the risk factors are modified as children age hence the need to study all the children below five years and not just those with the highest risk of contracting diarrhoea (Ibid)

2.3.1 Socio-Demographic Factors

a) Age

Numerous studies in Africa and Asia have confirmed that age of the child plays an important role in the occurrence of diarrhoea In most studies diarrhoea is least common among children below six months and peaks between children aged 7-23 months with the low incidences in children below six months being the effect of exclusive breastfeeding; diarrhoea peak among children aged 6-23 is due introduction of supplementary feeding and environmental factors as most of this children spent most time playing on contaminated ground (WoldemicaeL 2001. Manun'ebo, Haggerty, Kalangaie, Ashworth and Kirkwood. 1994)

In Salvador Brazil, a community-based longitudinal study of 902 children (below the age of 3 years) was conducted to investigate risk factors associated with childhood diarrhoea. The study was conducted between October 2000 and January 2002 taking into account both the time-varying variables and autoregressive effect of past diarrhoea episodes. The study established that diarrhoea rale varied substantially with age peaking at 5.9 episodes/child-year in children aged 7 to 12 months and decreased with increasing age to 0.9 episodes/chiId-year in children aged 43 to 48 months. Incidence rate was also found to be decreasing with time-on-study which was partially explained by age; the age adjusted rate decreased from 7,6 episodes/chi Id-year during the first 3 months to 1.1 episodes/child-year after 14 months Evidence of autoregressive effect of past diarrhoea

of which increases the risk of diseases. Maternal age is considered as a proxy for a host of factors including family size, educational level, modernity, knowledge and practice related to childcare and energy/capacity to care for a child (Mock et aJ., 1993).

d) Duration of Breastfeeding

Breast milk contains the nutrients, antioxidants, hormones and antibodies needed by a child to survive and develop. Infants who are exclusively breastfed for the first six months of life and continue to be breastfed until two years of age and beyond develop fewer infections and have less severe illnesses than those who are not, even among children whose mothers are HIV-positive (UNICEF/WHO, 2009).

Several studies in developing countries have found that exclusive breastfeeding plays an important role in protecting infants against diarrhoea (Martins, Phillips, and Feachem. 1993). According to the DHS comparative studies (number 27 of 1998), in 24 of 31 countries for which data are available (i.e., a sufficient number of children for statistical analysis), it appears that children age 0-2 months who are fully breastfed have lower prevalence of diarrhoea than those who are partially breastfed On average, diarrhoea prevalence is 57 percent higher among partially breastfed children (Rayland and Raggers, 1998) However, the protective effect of breastfeeding becomes less prevalent as children age due to the introduction of other food supplements In Brazil, there were no significant differences in these prevalences between breastfed and non-breastfed children even after controlling for the confounding effects of age. family income, and more frequent diarrheal episodes (Barros and Victoria, 1990).

2.3.2 Socio-Economic Factors

Socio-economic factors are the independent variables that act through proximate determinants to influence the level of morbidity and mortality. They can be grouped into individual level, household level and community variables. Socio-economic factors may affect, directly and indirectly, environmental, behavioural, nutritional and demographic risk factors with the exception of age and sex (Victoria et al., 1997).

a) Place of Residence

Differentials in mortality by urban/rural residence have commonly been observed, with urban areas having more advantages and therefore better child survival prospects. The place of residence is one of the predictors of child health in general and diarrhoeal disease in particular. In developing countries, socio-economic status, access to health services and environmental conditions all affect the health of children of the rural areas (Timaeus and Lush, 1995) Children in urban areas where proper sanitation and water are available, and where modem treatment is more frequent will have a lower prevalence of diarrhoea. In Ethiopia, rural children exhibited more than five higher odds of getting diarrhoea than their urban counterparts In Eritrea, children living in urban areas are 46% less likely to have diarrhoea The variation in prevalence between urban and rural persisted even after adjusting for environmental, behavioural and other socio-economic variables. Researchers suggest that the difference in diarrhoea prevalence between urban and rural areas is attributable to differences in literacy status, type of water source and latrine availability Place of residence, urban-rural, affects mothers' exposure to education and the extent to which proper sanitation, clean water and health care facilities are available (Woidemicael. 2001; Mulugeta. 2003).

b) Wealth Index

Differences in rates of diarrhoea by socio-economic status are mainly due to differences in childcare practices, such as preparation of weaning foods, boiling of drinking water, or personal hygiene practices (Mock et al., 1993; Timaeus and Lush, 1995, Calogero, Calogero, Hoddinott and Chnstiaensen, 1999).

In developing countries, there is a consensus that childhood mortality and morbidity are significantly related to socio-economic status of the child's parent which forms the immediate environment to the child. Socio-economic position refers to holdings of assets, income that the assets yield, and the consumption that such income permits (Calogero et al., 1999),

A comparative study of urban areas of Ghana, Egypt, Brazil and Thailand by Timaeus and Lush (1995) clearly indicates that children's health is affected by environmental conditions and economic status of the household aid are strongly

intertwined. According to these authors, children from better-off households have lower diarrhoeal morbidity and mortality in Egypt, Thailand, and Brazil. Such differentials in diarrhoeal diseases by household economic status are probably due to differences in child care practices, for instance preparation of weaning foods and personal hygiene (Timaeus and Lush. 1995). Forsberg. Gwatkm, Tomsona, Ailebecka and Pet/old (2009), through a review of Demographic Health Surveys (DHS) in 55 countries from 1990 to 2005 established that households in the poorest socio-economic group consistently showed higher morbidity attributable to diarrhoea and less frequent use of oral rehydration therapv (ORT) when compared with households in the richest socio-economic group

c) Maternal Education

Mother's education has frequently been used as a proxy indicator of socio-economic status in international surveys and studies. However, mother's education is also thought to be associated with hygiene, care seeking, and treatment of illness behaviours pertaining to early childhood morbidities (Stalling, 2004; kirk wood. 1991). Some authors argue that socio-economic factors including education may have a greater effect on diarrhoeal mortality than on morbidity (Root, 2001) According to them, well-educated mothers may be unable to reduce risk of exposure due to factors beyond their control, such as a contaminated community environment, or lack of water. However, their knowledge and wealth may allow them to use healthcare services more effectively than uneducated women (Root, 2001). 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.

The relationship between parental education and family income/wealth with the occurrence of diarrhoea has been studied more than any other socio-economic v ariable. Many studies have shown a negative and significant relationship between level of education as well as family income and diarrhoea morbidity; being significantly lower

among children of more educated mothers (secondary or higher) than among children of mothers with no or primary education.

According to the DHS comparative studies (1998), there is a marked difference in prev alence among children whose mothers have secondary or higher education compared with those whose mothers have primary or no education. On average, diarrhoea prevalence is 38 percent lower among children whose mothers have some secondary or higher education. In across-sectional survey conducted in The Republic of Congo, highly educated mothers reported less diarrhoea cases (Mock et al., 1993). A follow-up study from Zaire also indicated that both mother's and father's education were significantly associated with diarrhoea incidence (Manun'ebo et al , 1994). Similar results have also been reported in Nigeria and Bangkok (Oni, 1996; Getaneh, Assefa and Taddesse, 1997). Results from Eritrea's DHS showed a significant effect of education on diarrhoea morbidity in a univariate analysis but the effect diminished after adjusting for other variables (Woldemiceal. 2001) In Israel, a 6 year prospective study for diarrhoea! illness failed to establish any linkage between diarrhoea and maternal education (Bilenko, Fraser and Naggan. 1990).

d) Family Size

Family size has been found to influence diarrhoea in many studies. When many people live together, the chance of contact with pathogens increases, and hygiene may deteriorate (Woldemicaei. 2001, Manun'ebo et al., 1994). A large number of children in a household increase the likelihood of having diarrhoea because of crowding and competition for mother's time and attention and other resources (Woldemicaei, 2001). In Eritrea, the probability of having diarihea is about 60% higher if There are six or more children living in the house than if the number of children is less than three. In Ethiopia, the odds of having diarrhoea associated w ith the number of children remained significant even after controlling for all environmental, behavioral and other socio-economic variables considered in a study conducted in study.

e) Nutrition

Children with poor nutritional status and overall health, as well as those exposed to poor environmental conditions, are more susceptible to severe diarrhoea and dehydration

than healthy children. Children are also at greater risk than adults of life-threatening dehydration since water constitutes a greater proportion of children's body-weight (UNICEF/WHO, 2009).

Diarrhoea and malnutrition are known to have a bi-directional relationship; undernourished children are at higher risk of suffering more severe, prolonged and often more frequent episodes of diarrhoea Repeated bouts of diarrhoea also place children at a greater risk of worsening nutritional status due to decreased food intake and reduced nutrient absorption, combined with the child's increased nutritional requirements during repeated episodes (WHO/UN ICEF, 2009; Nel, 2010). It has been suggested that poor nutritional status is a risk factor of diarrhoea (Chen. Huq and Huffman, 1981; Schorling, Wanke and Schorling, 1990). A pooled analysis of nine cohort studies from different countries also indicated thai a higher cumulative burden of diarrhoea prior to 24 months of life was associated with an increased prevalence of stunting at 24 months of age (Checkley, Gilman, Black. Epstein. Cabrera, Sterling and Moulton. 2004)

2.3.3 Environmental Factors

Environmental factors include water sources, availability of toilet facilities and method of excreta disposal. Most environmental factors are usually associated with socio-economic status and place of residence (Woldemicael, 2001, Rustein. 2000). The effect of the environment on health is complex and is conditioned by a wide range of characteristics and behaviours. For example, the effect of improved water and toilet facilities on child health may vary depending on parental education, child feeding practices or income (Timaeus and Lush, 1995).

Tukei (1984) observes that even if water is from a clean tap, fetching it with unclean containers and improper storage can facilitate contamination with diarrhoea causing organisms. WHO (1984) reiterates that the most common and widespread danger associated drinking water is contamination either directly or indirectly by sewage, other waste including human and animal excrement. If drinking w ater is contaminated and then used in preparing foods, it may result to further cases of infection Faecal contamination of any other source of pollution may introduce a v ariety of intestinal pathogens, parasites and bacteria WHO (1984) holds that the organisms in water may cause severity from

mild to sometimes fatal dysentery, cholera and typhoid. Using clean and treated water can prevent diarrhoea. Families who have plentiful supply of safe piped water and use it properly have fewer incidences of illness

Researchers have shown that children liv ing in households with some kind of toilet facility are less likely to be sick than children in households which do not have toilet facilities In Ghana, the risk of having diarrhoea was found to be significantly associated with toilet facility, where children living in houses with toilet facilities are about 50% less likely to contract diarrhoea than children living in houses with no such facilities (Tagoe, 1995). A similar finding was reported in Rural Zimbabwe where a cohort study on childhood diarrhoea was conducted for 45 weeks in two neighbouring semi-arid communities with similar characteristics in terms of healthcare provision, water supply and socio-economic characteristics but different in terms of sanitation and population density One community was densely populated and had improved sanitation facilities while the other was less dense but openly defecated. Children from the less dense community that openly defecated had three times as many episodes of diarrhoea as the community' which was densely populated but used an improved sanitation (Root, 2001). Similar results have also been obtained from studies in Uganda. Brazil. Bangladesh and Ethiopia (Mbonye. 2004; Genser et al., 2006; Buttenheim. 2008; Girma, Wondwossen, Bishaw and Tefera, 2008) Buttenheim (2008) argues that children's toileting matters more than adult toileting behaviour in creating a safe, hygienic environment and reducing diarrhoea! disease especially in crowded urban slums Only one study conducted in Southwestern Ethiopia identifies availability of a toilet facility as a risk factor associated with diarrhoea (Teklemariam, 2000). This could be explained by poor use of the toilet facility for instance having faeces on the floor of the toilets which are later transferred to food by flies. Other studies have also highlighted that first, that it is the safe disposal of children's feces that provides the greatest health benefit (Ezzati, Pongou and Salomon 2005; Shordt. 2006; Yeager, Huttly, Bartohni, Rojas and Lanata, 1999) and that sanitation improvements are likely to make the greatest impact in crowded urban areas where feacal matter can easily contaminate residential areas (Esrey, 1996; Ezzati et al.. 2005, Buttenheim, 2008). In Salvador Brazil, the effect of poor socio-economic conditions on diarrhoea incidence was mediated by inadequate sanitation and childcare

related variables and showed strongest association in children older lhan 36 months (Genser et al., 2006).

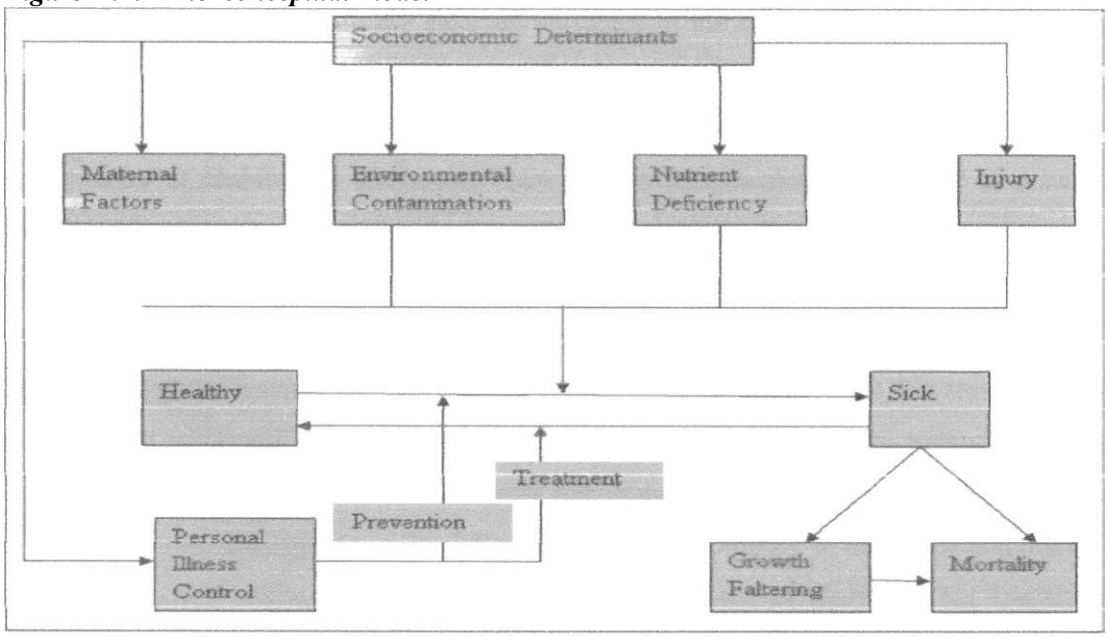
The health benefits of improved water supply have been established in several studies. Improved sources of drinking water are less likely to be contaminated and likely to prevent the spread of water-related diseases, such as diarrhoea and cholera (Bateman and Smith, 1991). Using DHS data from eight Sub-Saharan African countries, Fayehun (2010) establishes that in countries with low under-five mortality such as Namibia and Lesotho, the proportion of children living in households with an improv ed source of drinking water is greater than in countries in the high under-five mortality group. Seventy one percent of households in Namibia and 55% of households in Lesotho access their drinking water from improved sources. Conversely, in countries with high under-five mortality at least 40% of children live in households with an open well or surface water as their source of drinking water (Fayehun, 2010). Researchers have also focused on the effects of handwashing as a preventive measure to diarrhoea and other infectious diseases. How ever, the impact of handw ashing can only be felt if water is av ailable. Most of the handwashing interventions have also focused on the promotion of handwashing rather than the actual practice of handwashing making it difficult to ev aluate the actual behavior change (hand washing practice) On reviewing studies published in English up to the end of 2002 relating handw ashing to the risk of infectious intestinal or diarrhoea] diseases, Cairncross e! a! (2010) established a net reduction of 43% in diarrhoea from a pool of 17 studies. In another context, three studies conducted in settings where water use was known to be constrained; one in Lima, Peru, where vendors sold water expensively; another one in a refugee camp in Malawi and the last one in Burundi where water usage was only 51% per capita per day. yielded a reduction risk of 11, 26 and 41 % respectively; all of which were below the proposed 43% reduction risk (Cairncross et al, 2010). Information on the practice of handwashing was not exclusively established in the KDHS (households were asked about the presence of a soap in the household and not the actual handwashing behaviour) and was excluded in this study.

2.4 Conceptual Framework

As noted by the World Bank (2005), child mortality/morbidity has broad sets of determinants which interconnect with many factors such as fertility, maternal factors, nutrition, education, infrastructure development, safe water supply, electrification, disaster prevention and relief, agricultural output, and public policies and private acquisitions that aim for income generation Several analytical frameworks through which to v iew the effects of different determinants on childhood mortality and morbidity have been developed Moslev and Chen (1984) and Schultz (1984) made distinctions between variables considered to be exogenous or socio-economic; cultural, social, economic, community and regional factors, and endogenous or biomedical factors; breastfeeding patterns, hygiene, sanitary measures, and nutrition.

The effects of the socio-economic variables are considered indirect because they operate through the biomedical factors to bring about morbidity or mortality. The bio-medical factors are called intermediate variables or proximate determinants because they constitute the middle step between the exogenous variables and child mortality/morbidity (Moslev and Chen. 1984; Schultz, 1984) as illustrated below.

Figure 2.1: The conceptual model



Source: An Analytical Framework for the Study of Child Survival in Developing Countries by Mosley and Chen (1984)

The five groups are expanded as follows:

- Maternal factors: age: parity: birth interval
- Environmental contamination: air/food/waler/fingers, skin/soil/inanimate objects; insects vectors
- Nutrient Deficiency: calories, protein; macronutnents
- Injury accidental, intentional

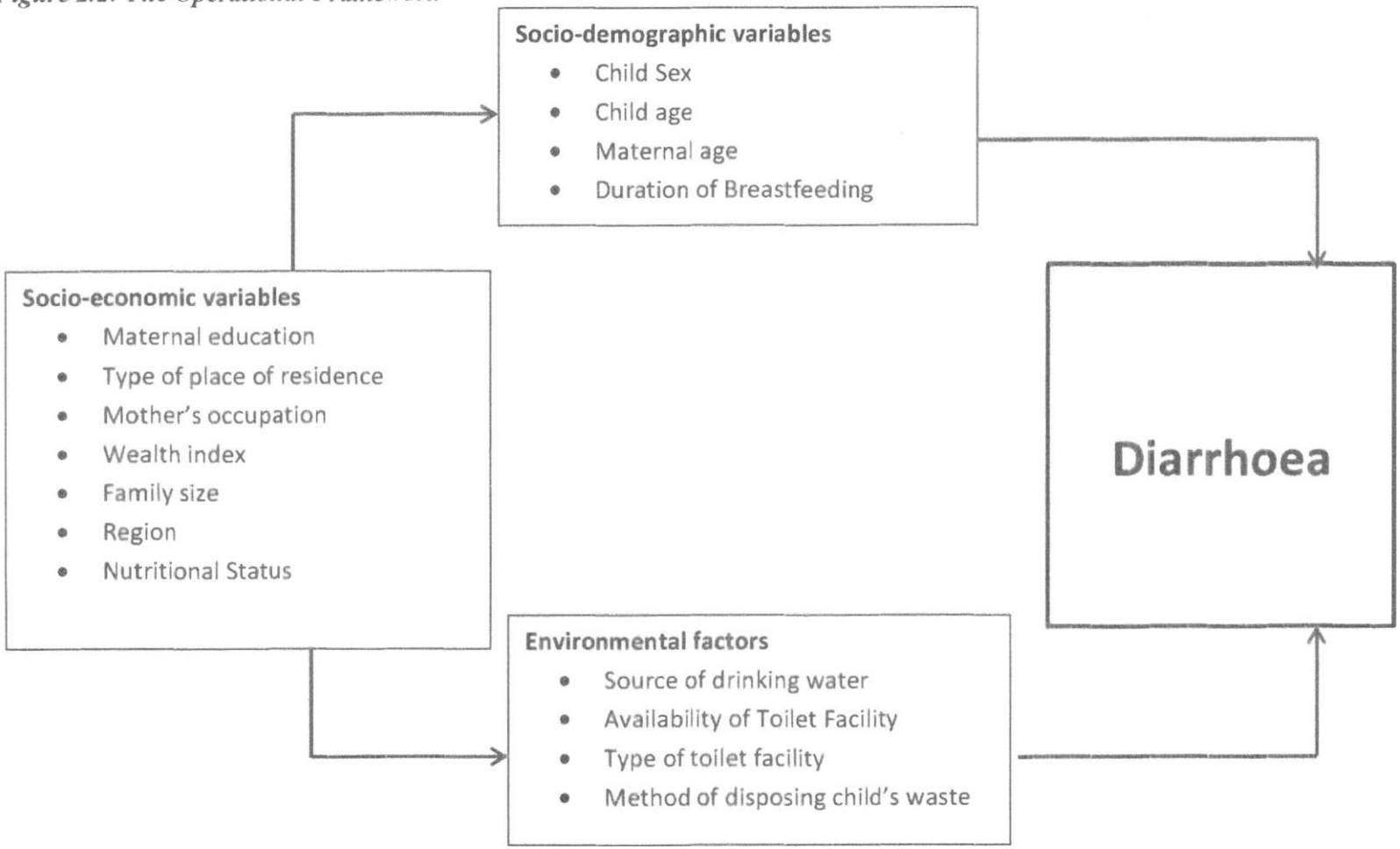
Personal illness control: personal preventive measures; medical treatment

Maternal factors, environmental contamination factors, nutrient deficiency and injury influence the rate at which the healthy children may shift towards sickness while personal illness control influence the rate of the incidence of illness through prevention and the rate of recovery from illness through cure. The consequence of sickness is either growth faltering or death.

2.5 Operational Framework

The study seeks to modify the Mosley and Chen framework and operational i/e it as illustrated in figure 2.2 below. The framework demonstrates how the conceptual model (in Figure 2.1) is applied on the selected variables in the study of childhood diarrhoea morbidity. The independent variables are the level of education of the mother, type of place of residence, occupation of the mother, region of residence, maternal age, family size/number of children in the house, source of drinking water, availability of a toilet facility and the type of toilet facility of a household. The dependent variable is dichotomous; whether a child had diarrhoea in the two week period prior to the survey or not. The study excludes nutrient deficiency and injury factors mentioned in Mosley and Chen's model because the surveys whose data is being employ ed in this study did not collect such information at the time of the survey. It also eliminates personal illness control in form of diarrhoea treatment/ oral rehydration therapy because the focus of the study is to assess the impacts of the differenl factors on incidence of diarrhoea and not the prevalence ORT has significant impact on the resurgence of diarrhoea but has little impact on its onset.

Figure 2.2: The Operational Framework



2.6 Operational Hypotheses

i Diarrhoea incidences are low among children residing in households with a toilet facility compared to those residing in households with no toilet facility.

ii. There is a negative relationship between maternal age and diarrhoea incidenccs.

iii. There is a positive relationship between family size and diarrhoea.

iv. Diarrhoea incidences are low among families of rich socio-economic status as compared to the poor

v. Children born by mothers with secondary education or higher have low diarrhoea incidences compared to children born of mothers with no education.

vi. Children born by mothers who are working suffer from low diarrhoea incidences as compared to children whose mothers are un-cmp!o\ ed

vii. Households with improved sources of drinking water cxpcriencc less diarrhoea incidenccs compared to children born in household with a non-improved source of drinking.

viii. Children who are breastfed for a longer duration have low diarrhoea incidences as compared to those who are breastfed for a short duration.

CHAPTER THREE
DATA AND METHODOLOGY

3.1 Introduction

This chapter presents a description of the sources of data, sample selection, data quality and the analytical tool used in this study so as to yield the necessary conclusions of the risk factors associated with diarrhoea among children between 0-59 months.

3.2 Data Quality

The definition of diarrhoea differs across different contexts due to the fact that the frequency with which stools are passed and the consistency of the stools depend very much on diet and varies from one individual (or society) to another, making the ascertainment of a diarrhoea attack difficult. In the KHDS survey, diarrhoea was defined by the respondent/mother of the child (verbal autopsy) which would have resulted in under reporting of diarrhoea cases especially for areas that are prone to diarrhoea attacks. However, on running the frequency of diarrhoea incidences across the different regions, those who failed to determine an episode of diarrhoea attack were very few (81 cases; approximately 0 2 per cent), with the highest non response rate being in Nairobi which experienced the least incidences of diarrhoea attack System missing cases were also very few; 6.1 per cent and could not be assumed to have solely been caused by lack of response by those interv iewed Both system missing and non-response cases were eliminated from this analysis

3.3 Data Sources

This study used the KDHS survey carried out in 2008 as pari of the international program of DHS Among others, information on dianhoea and other health related factors was collected from a total of 5481 children aged between 0-59 months. For living children born three years prior to the survey, mothers were asked whether their children had experienced diarrhoea during the two weeks period prior to the surv ey . The analy sis of this study was confined to 5481 children aged between 0-59 months who were living with their mothers al the time of the surv ey .

3.4 Description and Categorization of Variables

The dependent variable for this study was recent diarrhoea morbidity. For the purpose of analysis, whether a child had had diarrhoea in the two weeks before the survey[7] was used as a dichotomous dependent vanable (ill or not ill during the two weeks prior to the survey). Explanatory variables included in the analysis were categori/ed under the following classes. (1) Demographic variables, (2) household environmental variables, and (3) socio-economic variables. The demographic variables included age and sex of child and maternal age. The environmental variables considered availability and type of toilet facilities in the house, source of water supply and the disposal of children's excreta. The socio-economic v ariables included education of the mother, household economic status and rural-urban residence, maternal age, and number of persons living in the house The description and categorization of each of these variables is given below and summarized in tablel.

3.4.1 Age of Children

Age is one of the most important factors in morbidity analysis because both feeding and disease incidcnce are largely dependent on it. The level of exposure of children to disease organisms and the type of immune response to infections vary with the age of the child. Infectious diseases such as diarrhoea are less frequent when the child is small because of the immunity acquired and the level of care and breast milk it receives from the mother as well as the less exposure to contaminated agents When the child has lost inborn immunity and becomes more vulnerable to different infections, the prevalence of diarrhoea becomes high. Thus, assessing the prevalence of diarrhoea by age of the child will give important information about the age pattern of diarrhoeal prev alence The age of child is categori/ed as 6-11 and 12-23 months.

3.4.2 Family Size

Number of persons in the house may have some impacts on the incidence of child diarrhoea. A large number of people in a household may be more likely of hav ing diar rhoea because of crowding. Thus, number of children living in the house is included as an indicator of crowding Two categories are distinguished; five or less and six or more persons in a household.

Table 1: Variable descriptions and categorization

Variable Type and classification	Variable Name and Categorization
Dependent Variable: Diarrhoea Incidences	**Experienced diarrhoea recently (two weeks before the survey):** 1. Yes 2. No
Independent Variable (s): **a. Socio-economic characteristics:**	**Maternal Education:** 1. No Education 2. Primary Education 3. Secondary and Higher
	Type of Place of Residence: 1. Rural 2. Urban
	Mother's Occupation: 1. Employed 2. Un-employed
	Wealth Index: 1. Poor 2. Middle 3 Rich
	Family Size: i. Five or fewer 2. Six and Above
	Region: 1. Nairobi 2. Central 3. Coast 4. Eastern 5. Nvanza 6. Rift Valley 7. Western 8. North-eastern
	Nutritional Status: 1. Well-Nourished 2. Malnourished
b. Environmental characteristics	**Source of Drinking Water:** 1. Improved 2. Non-Improved
	Availability of Toilet Facility: 1. No Toilet Facility 2. Toilet Facility Present
	Method of disposal of Child's Waste: 1 Improved 2. Non-Improved

Table 1: Variable Description and categorization (Continuation)

c. Socio-demographic	**Child Age:** 1. <6 2. 6-11 3. 12-23 4. 24-35 5. 36-47 6. 48-59
	Child Sex: 1. Male 2. Female
	Maternal Age: 1. < 18 2. 19-24 3. 25-35 4. 36 and above
	Duration of Breastfeeding (months): 1. <4 2. 5-11 3. 12-23 4. >24

3.4.3 Availability of Toilet Facility

Respondents were asked whether the dwelling had some kind of toilet facilities. Literature also establishes that the presence of a toilet facility alone is not sufficient in preventing diarrhoea but the type of the available facility and how its usage. The availability of a toilet facility was categorised into two: no toilet facility and toilet facility present. The type was categorised into improved and non-improv ed.

3.4.4 Maternal Education

The KDHS collected information on the highest educational level of respondents at the time of the interview . The six categories identified by the KDHS were no education, primary incomplete, primary complete, secondary incomplete, secondary complete, and higher education. For the purpose of this study, due to the few cases of responses in some of the categories, the responses were reclassified into three, no education, primary and secondary and above.

3.4.5 Household Economic Status

Most surveys do not collect direct information on parental income but seek information on the number of consumer durables possessed by households (such as a radio, bicycle, etc.). Like most DHS surveys, the KDHS did not attempt to collect information about income directly. Instead, respondents were asked about ownership of household goods such as radio, bicycle, television, car, and the like. Ownership of radio, bicy cle, and car are here regarded as a proxy for general household wealth, which may affect infant and childhood health but for which information was not directly available. These items were used to construct a new household economic status variable with three categories which were defined as (1) "low' if the household was "poorest" or "poorer", (2) 'medium' for households with medium wealth index and (3) "high' if the households were "richer" or "Richest". This variable categorisation avoided the problem of income measurement in rural areas and might be a reasonable indicator of relative economic status.

3.4.6 Rural-Urban Residence

Whether a mother resides in an urban or rural locality may affect her exposure to education and the extent to which proper sanitation, clean water and health-care facilities are available. It might therefore be expected that children in urban areas where proper sanitation and health facilities are available as well as where modem treatment is more frequent, would have lower prevalence of diarrhoea. Thus, a distinction was made betw een rural and urban areas in this study.

3.4.7 Water Supply

The health benefits of improved water supply have been established in several previous studies (Esrey and Habicht, 1986). Clean w ater prevents the spread of w ater-related diseases, such as diarrhoea and cholera (Bateman and Smith, 1991) Sources of water are country specific according to the DHS. In Kenya the major sources of water include piped source within the dwelling or plot, public tap, tube well or borehole, protected well or spring, rainwater, lakes, streams and rivers The water sources were further categorized into improved and un-improved sources for the purposes of this study.

3.4.8 Duration of Breastfeeding

Breast milk has a protective effect on various infections. Some studies suggest that the anti-infective and protective effects of breast milk are reflected in milder illnesses from various infections and lower risks of death (Palloni and Tienda, 1986; But/, et a1, 1984) Exclusive breast-fed babies are much less likely to get diarrhoea or to die from it than babies who are not breast-fed or partially breast-fed (WHO, 1990). The greatest challenge in identifying the protective effect of breastfeeding is the difficulty to distinguish periods in which the child is in the process of being weaned The introduction of supplementation with other liquids or foods marks the beginning of a child's exposure to possibly contaminated foods and liquids The duration of breastfeeding is used to evaluate any effect of breastfeeding in this study and is categorised into. (1). those who were breastfed for four months or below, (2) those who were breastfed for five to eleven months, (3). those who were breastfed for twelve to twenty three months and lastly (4). those who were breastfed for more than two years

3.4.9 Nutritional Status

The nutritional status of the index child is established using the child's weight-for-height index, which captures more recent, short-term nutritional or disease insults. A decline in weight-for-height can be caused by a severe bout of illness (particularly diarrheal disease), a short-term reduction in food intake, or both. The DHS provides standardized weight-for-height /-scores using the CDC 2000 Growth Charts (Kuczmarski. Ogden, & Guo, 2002). The weight-for-height /-score (WHZ) indicates the number of standard deviations away from the median of the reference population. A child with a weight-for-height /-score of less than -2.0 is defined as wasted/malnounshed. Two categories were identified for this study and include: the well-nourished and the mal-nounshed children

3.5 Methods of Analysis

Descriptive statistics was used to show the distribution of the study population by different background characteristics and diarrhoea incidences across the study population. Cross tabulations were used to show any significant relationships that exist between each of the independent variables and the dependent variable To determine whether these

CHAPTER FOUR
FINDINGS FROM THE STUDY

5.1 Introduction

This chapter is organised into two sections; section one deals with the distribution of the study population by different socio-economic, socio-demographic and environmental characteristics while section two gives the distribution of the study variable by the different socio-economic, socio-demographic and environmental characteristics

5.2 Descriptive Statistics of the Study Population

A total of 5481 children were included in this study Out of these children, 937 (17.1%) had diarrhoea while 4544 (82.9%) did not experience diarrhoea in the two weeks period preceding the survey. The sample included 1283 children from urban areas while 4198 were from rural areas Rift valley and Nyan/a province had the highest number of children in the sample with 980 and 950 children respectively while Nairobi had the least with 365 children representing 6.7% of the study population.

The study population had slightly more males than females; 51 3% (2812 children) of the study population were males while 48.7% (2669 children) were females. The mean age of the study population is 28 4 (±17 4) months More than two thirds (62 7%) of the study population were below the age of three years The largest proportion of the study population (20.2%) was aged between 24-35 months

The mean age of the children's mothers in the study was 28.2 (±6.6) years. Children who lived in urban areas had mothers who were slightly younger |27 2 (±6.0) years] than those in rural areas [28.6 (± 6.8) years J ($p<0.05$). There was a marked difference in ages of the children's mothers across the regions; Central and Eastern provinces had children with slightly older mothers [29.1 (±6.7) and 29.2 (±6.7)] years respectively while Nyanza had children whose mothers were the youngest averaging 27 (±6.5) years. More than 80 % of the children's mothers were below the age of 35 years (Table 2).

Table 2: Descriptive characteristics (Continuation)

Child's Age			
	<6	594	10.8
	6-11	646	11.8
	12-23	1091	19.9
	24-35	1105	20.2
	36-47	1025	18.7
	48-59	1020	18.
Sex of the child			
	Male	2812	51.3
	Female	2669	48.7
Maternal Age			
	<18	3.6	195
	19-24	29.9	1638
	25-34	47.4	2600
	35+	19.1	1048
Duration of Breastfeeding			
	<5	624	11.8
	5-11	1212	22.9
	12-23	2330	44.0
	24+	1128	21.3

Majority of the children's mothers were engaged in some form of employment (56.7%). Three thousand and seventy five (56.1%) had attained primary education and two thousand six hundred and elev en (47.6%) were poor Majority of the children's mothers with no education (81%) belonged to the low socio-economic group/poor while majority of mothers w ith secondary and higher education group (69%) were of high socio-economic group/rich.

Rural areas had twice as many children with mothers having no education (24.8%) as urban areas (11.1%) whereas urban areas had more than twice (42.8%) children with mothers having secondary education as compared to their rural counterparts at 16% although maternal employment status failed to depict a significant difference with children whose mothers were employed in rural areas being slightly higher (57.3%) than those in urban (54.7%).

Across the regions. Central province had both the least number of children whose mothers had no education (0.9%) and those whose mothers were not employed (24.6%), while North-eastern prov ince had the highest number of both children whose mothers had no education (88%) and no employment (85%). Nairobi had the highest number of children whose mothers had attained secondary and higher education totalling 227 (62.2%) while North-eastern had the least totalling just twelve in number (2.3%).

The mean household size of the study population was 6.0 (±2.4) persons. Urban areas had a slightly smaller average number of persons per household of 5 1 (±2.1) persons compared to rural areas which had a mean household size of 6.3 (±2.5) persons. Nairobi province, being predominantly urban had the lowest average household size [4.2 (±1.9) persons] while Coast province had the highest average number of persons per household [6.5 (±3.0) persons |

Majority of the children (92.9%) \sere well nourished. Urban areas had a slightly higher majority (94.4%) of well-noun shed children compared to rural areas (92 4%). Across the regions. Western and Nyanza had the highest proportions of the well-nourished children at 97.7 and 97.1% respectively. North-Eastern, Coast and Eastern provinces had the highest number of malnourished children at 18%, 10.8% and 9.1% respectively. Households with poor socio-economic status had a higher proportion of malnourished children (9.5%) compared to households of rich households (5.0%) The highest proportion of malnourished children (10%) was between the ages of 12-23 months while the least proportion was between 0-6 months.

Out of the total 5,481 children included in the sample, 5,411 children (98.7%) lived in households that reported their source of drinking water Majority of the children (57.4%) lived in households with an improved source while 42.6 % lived in households with a non-improved water sources including open dams, rivers and streams. Comparatively, majority of children in urban areas (87.7%) lived in households with an improv ed water source while children in rural households were almost split in half with those living in households with a non-improved water source hav ing a slight majority of 51 8 %.

Differences in sources of drinking water also existed between the regions Apart from Rift Valley and Eastern province in which majority of children lived in households that got water from a non-improved source (56 1% and 55 9% respectively), all the other regions had majority of children living in households that got their water from improv ed sources. Nairobi province had the highest proportion of children (92.2%) who lived in households w ith an improved source of drinking w ater

Nearly three quarters of children (74 8%) in this study lived in households which had a toilet facility. A notable difference exists between urban and rural households in that an overwhelming majority (96.8%) of children who lived in households with no toilet facility

were From rural areas. The number of children who lived in households with a toilet facility in urban areas is more than twice (69.8%) the number of households with toilet facilities in rural areas (30.2%). Regionally; ali children in Nairobi and Central provinces lived households which had a toilet facility. North-Eastern and Coast provinces had the majority of children who liv ed in households with no toilet facility (58.8% and 41% respectively).

Fifty two percent of children in the study lived in households that did not share a toilet facility. There was a major difference in type of toilet facility by type of place of residence. Majority of children (67 8%) who resided in urban areas lived in households that had improved toilet facilities which were not shared with other households compared to 45.2% of those who resided in rural areas There was also a major difference in the use of toilet facility by region. North-Eastern province had the highest number of children (65.7%) who lived in households with an improved toilet facility while Eastern Province had the least (42.3%).

Over one third (34.6%) of children in the study population had their stools disposed openlv/unsafe. Majority (92.2%) of those who disposed children stools openly resided in rural areas Regionally, Nairobi province had the least (4.7 %) proportion of children whose stools were disposed openly while North-Eastern province had over two thirds (68.6%) of children disposing their stools openly.

The mean duration for breastfeeding in the study population was 16.6 (±14.2) months with a median duration of 15 months. Over three quarter (78.7%) of the children in the study population had a breastfeeding duration of less than two years with majority (44 %) hav ing a breastfeeding duration of between 12-23 months

5.3 The Association of Children's Background Characteristics and Diarrhoea

Table 3 presents selected characteristics of the child in relation to under-five diarrhoeal incidences. From the socio-economic v ariables included, only the type of place of residence did not show significant association with under-ftve diarrhoeal incidences. Sixteen point four percent and seventeen point three percent of children in urban and rural areas respectively contracted diarrhoea in the two week period preceding the survey.

Table 3: Bivariate Analysis of Diarrhoea and Child's Background Characteristics

Study Variable	Had Diarrhoea Recently (%)	
	No	Yes
Region of residence:		
Nairobi	328 (89.9)	37(10.1)
Central	387 (86.2)	62 (13.8)
Coast	616(76.5)	189(23.5)
Eastern	610(87.4)	88(12.6)
Nyanza	769 (80.9)	181 (19.1)
Rift Valley	819(83.6)	161 (16.4)
Western	569 (80.5)	138 (19.5)
North-Eastern	446 (84.6)	81(15.4)
X^2=55.87: P 0.00; df 7		
Maternal Education:		
No Education	953 (80.4)	232(19.6)
Primary	2516(81.8)	559(18.2)
Secondary and higher	1075 (88.0)	146(12.0)
X^2 30.44; P OM); df 2		
Mother's Occupation:		
Employed	2545 (82.1)	556(17.9)
Un-employed	1988 (84.0)	379(16.0)
X^2=23.48; P 0.06; df I		
Wealth Index:		
Poor	2114(81.0)	497(19.0)
Middle	751 (84.3)	140(15.7)
Rich	1679(84.8)	300 (15.2)
X^2=13.37; P 0.00; df=2		
Place of Residence:		
Urban	1072 (83.6)	211 (16.4)
Rural	3472 (82.7)	726(17.3)
X^2=0.50; P-0.48; df 1		
Nutritional Status:		
Well-Nourished	3913 (83.0)	799(17.0)
Malnourished	271 (74.9)	91(25.1)
X^2 15.56; P 0.00; df 1		
Family size:		
<5	2268 (84.5)	415 (15.5)
6+	2276(81.3)	522 (18.7)
X^2=9.82 ; P 0.00 ; df I		
Availability of Toilet facility:		
No Toilet Facility	1055 (77.5)	306 (22.5)
Toilet Facility Present	3429 (84.7)	621 (15.3)
X^2-36.68; P 0.00; df l		
Type of Toilet facility:		
Non-Improved	1691 (87 1)	250(12.9)
Improved	1734 (82.4)	370(17.6)
X^2 = 17.23; P 0.00; df 1		

Table 3: Bivariate analysis (continuation)

Study Variable	Had Diarrhoea Recently (%)	
	No	Yes
Child's Waste Disposal:		
Open Stool disposal	1502(79.3)	391 (20.7)
Safe Stool Disposal	3030 (84.8)	543 (15.2)
X^2=26.02; POM; d f l		
Sources of Drinking Water:		
Non-Improved	1869(81.2)	434(18.8)
Improved	2625 (84.1)	493 (15.9)
X^2=8.29; P 0.00; df l		
Child's Age in Months:		
<6	523 (88.0)	71 (12.0)
6-11	453 (70.1)	193 (29.9)
12-23	779 (71.4)	312(28.6)
24-35	930 (84.2)	175 (15.8)
36-47	914(89.2)	111(10.8)
48-59	945 (92.6)	75 (7.4)
X^2=285.32; P=0.00; df 5		
Maternal Age in Croups:		
<18	137 (70.3)	58(29.7)
19-24	1324 (80.8)	314(19.2)
25-35	2176(83.7)	424 (16.3)
36+	907 (86.5)	141 (13.5)
X^2=37.93; P=0.00; df=3		
Child's Sex:		
Male	2313(82.3)	499 (17.7)
Female	2231 (83.6)	438(16.4)
X^2=1.72; P=0.19; df=l		
Duration of Breastfeeding (Months):		
<5	551 (88.3)	73(11.7)
5-11	931 (76.8)	281 (23.2)
12-23	1900(81.5)	430 (18.5)
24+	1005(89.1)	123 (10.9)
A'' 77.94: P 0.00; df 3		

Diarrhoea incidences were strongly associated with region of residence (/?-value 0.00). There was a marked difference in the occurrence of diarrhoea by geographical regions. Coast, Western and Nyan/a province had the highest proportion of children with diarrhoea (23.5%, 19.5% and 19.1 % respectively) while Nairobi had the least (10.1 %).

The proportion of children born to mothers with no education who experienced diarrhoea was more one and a half times (19.6%) the proportion of children bom to mothers with secondary' or higher education (12 0%) However, only a slight difference exists in the

proportion of children who experienced diarrhoea between mothers with no education and those with primary education (19.6% and 18% respectively).

Mothers' occupation aiso showed a significant association with childhood diarrhoea incidences (/?-value 0.06). 17.9% of children whose mothers were employed contracted diarrhoea compared to 16.0 % of those whose mothers were un-employed. Diarrhoea incidences were also high among children who lived in households of low socio-economic status and decreased with increasing socio-economic status (/>value 0.00). 19.0% of children in poor households had diarrhoea compared to 15 2% of children in rich households.

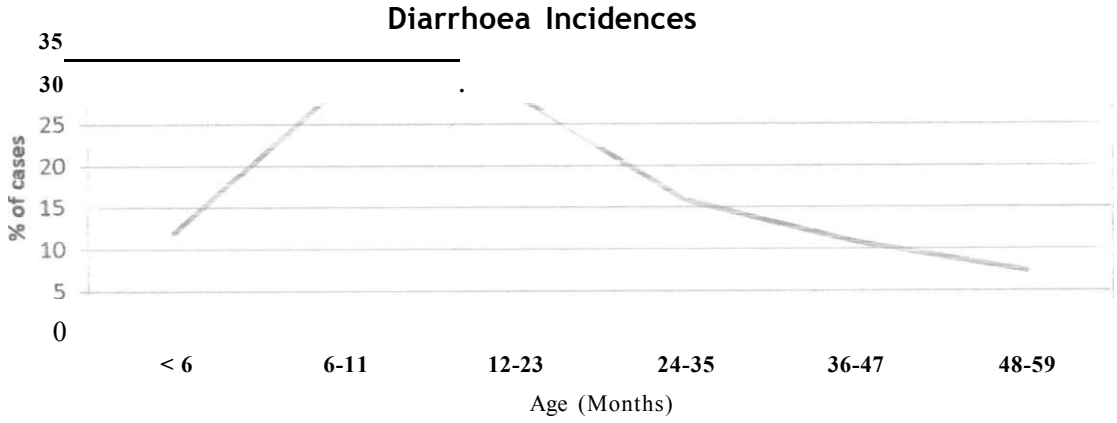
Nutritional status of the index child had a significant association w ith diarrhoea *(p*-value 0.00); children who were malnourished had higher diarrhoea incidences (25.1%) compared to 17.0 % of the well-nourished children

Number of people in the household was also significantly associated with diarrhoea incidences (/>-value 0.00). Children living in households with less than six members had lower cases of diarrhoea (15.5%) compared to 18.7% of children in households with six or more members.

All the selected environmental variables showed significant association with diarrhoea incidences Diarrhoea incidences were low (15 3%) among children who lived in households with a toilet facility compared to 22.5% of those who lived in households that were lacking a toilet facility (/>-value 0.00). However, although children in households with improved toilet facilities were expected to have fewer cases of diarrhoea, this study established that diarrhoea cases were high in households with an improved toilet facility than those with non-improved toilet facility (/?-value 0.00). The proportion of children with diarrhoea was 12.9% for households with a non-improved toilet facility and 17 6% for households with an improved toilet facility Diarrhoea was also significantly associated w ith the method of disposing children's waste (/?-value 0.00). The proportion of children whose waste were safely disposed and had diarrhoea was 15,2% compared to 20.7% whose waste was disposed openly. Diarrhoea incidences were also strongly associated with sources of drinking water (p-value 0.00). Diarrhoea incidences were higher (18 8%) among households with a non-improved source of drinking water compared to households improved water sources (15.9%).

Diarrhoea incidences peaked among children aged between 6-11 months (29.9%) as shown in figure 4.1. Beyond six months, diarrhoea incidences decrease with increasing age. The proportion of children with diarrhoea aged 6-11 months is almost four times the proportion of children aged 48-59 months with diarrhoea. The mean age of children with diarrhoea was 22.52 months as compared to 29.63 months for those with no diarrhoea.

Figure 4.1: Diarrhoea incidences by age



Childhood diarrhoeal incidence was also significantly associated with maternal age *(p-x*alue of 0.00). Approximately thirty percent (29.7%) of children bom to mothers who were eighteen years and below had diarrhoea compared to 13.5% of children bom to mothers beyond the age of thirty five years Sex of the index child showed a weak association with diarrhoea incidence (p-vaiue 0.19); 17.7% of maies and 16.4 % of females experienced a diarrhoea episode in the two week period preceding the survey

Duration of breastfeeding was significantly associated w ith diarrhoea *{p-*\ alue 0.00). For children who were breastfed for more than five months, diarrhoea incidences declined with increasing duration of breastfeeding The mean duration of breastfeeding for children who experienced diarrhoea was 15.7 months compared to 16.8 months for those who did not experience the disease.

5.4 Results of the Multivariate Analysis

Multivariate analysis is performed by taking the conceptual framework (Fig 2.2) into consideration Stepwise logistic regression technique was used to assess the relative effect of

the explanatory- factors on the outcome factor. To avoid an excessive number of variables and unstable estimates in the subsequent model, only variables which reached a p-value less than 0.3 were kept in the subsequent analyses from the bivariate analysis.

The overall effect of the selected socioeconomic variables (Table 4) on childhood diarrhoeal morbidity was assessed in the first step. In the second step of the analysis, the environmental variables were added, and their effect was assessed in the presence of the socioeconomic variables. Socio-demographic variables were entered in the third step. In this step, the effect of the selected socio-demographic factors was assessed in the presence of both socioeconomic and environmental factors. Table 4 presents the socioeconomic, env ironmental and socio-demographic variables which remained in each step of the analysis.

From the socioeconomic variables entered in the first step of the analysis, family size, nutritional status of the index child and region of residence remained significant in the final step (Table 4)

There was a marked differential in the risk of having diarrhoea regionally. In this study. Children living in Western province were two times more likely to have diarrhoea than children living in Nairobi. The odds of having diarrhoea for a child liv ing in Western province decreased slightly when env ironmental and socio-demographic characteristics of the child were considered and remained significant at 0.01 Although the risk of having diarrhoea was also significant and increasing for Coast province in the first and the second model at p-values of 0.05, it disappeared in the final model after accounting for the socio-demographic characteristics if the child. The results were similar to results obtained in rural Zimbabwe (Root, 2001) and could be explained by differences in socio-economic status, access to health services and environmental conditions (Timaeus and Lush, 1995).

According to this study, the odds of having diarrhoea in children who lived in households where there were six or more people was **1**.3 times higher than the odds in children who lived in households where there were five or less persons. Family size failed to show any significance when only socio-economic variables were considered and only became significant after environmental factors were introduced The significance level of family size increased from 0.05 to 0.01 in the final model when the socio-economic, the environmental and child's socio-demographic variables were introduced.

Table 4: logistic regression outputs

Study Variable		Model 1 Odds Ratio	Model li Odds Ratio	Model III Odds Ratio
Region	Nairobi *(REF)*			
	Central	1.331	1.306	1.363
	Coast	1 618*	1.625*	1.585
	Eastern	1.144	1.154	1.112
	Nvan/a	1.589*	1.520	1.398
	Rift Valley	1.542	1.501	1.423
	Western	2.049***	2.023**	2.006**
	North-Eastern	1.284	1.258	1.215
Maternal Education	No Education *(REF)*			
	Primary	1.068	1.124	1.000
	Secondary and Higher	.715	.793	.694
Mother's Occupation	Employed(l)	.952	.956	1.075
Wealth Index	Poor *(REF)*			
	Middle	1.025	1.032	1.045
	Rich	1.244	1.209	1.210
Family size	Six and Above (1)	1.119	1.217*	1.343**
Child's Nutritional Status	Malnourished	1.862***	1.858***	1.653**
Source of Drinking Water	Improved Sources (1)		.870	.854
Type of Toilet Facility	Improved (1)		1.454***	1.394***
Disposal of Child's Stool	Safe Stool Disposal (1)		1.067	1.046
Child's Age	< 6 *(REF)*			
	6-11			2.448**
	12-23			2.111*
	24-35			895
	36-47			.619
	48-59			.382**
Sex of child	Female			.915
Maternal Age	< 18 *(REF)*			
	19-24			.850
	25-34			.835
	35+			.577*
Duration of Breastfeeding (Months)	< 5 *(REF)*			
	6-11			1.217
	12-23			1.344
	>24			1.397

*Key: *p<0,05; **p<O.Ol; ***p<0.001*

The findings were similar to results obtained from other studies in Ethiopia and Eritrea (Woldemicael, 2001), which could be explained by the fact that when many people live together, the chance of contact with pathogens increases, and hygiene may deteriorate because of crowding and confirms the hypothesized association between diarrhoea and family size.

This study also confirmed the significant effect of nutrition on diarrhoea Children who were malnourished were more than 1.6 times more likely to have diarrhoea than children who were well nourished. Nutrition remained significant in the entire analysis although the odds reduced when environmental and socio-demographic characteristics were introduced. The significance level of nutrition on diarrhoea also reduced when socio-demographic variables were taken into account. It reduced from 0.00 to 0.01. The result confirmed the hypothesized association between diarrhoea and nutrition and was similar to the findings of UNICEF and WHO (2009) that children with poor nutritional status are more susceptible to diarrhoea than healthy children.

Although maternal education, occupation and wealth index were significantly associated with diarrhoea in the bivariate analysis, they failed to show any significance in the multivariate analysis Similar results were obtained from Eritrea's DHS where education was found to have a significant effect on diarrhoea in the bivariate analysis but the effect diminished after adjusting for other variables and in Israel where no linkage was established between education and diarrhoea. The results were supported by authors who argue that socio-economic factors including education may have a greater effect on diarrhoeal mortality rather than on morbidity since well-educated mothers may be unable to reduce risk of exposure due to factors beyond their control, such as a contaminated community environment, or lack of water and can only use their knowledge and wealth to use healthcare serv ices more effectively than uneducated women (Roof 2001)

The type of toilet facility available to the household remained significant in the final model, from all the environmental variables tested in the second step of the analysis. Although it was expected that children living in households with an improved toilet facility would have a lower risk of having diarrhoea, as was established by other studies carried out in Ghana, Zimbabwe, Uganda, Brazil, Bangladesh and Ethiopia (Tagoe, 1995; Mbonye, 2004; Genser et aL 2006; Buttennheim, 2008; Girma, 2(X)8), this study showed that children

living in households with an improved toilet facility have a 1.4 higher odds of having diarrhoea than children in households that have a non-improved toilet facility and is similar to results obtained from South-western Ethiopia (Tekiemariam et al., 2(X)0). the results could be explained by poor use of the toilet facility for instance having faeces on the floor of the toilets which are later transferred to food by flies. Although the odds of having diarrhoea reduced slightly when the child's socio-demographic characteristics were taken into account, its significance remained constant at 0.00 in both the second ant the final model Availability of toilet facility was positively correlated with the type of toilet facility and was excluded from the multivariate analysis.

Although significant in the bivariate analysis, source of drinking water and method of disposing children's waste failed to show any association with diarrhoea in the multivariate analysis.

There was a significant association between the age of the index child and diarrhoea The risk of diarrhoea increased with increasing age up to 23 months Children aged 6-23 months were more than twice more likely to have diarrhoea than children who were below six months old and significant at 0.01 Diarrhoea risk was lowest among children aged 48-59 whose odds of having diarrhoea were about 0.4 times lower than the odds of children less than six months old and significant al 0.05 Similar findings were established in other studies in Salvador and Caera Brazil, Ethiopia and Uganda (Genser et al . 2006; Mirza et al., 1997; Mbonye, 2004). The above authors argued that the diarrhoea peak in children below two could be explained by weaker inborn immunity in early stages of life, exposure to contaminated weaning foods which is increased beyond 7 months and contaminated neighbourhood environmental conditions

According to this study, children whose mothers were thirty-five years and above were less likely to have diarrhoea than those whose mothers were below eighteen years. Children whose mothers were thirty five years and above had 0.577 lesser odds of having diarrhoea than children whose mothers were below eighteen years The significance level of maternal age for children born to mothers over thirty five years on diarrhoea was 0.05. The findings of this study were similar to others finding which established that young mothers are usually inexperienced in looking after the infant and pointing to the fact that maternal age maybe considered as a proxy for educational level, modernity, knowledge and practice related to

childcare and energy/capacity to care for a child (Mock, Sellers, Abdoh and Franklin, 1993). The results confirmed the hypothesised association between maternal age and diarrhoea

Duration of breastfeeding, though significant in the bivariate analysis, failed to show significant association with diarrhoea in the multivariate analysis, similar to results obtained in Brazil (Barros and Victoria, 1990). The duration of breastfeeding in this study was considerably long with a mean 16.6 months and a median of 15 months with majority of the children (44 %) breastfeeding for duration of between 12-23 months. This could explain why it failed to show any significance as there was lack of variability.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusion and recommendations on policy, programmes and further research on risk factors associated with under-five diarrhoea in Kenya based on the findings from descriptive as well as inferential statistical techniques of analysis.

5.2 Summary

This study examined the factors associated with under-five diarrhoea in Kenya as measured by incidences of diarrhoea disease for the two weeks period preceding the survey. Socio-economic, Environmental and socio-demographic factors that were hypothesized to be associated with under-five diarrhoea included: maternal age, maternal education, maternal occupation, household's wealth index, nutritional status of the index child, region, type of place of residence, family size, source of dnnking water, availability and type of toilet facility available to the household, method of disposing child's faecal matter, duration of breastfeeding and the age and sex of the index child.

The diarrhoea incidence rate for the two week period was 17.1 %. All the environmental factors considered in this study were significantly associated with diarrhoea in the biv ariate analysis but only the type of toilet facility persisted in the final model. This study establishes thai children living in households with an improved toilet facility have a higher risk of having diarrhoea and contradicts the findings of other similar studies which established a reduction in the risk of having diarrhoea with an improved toilet facility and points to poor use of the toilet facilities though not conclusive due to lack of data on hand-washing behaviour and recommends a further research to establish the linkage between improved toilet facility and diarrhoea.

This study failed to establish any linkage between diarrhoea and type of place of residence from all the socio-economic variables Family size, nutritional status and region of

residence remained significant even after accounting for effects of environmental and socio-demographic variables

As expected, children living in households with more than six members had a higher risk of having diarrhoea than children living in households of five or less members. This illustrates that crowding increases the chance of contacts with pathogen and deteriorates hygiene.

This study also confirms that nutritional status of a child has a significant influence on diarrhoea. The findings revealed that malnourished children have a higher risk of having diarrhoea than children who are well nourished and depicts {hat nutrition provides the body with more energy and protection to fight diseases.

This study also confirms a significant relationship between region of residence and diarrhoea Children living in Western. Coast and Nyan/a provinces have a higher risk of having diarrhoea and the significance persists for Western province even after taking the Child's demographic characteristics into consideration and points to difference in environmental conditions though it was insignificant for Central, Eastern, Nvanza Coast, Rift valley and North-eastern provinces.

This study revealed that children born to older women have a lower risk of having diarrhoea especially for those born to women aged 35 years and above Young mothers are usually inexperienced in looking after the infant and lack knowledge and practice related to childeare and energy/capacity to care for a child.

As expected, the child's age was significantly associated with diarrhoea. Diarrhoea risk increased with increasing age up to the age of 23 months. The effect of age on diarrhoea persisted even after accounting for socio-economic and environmental factors. Children between the ages 6-23 monihs are more than twice more likely io have diarrhoea than children below six months. This points to increased exposure to contaminated weaning foods which is increased beyond 7 months and contaminated neighbourhood environmental conditions as children in this age group spent most of their time on the ground Lowest risk of having diarrhoea was associated with children beyond 48 months which can be explained by the fact that this children are likely to take care of themselves especially when defecating as they are more likely lo use a toilet facility on their own.

5.3 Conclusion

This study has established that under-five diarrhoea incidences in Kenya are influenced by demographic, socio-economic, and environmental factors. During the bivariate analysis, all the environmental variables were significantly associated with diarrhoea incidences but only one; type of toilet facility persisted in the final multivariate analysis (significant at 0.001) and the direction of its association with diarrhoea changed from the one hypothesized. Type of place of residence failed to show any association with diarrhoea in the bivariate analysis, from all the socio-economic variables. In the multivariate analysis, nutritional status of the child. Family size and the region of residence persisted in the final model Mutational status, Family size and region of residence were significant at 0.01 while maternal age was significant at 0 05 Child's age is also established a key determinant of the risk of diarrhoea

This study evident!) reveals that an intervention is required not only to improve the hygiene standards and community environments in which we live but also the proper use of toilet facilities in order to prevent diarrhoea the occurrence of diarrhoea

5.4 Recommendations for Policy

The findings from this study have shown that clean environment is a major determinant of diarrhoea among under-five children. It goes further to point that the availability and type of toilet facility is not sufficient in preventing diarrhoea among children but the usage. These should therefore inform programmes on the need to create awareness for proper usage of toilet facilities. Programmes should also aim at promoting proper food handling behaviour especially during weaning. More emphasis should be put on Western and Coast provinces. Nationally, policy formulation should strive to guarantee children proper nutrition and high quality housing to prevent overcrowding. However, with proper hygiene, chances of coming into contact with diarrhoea pathogens will greatly reduce and therefore crowding will not have a significant effect on diarrhoea

5.5 Recommendations for Further Research

The results from the multivariate analysis revealed improved toilet facility as a risk factor to diarrhoea. Further research should be done lo establish the real cause of diarrhoea associated with improved toilet facility and should encompass the role of hand-washing.

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