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# THE INFLUENCE OF ENVIRONMENTAL FACTORS ON INFANT AND CHILD MORTALITY: A STUDY OF SIX DISTRICTS IN KENYA

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Lastly, I wish to thank my parents, who have worked hard to give me what they could not have yesterday.

## DECLARATION

This thesis is my own work and has not been presented for a degree in any other University.

*Sign*____________________________________

*Kimani Paul Wanjohi*

This thesis has been submitted for examination with our approval as the University supervisors.

*Sign*_________________ 17/10/96 ________

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## ABSTRACT

This study examines the influence of selected micro-environmental factors on infant and child mortality. They are defined as micro because the environmental risks investigated do not extend beyond the mother and the room they inhabit. The environmental threats at this level are; poor housing conditions, crowding, inaccessibility and unavailability of clean water and sanitation as measured by types of latrines and bathrooms.

The focus of the study was on six districts, namely, Kwale, Embu, Mombasa, Kitui, Baringo and South Nyanza, covered in the National Household Welfare Monitoring and Evaluation Survey (NHWMES) of 1991. The investigation was divided into four chapters. Chapter one gives the statement of the problem, the objectives, the frameworks utilized, historical background of mortality in developing countries, including Kenya and a general background of the six districts examined. Chapter two discusses and presents all the data utilized in this research and describes the models, both demographic and statistical, used in this study. Chapter three examines the relationship between infant and child mortality and the independent factors. The methods adopted here are simple cross tabulations and multivariate regression analysis. Chapter four gives a summary of the findings, conclusions and recommendations for further studies. This is followed by selected references and an appendix.

Cross-tabulations showed a close and consistent relationship between the environmental variables and mortality. On the other hand, socioeconomic and demographic variables, considered as controls in this study showed, in several instances, a more or less conflicting relationship with mortality. Particularly disturbing was the lack of mothers education to adhere to the traditionally observed relationship with mortality, that is, increasing education is related to higher child survival. A multivariate analysis was used to examine this data for selected environmental variables. controlled for socioeconomic and demographic factors. It was found that a significant correlation existed between infant and child mortality and sanitation aspects such as types of latrines and bathrooms, availability and accessibility of water and type of housing material, and these results varied depending on the district under investigation. Mortality was also found to be significantly related to demographic factors, that is age and marital status, and to a lesser extent, on income and education. Controlling for extraneous variables was thus vital as it enabled the investigator to observe the un-confounded influence of environmental factors on mortality. Thus the hypothesized relationship, were confirmed.

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# 1.0.CHAPTER 1: INTRODUCTION AND BACKGROUND

## 1.1. PROBLEM STATEMENT

It is well Known that a large chunk of the world's population live in conditions not conducive to good health. Shanties abound in most urban centres of the world. These shanties are usually constructed of paper and at best wood and serve as very poor detractors of harsh environmental conditions. Recall that many Nations seek to achieve 'a shelter for all by the year 2000' or 'water for all by the year 2000'. These slogans although pertinent and much repeated, are still far from the expected target and a significant proportion of the population especially in the third world are yet to enjoy these privileges. It is not uncommon to see large heaps of garbage piled up within the vicinity of households, thus increasing the threat of exposure to certain diseases.

Hundreds of millions of people mostly in developing countries are huddled in vast urban slums and rural shacks. For them, surviving a day itself is a nightmare. They lack food, shelter and such other necessities as clean water, hygienic sanitation and waste disposal facilities, affordable fuel for domestic use, affordable transport, educational and recreational facilities.

According to studies by Mosley and Chen (1984), exogenous health care variables characterized as environmental contamination adversely affect survival. Evidence from a study in Kenya by Bunyasi (1984) suggested that environmental factors were responsible for both regional and seasonal variations in patterns of death. By viewing region of study as a proxy for the current environmental setting, he concluded that it acted as a mediator for associated characteristics which are either undefined or ill-defined. This study thus attempts to utilize more well defined variables in an attempt to give us an idea as to what further interventions may be required to achieve the goal of improving infant and child survival.

## 1.2. RESEARCH OBJECTIVES

On the basis of the above problem the following research objectives will serve a useful purpose in guiding our study.

1. To study selected environmental conditions in Kenya using data from six districts covered in the National Household Welfare Monitoring and Evaluation Survey (NHWMES), carried out in 1991 by the Ministry of Planning and National Development (hereinafter referred to as MPND) in conjunction with the Central Bureau of Statistics (CBS) and United Nations Children Fund (UNICEF).

2. To relate environmental (housing, water and sanitation) conditions and some appropriate mortality indicator i.e. mortality index (MI).

3. To analyze the possible existing relationship between environmental conditions and one demographic factor: namely Mortality. This will be done with the intention of quantifying the strength of selected environmental factors in predicting infant and child deaths. Socioeconomic and demographic factors shall be used as controls.

## 1.3. RATIONALE OF THE STUDY

The study is concerned with environmental aspects or conditions under which humans live, and how they affect their survival. These environmental conditions include housing conditions (number of rooms, toilet and bathing facilities, number of people per house/room and others). It also involves the sanitation aspect by considering the conditions of the immediate environment, the availability of clean drinking water, and waste disposal mechanism. The study population will be restricted to the infants and children under five years of age on the assumption that they are a good indicator of the health conditions of any given society.

Environmental conditions as those mentioned above do influence the very survival of human beings. For example, unavailability of toilet facilities lead to increased infection (morbidity) and possibly mortality through lack of proper sanitation. Crowding also increases the speed of airborne infection. Now, most scholars have concentrated on socioeconomic and demographic variables whose effect on mortality does not explain the cause and effect relationship with the dependent variable, mortality. Environmental risk factors are more proximate to mortality but have had little attention. One should obviously not forget that most (if not all) of these environmental conditions are influenced by the socioeconomic status of persons. Thus for example, persons receiving good incomes are bound to have a large good house with clean water, toilet and bathroom and waste disposal system. Similarly education makes one more aware of the necessity of a clean environment.

## 1.4. SIGNIFICANCE OF THE PROBLEM

The following salient points illustrate the significance of the problem to specific issues.

Significance of the problem:

- As it relates to a wide population:

The world is inhabited by a massive number of poverty stricken population. Masses of people (billions) especially in the third world are greatly exposed too harsh environmental conditions as explained above. Thus the problem affects a wide population.

- As it relates to an influential or critical population:

It is well known that infant and child mortality is a good indicator of the general health status of a given society. With unfavorable condition. the young ones are among the first to be affected and quite easily too. It is worth noting that control of the environmental risk factors that infants and children may be exposed to can very well lead to increased child survival and longevity.

- As it fills a research / theoretical gap:

Most studies on infant and child mortality have tended to deal with determinants and differentials of infant and child mortality. Much of these have been on socioeconomic, cultural and demographic differentials and determinants. Their effect on infant and child mortality has been largely indirect and does not reflect on the cause and effect of mortality. Environmental risk factors which can be viewed as more proximate to mortality in the causal chain have not been adequately covered. More so in this study, we shall use different data set as compared to those previously used and it is worthwhile to know how these risk factors have changed over time and with different data sets for comparative purposes.

## 1.5. SCOPE OF THE STUDY

In a study like this concerning the nature of household characteristics and the use of water and sanitation, the influence of sociocultural factors cannot be ignored. Their impact on the above mentioned subjects may necessitate their being recommended for further research. Also the socioeconomic variables meant in this study to act as control variables are but just a few of those affecting the relationship between environment and mortality. Many of the socioeconomic factors such as place of residence and occupation are likewise likely to affect the variables of housing, water and sanitation and it is vital to keep this in mind while interpreting the findings.

The study will also be limited to the six districts covered in the household welfare monitoring and evaluation survey. It will also be limited to the respondents within the districts who were interviewed on the assumption that they will be representative of the country.

An important aspect that cannot be left unattended is that the time frame taken into account when the data was collected. Most variables may have been different either just immediately before the survey or far in the recent past. The fact that a time frame was not included in the data makes it difficult to justify some of the findings and as such, they should be treated with caution.

## 1.6. LITERATURE REVIEW

### 1.6.1. General

The most widely accepted view for the dramatic increase in mortality rates is that the decrease was largely independent of economic factors and due mainly to factors associated with government action, such as improved medical technology, disease control, and availability of medical facilities (Stolintz, 1955 and 1975).

To support this opinion, he argued that:

- Mortality rates have fallen in all parts of the developing world, even in areas which have not experienced extensive development.
- Mortality has fallen very rapidly in a number of countries... much too rapidly to be explained only by economic development.

Decreasing infant and child mortality in Kenya cannot be attributed to any one cause. Mortality differentials are found to be significantly related to both socioeconomic conditions and to micro-environmental and health conditions (especially disease prevalence) as well as to demographic factors (sex and cohort).

Whether gauged from a psychological, social or economic perspective, the death of an infant or a small child represents one of the most critical of human experiences. Every human birth is a unique event and the cost of death of a child to the family and friends in psychological terms is of course inestimable. From a social perspective, a high infant death rate colours the attitudes and perspectives of a whole society regarding the 'value of a child'. A society hesitates to place to high a value on a new human life which at best has an uncertain probability of reaching productive adulthood. Finally, the economic cost of a prematurely terminated life is considerable; for example, the nutritional, health and medical resources spent on children who do not live past early childhood, are, from a societal perspective, largely wasted resources.

### 1.6.2. Environmental literature

Katende (1983) defined the term 'housing conditions' broadly as one that encompasses a number of factors which are very fundamental to man's survival, general well being and effective social and economic performance. These factors include shelter, access to sources of water, sanitation, power for cooking and lighting, communication systems, and among the many others, availability of essential services like health, education and marketing facilities to mention a few. Considering the relative importance of all these factors, shelter, source of water and sanitary facilities are no doubt the most important of all.

Shelter forms a base from where man organizes and spends most of his life. It protects him from adverse climatic conditions, as well as the dangerous animals, insects and other hazards of nature. In addition to protection, it provides man with a framework within which he develops his talents and gains various types of cultural values, economic and socio-psychological satisfaction. Furthermore, shelter provides man privacy and enables him to carry out a number of socioeconomic activities, sleeping as well as reproducing. It actually facilitates conditions for the creation and bringing up of man's basic socioeconomic unit - the family.

Also, the central demand of good water and sanitary facilities to man's good health is too well known to demand emphasis. For example, people who have inadequate sources of water and sanitary facilities normally suffer and die from cholera, typhoid and other gastro-intestinal diseases.

In Pakistan, the principal causes of infant death after the first month of life are acute respiratory infections, gastroenteritis, other communicable diseases and malnutrition (Awan, 1986: 188). Results from the National Health Survey of 1982 - 1983 have revealed that better facilities, such as piped drinking water, flush toilets and gas cooking stoves, tend to improve the health standards of the community (Government of Pakistan, Federal Bureau of Statistics, 1986: 30).

Some exogenous health - care - variables, which Mosley and Chen (1984) characterized as environmental contamination, adversely affect survival. They include mother's exposure to postpartum infections and families lack of access to drinking water, sanitary toilets, or disease prevention measures such as inoculation programs. The introduction of sanitary toilets has been found to reduce infant mortality in the Philippines (Martin et al. 1983) and in Malaysia (Peterson et al., 1986).

Benjamin (1965) contends that the most important effects of housing conditions on child mortality work through their impact on the incidence of infectious diseases: in particular, he singles out diarrhoeal diseases, which he found to increase with the incidence of crowding. Particularly problematic were the instances where rooms were used for both day to day living and sleeping and where more than one family shared the same sanitary facilities. He calls attention to the difficulty of separating the effects of housing characteristics from other determinants of child mortality with which they are highly correlated: social class, social status, income, unemployment and urban-rural residence.

Variables related to type of dwelling have not always been found to be closely related to child mortality. Sloan (1971) found that sanitation variables and other measures of the quality of housing explained very little variation in mortality rates and thus concluded that there is very little proof of casual relationship.

Walter (1986) carried out a study to test the proposition that the contribution of environmental factors to the reduction of mortality in the twentieth century was greater than that made by the alleviation of poverty. She found that urban development was more important than alleviation of poverty for explanation of infant mortality decline between 1895 and 1910. Urban development was a suitable index for environmental improvement. The results suggested that raising private incomes without changing environmental conditions would do little to improve mortality levels.

Black (1983) examined a study on diarrhea diseases in children in Maltab Bangladesh. The diarrhoeal pathogen is transmitted via weaning foods to young children. The foods may become faecaly contaminated from impure water, unhygienic utensils or food handling. The bacteria multiplies further when food is stored at household temperatures. He proposes intervention such as safe disposal of human faeces or protection of water supplies from contamination. But he suggests that the most promising intervention would focus on the household environment and on the immediate risks to which the child is exposed. Improvements in the quality of weaning foods from hygienic point of view and reduction in the degree of household faecal contamination by hand washing is effective in reducing the incidence of diarrhea.

In his study of neonatal mortality in Sri Lanka, Meegama (1980) examines deaths per thousand live births by type of lavatory facilities in the dwelling: the lowest mortality, as expected, is associated with the presence of flush lavatory system or water seal system, and the highest, with the absence of no system at all. Expanding his analysis to include two- and three way cross classification of sanitary facilities with husband's education and mother's literacy, he finds lavatory facilities to have the most important impact on neonatal mortality.

Merrick cited the contribution of clean water, environmental factors like housing and sanitation to child mortality in Brazil. He carried out a study on the effect of piped water on early childhood mortality in Brazil. He found strong correlation between poor nutrition and environmental factors and concluded that children who are undernourished after birth were more susceptible to infections associated with unsafe water, poor sanitation and inadequate housing.

Bunyasi (1984) studied patterns of causes of deaths. He also studied seasonality of deaths in Kenya. The study revealed that environmental factors were responsible for both regional and seasonal variations in patterns of death. Three leading groups of diseases were: infective and parasitic diseases, diseases of the respiratory system and circulatory system.

It is suggested that region of study is not a determinant of mortality in the same sense as other demographic or socioeconomic factors (Farah and Preston, 1982). More properly, region should be viewed as accounting for the current environmental setting, and as such, it acts as a mediator for associated characteristics which may be either undefined or ill-defined.

Conteh, David and Bauni (1990) used data from the Liberian Demographic and Health Survey, LDHS, 1986 on survival of 5604 children and mother's household characteristics with the aim of seeking environmental risk factors of childhood mortality. The multivariate logistic regression analysis revealed that water source from river/stream had 30% higher risk of childhood mortality level. The effect of toilet facilities was insignificant once water supply was considered.

A review of the Caribbean population by Roberts (1975) disclosed an infant mortality rate consistently higher for illegitimate than legitimate births. The differential was much larger in the post-neonatal than in the neonatal period, which suggests that it may be produced principally by environmental factors including aspects of child-care, rather than endogenous factors present at a child's birth.

In studying the cause structure and determinants of the decline in infant mortality in Latin America, McKeown identified three sets of factors that determine mortality in general and infant mortality in particular. The three are:

- factors affecting exposure to agents of disease, factors affecting resistance to or recovery from exposure agents of disease and factors affecting the relation between host and agent of disease.

Exposure to disease among infants depends on climatic and ecological conditions that affect the most prevalent type of disease. for example, Andean highlands are less affected by bacillary dysentery, stomach infections and some kind of vector borne diseases that are characteristic of tropical areas. More prevalent are bacterial and viral agents responsible for disease of the respiratory system such as pneumonia and bronchitis, both typical of cold and humid climates.

Exposure is also a function of the access to clean sources of food and water. The third set of factors is related to the availability of waste and excreta disposal systems: their absence increases the chances of bacterial reproduction and transmission. Exposure to disease is dependent on characteristics off the household such as physical make up and crowding. Exposure is a function of knowledge and transmission of disease and acceptability of means for minimizing the risks of exposure.

Factors affecting level of exposure are more sensitive to socioeconomic well being than to public health measures, but public campaigns may alert individuals to the dangers of poor personal hygiene or unsanitary practices at or after delivery of a child. Nevertheless, they can do little to prevent crowding or to increase the quality of water resources.

Poverty as a composite index of deprivation extending from command over economic resources, access to education and social support, to control of housing and physical environment quality remains the most significant predictor of urban and rural morbidity. Virtually all neighborhoods of poorer groups share two characteristics with serious impact on health: The presence in the living environment of pathogenic micro-organism (especially those in human excreta), because of lack of infrastructure or services to remove and safely dispose of them. and crowded. cramped housing conditions. A lack of readily available drinking water (or other systems to dispose of human waste), of garbage collection and basic measures to prevent diseases and provide health care ensure that many diseases are endemic: diarrhea, dysentery, typhoid, intestinal parasites and food poisoning among them. These combined with malnutrition, so weaken the baby's defense that measles and other common childhood diseases become major killer. (The Courier, No. 131, Jan - Feb., 1992).

Most urban centres in Africa have no sewerage system at all - including many cities with a million or more inhabitants. Rivers, streams, canals, gullies and ditches are where most of the human excrement and household waste end up, untreated. For those cities with sewerage system rarely does it serve more than a small proportion of the population - typically the richer, residential government and commercial areas.

Garbage collection services are inadequate or non existent in most residential areas: commonly, 30 - 50% of the solid waste generated within urban centres is left uncollected. It accumulates on streets, open spaces, between houses and wastelands, causing blocked drains or contributing to serious health problems.

Crowding ensures that diseases such as tuberculosis, influenza and meningitis are easily transmitted from one person to another.... their spread often being helped by low resistance among the inhabitants due to malnutrition. It is common for poorer households to have less than one square meter of space per person in their homes, and even smaller rooms may be subdivided to allow multiple occupancy.

### 1.6.3. Socioeconomic and demographic literature

Mother's education is more important influence on child mortality than on infant mortality. Other factors have similar effect on child mortality as on infant mortality except perhaps, birth-weight.

DaVanzo, Butz and Habitch. (1983) found that the effect of education increases as infants become older, while those of the proximate determinants at birth begin to wane. The relative influence of education on child mortality is small and insignificant in Kedan, Kelantan. Perlis and Tregganu (Malaysia), is large and significant other states. This conforms to the pattern that the influence of education appears to become more important after mortality has begun to fall (DaVanzo and Habitch, 1986).

Higher female education leads to improved child care skills and preventive care (Das Gupta, 1989), better child feeding patterns (Caldwell and McDonald. 1981), women's ability to make their own decisions and understand the importance of hygiene and sanitation (Ware, 1984), reduced fatalism and enhanced focus on child quality (Caldwell, 1979), and preference of modern health care practices that improve children's survival (Mosley and Chen, 1984).

Sathar, (1987) argues that in Pakistan, maternal education improves infant's survival chances regardless of the availability of health services because it leads mothers to provide better nutrition and care for their children.

For Latin America, Palloni (1981), has shown that literacy has a much greater influence on child mortality than on infant mortality. Instances of excess child mortality are associated with a disproportionate contribution of the complex - of water - food - airborne diseases. As Palloni argued, the extent of illiteracy in a society reflects not only the limitations of families, but more importantly, limitations in the capacity to organize and mobilize to fulfill societal necessities.

Levels of infant and child mortality derived from the analysis of Pakistan Contraceptive prevalence Survey (PCPS) indicated that children's survival chances have hardly improved in recent years. Rural areas continue to have much higher child mortality than urban areas, despite recent efforts by the government to meet basic health needs in the countryside. Parents with some education exhibited a greater tendency than those with no formal education to engage in modern child care practices, but only in urban areas did the educational level of mothers have a statistically significant effect on children's survival chances.

Roth and Kurup (1990) in their study of survival patterns in southern Sudan found the importance of maternal literacy agrees with past studies (e.g. Caldwell & McDonald, 1981), noting this variable as the single most important determinant of child mortality. What remains unclear are the exact casual path that lead from this variable to reduce child mortality. In their discussion, they suggest that this may be as diverse as the simple task of having children wash their hands before eating, and female autonomy in the more elaborate cultural setting, exemplified by the overriding of cultural taboos associated with traditional childhood feeding and medical practices. No association was found between child survival and income. They noted that child mortality remains high in Southern Sudan because of the entrenched cultural values, crowded housing conditions, unclean drinking water, and poor sanitation are more difficult to attack compared to communicable diseases which are successfully controlled by modern technology.

Conteh, David and Bauni (1990) found out that maternal illiteracy, birth intervals less than two years, and male sex were predictors of childhood death. A very short interval (less than 2 years), was the most significant predictor of child death with a chance of dying 1.5 times greater than that of children born four or more years after their most recent sibling.

Demographic factors such as child's birth order and sex, the mothers age, the duration of the preceding and following birth interval and whether the mother has had a prior experience of child loss are known to affect child survival in many populations. Rapid, successive childbearing results in low birth weight infants and increased risk of child mortality. Successive childbearing and short birth intervals may also result in greater competition between siblings for scarce resources, resulting in poor nutrition and high infant mortality (Hobcraft et al.. 1983: Choe 1987: Winikoff 1983).

A short birth interval implies early weaning of the older child, which may cause that child to be exposed to malnutrition or infectious agents in food. First born children of very young women are at a special risk of infant mortality because of their mother's physical immaturity (Gubhaju,1986: Ruststein,1983). A mother's experience of losing a child is strongly associated with her greater risk of subsequent infant mortality (Cleland and Van Gunneken 1988: Sathar 1987: Gubhaju et al 1987). Births to women at older ages, especially after age, 35, also entail a higher risk of infant mortality (Galway et al., 1987).

Examples of social and economic factors are ethnicity, family's socioeconomic status, mother's work pattern, her education, the parent's sex preference and their place of residence. Peterson et al, (1986) and Choe et al., (1989), report ethnic differences in infant and child mortality in Malaysia and Nepal. Higher family income can generally be taken as an indicator of better nutrition and greater access to health facilities which improve an infant's chance of survival.

In Peninsular Malaysia, the poorest, most rural, and northernmost states of Kedan, Kelantan, Perlis and Tregganu (KKPT) have the highest infant and child mortality rates. Data from the Malaysian Family Life Survey was used to study:

Whether the rates in KKPT were due to low levels of factors known to reduce mortality. Whether the rates in KKPT were due to differences between KKPT and the rest of Peninsular Malaysia, in the nature of the relationships between mortality and its correlates.

It was shown that the higher average IMR in KKPT over the 1941-1975 period is mostly due to lesser presence in these states of measured factors associated with reduced mortality . Poorer sanitation and the lesser incidence of hospital births contribute to KKPT's higher IMR. While both the prevalence of piped water and the average level of mother's education are significantly lower in KKPT, those factors do not seem very important in explaining KKPT's higher average IMR.

The most important factor accounting for higher IMR in KKPT is it's ethnic distribution. The smaller proportion of Chinese in KKPT relative to the other states of Peninsular Malaysia is the primary reason for the differential in IMR between the two regions.

The differences would have been greater had it not been for their very different pattern of breastfeeding. The effect of breastfeeding is three to four times greater in KKPT. This is undoubtedly due to the fact that the impact of the change in breastfeeding is much greater when environmental conditions are poor (Butz, Habicht and Davanzo: 1984).

From the Egyptian Fertility Survey (E.F.S) household economic survey a research was done that examined the determinant of infant and child mortality in rural Egypt, primarily the effect of household economic status and the availability of health services. Certain features of the health service environment affect survival in the neonatal period. In early childhood, survival chances improve markedly as income increases and if the household depends almost exclusively on employment income. In infancy and in early childhood, mortality is strongly associated with region of residence and maternal demographic characteristics, and is weakly associated with parental schooling.

Results from separate micro-level and macro-level analysis are broadly consistent with each other and indicate the decreasing infant and child mortality rates in Kenya cannot be attributed to any one cause. Mortality differential are found to be significantly related to both socio-economic conditions and macro-environmental, and health conditions (especially disease prevalence) as well as to demographic factors (sex and cohort), (Anker and Knowles).

## 1.7. THEORETICAL FRAMEWORK

From the above summary, one can formulate the following conceptual statement.

Environmental conditions are directly related to infant and child mortality, but the causal path linking this relationship is largely influenced by the socioeconomic and demographic characteristics of individuals and households.

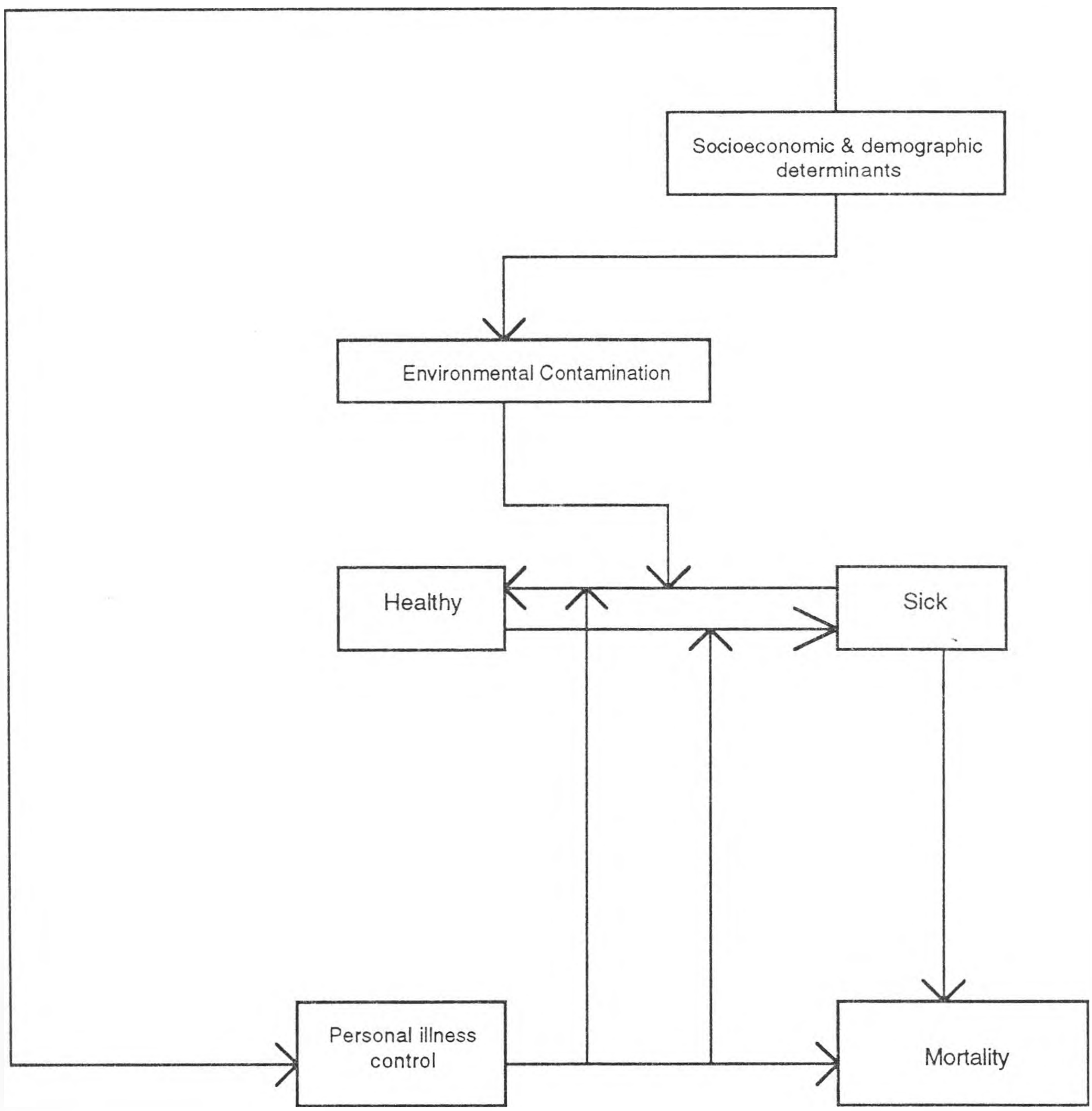
From the theoretical framework the following conceptual hypotheses can be deduced.

1. Infant and child mortality levels are inversely related to improved environmental processes in any given society.

2. Demographic factors are likely to affect the interaction between environmental processes and levels of infant and child mortality in any given society, thus modifying their (environmental's) impact on mortality.

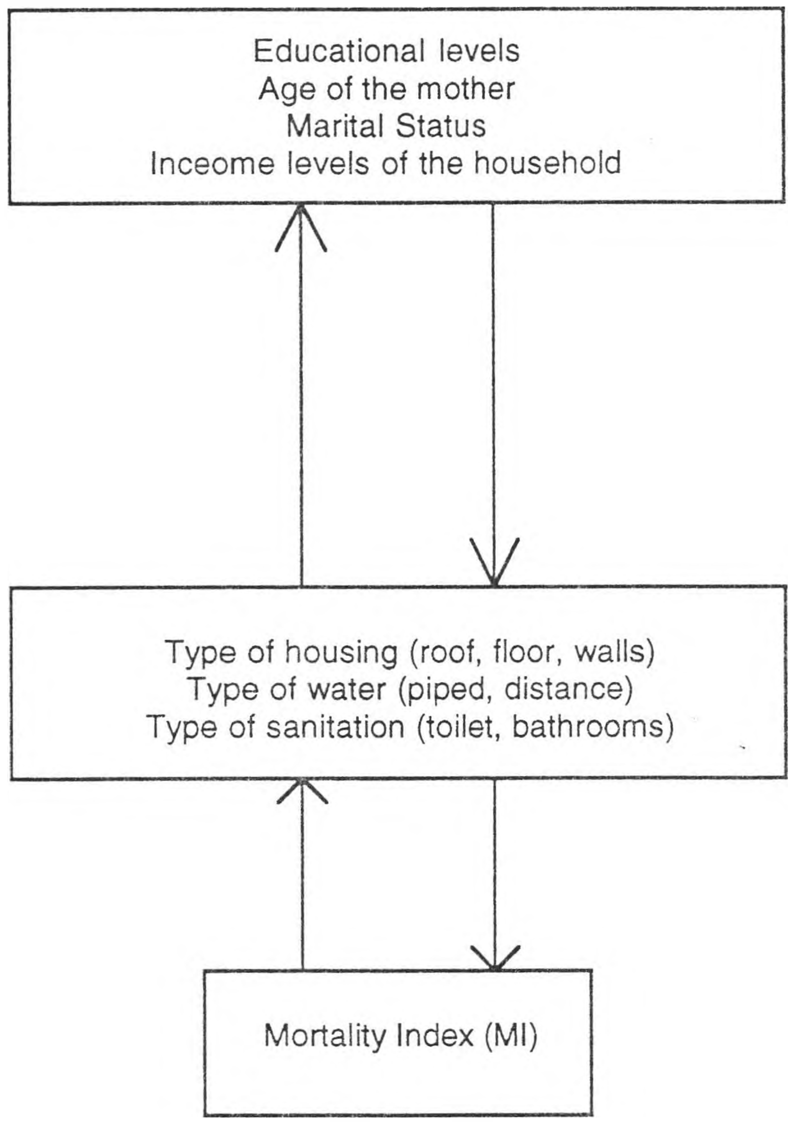
3. Levels of socioeconomic development have an influence on environmental processes, thus modifying their (environmentals's) impact on levels of infant and child mortality in any given society.

## Fig 1: Conceptual Model




Source: *Adapted and modified from Mosley and Chen Conceptual Framework (1985)*

Fig 2: Operational Model




*Operational Framewok: Compiled by author*

## 1.8. OPERATIONAL HYPOTHESIS

- Improved type of housing for example; one with many number of rooms, concrete type of floor and wall is to inversely related to infant and child mortality.
- Safe sources, availability and accessibility of water impact on infant and child mortality inversely.
- Improved sanitation availability for example, functional W.C toilet or pit latrines and bathrooms made from modern materials have a positive relation with infant and child survival.
- Levels of education of the household head do modify type of housing, water and sanitation such that the higher the levels of education, the better these facilities are likely to be and hence the lower the infant and child mortality rates.
- Age of the mother is expected to have a confounding effect on the relationship between type of housing, water and sanitation and infant and child mortality.
- Levels of income of the household head do modify type of housing, water and sanitation such that the higher the levels of income, the better these facilities are likely to be and hence the lower the infant and child mortality rates.

## 1.9. GENERAL INTRODUCTION OF THE STUDY DISTRICTS

This study covered six districts of Kenya as shown on the map. The districts were: Kwale, Kitui, Embu, Baringo, South Nyanza and Mombasa. The next section briefly explains the physical features, ecological conditions, demographic features, administrative units and mortality situation of the districts.

### 1.9.1. Physical features

Kwale District is situated in the South-Eastern part of Kenya, along the Indian ocean in the coast province. The district is bordered by Taita Taveta District in the west, Kilifi District in the north and the Republic of Tanzania in the south. It covers a total area of 8.322 sq.km of which 65 sq.km is water.

Kitui District is one of the six districts in Eastern province. Others are Meru, Embu, Machakos, Isiolo, and Marsabit. Kitui's total land area is about 31,099 sq.km. including Tsavo National Park in the southern part of the district. The National Park occupies 6,309 sq.km. and is uninhabited.

Embu District covers 2,714 sq.km and is bordered to the north by Meru, on the east by Kitui, on the south by Machakos and on the west by Kirinyaga Districts. The district is characterized by highlands and lowlands. It rises from 55m above sea level to the top of Mt. Kenya in the north west. The southern part of the district is covered by the Mwea Plains which rises northwards, culminating in hills and valleys in the northern and eastern parts of the district.

Baringo District covers an area of 10,949 sq.km. Its altitude varies from approximately 1000 to 3000m above sea level. The district is bordered to the west by the Kerio Valley and separated from Lake Baringo by the Tugen hills. The Laikipia Escarpment borders the district to the east. The district's topographical pattern resembles quite closely the whole formation of the East African Rift Valley.

South Nyanza District is located in south western Kenya along Lake Victoria and covers 5,725 sq.km. which is 45% of the total area of Nyanza Province.

Mombasa Municipal Council, whose boundaries coincide with the boundaries of Mombasa District, has as area of 275 sq.km. It borders Kilifi to the north, Kwale District to the south and west, and Indian Ocean to the east. Mombasa ranks as an international center of tourism and this combined with its commercial and industrial activities designates it as a principal town, second only to Nairobi. Mombasa is a coastal lowland area rising from 80m above sea level in the east to about 100m in the west.

Map 1 shows the location of the districts on the map of Kenya.

### 1.9.2. Ecological conditions

Both medium potential and marginal lands constitute 33% of the total land area of Kwale. The rest of Kwale District, (67%), is range and desert land suitable only for livestock production and limited cultivation of drought resistant crops. Annual precipitation is less than 800mm on the average and is extremely unreliable (Feokend and Horwegs).

The ecology of Kitui is generally fragile and greatly influenced by the topography and rainfall pattern. The land area of 3,109,900 ha. is classified on the basis of rainfall into three categories:

- High potential agricultural land receiving 762 -1,270 mm of rainfall and representing only 2.2% (67,000 ha) of the district.
- Medium potential land receiving between 500 and 800mm of rainfall representing 36.6% (1.137.000) of the district and useful only as rangelands.
- Low potential land receiving less than 500mm of rain representing 1.2% of the total area. Then forest area is estimated at 204 sq.km.

The ecology of Embu District is greatly influenced by its topography. Approximately 271,200 ha. are suitable for agriculture and livestock. 122 ha of Embu's "dry land" are under irrigation.

In Baringo District, there are a few water resources. The existing streams and springs dry up during prolonged dry periods while the dams and pans become silted during the rainy season due to high levels of soil erosion from the hills. Due to the delicate ecological balance, the rangelands in Baringo are extremely sensitive to misuse and there is evidence of serious over-grazing (MPND, Baringo District Development Plan, 1989 - 93).

The higher elevation of Baringo District are in a modified tropical zone and soils are generally well drained. This zone contains the major potential area for agricultural and improved livestock development.

South Nyanza District is endowed with medium and high potential agricultural land. The abundant and relatively under-utilized land resource base has been a major contributing factor to in-migration and increased population growth in some parts of the district. The eastern part of South Nyanza District is a high potential agricultural zone: Coffee, tea, sugar cane, maize, sorghum, potatoes, tobacco and bananas are grown in this part. The middle and lower parts of the district range from medium to low potential land. Here, crops like maize, sorghum, millet, cassava and beans also do well during the long rainy season.

Mombasa District can be divided into three main physiographic belts: a flat coastal plain, about 6 km wide, which includes the island; the eroded belt of Jurassic shell overlain in places by residual sandy plateau, dominated by Changamwe; and an undulating plateau of sandstone divided from the Jurassic belt by a scarp fault.

### 1.9.3. Demographic features

- **Population size and composition**

According to the 1979 population census, Kwale district had a population of 288,363 people. The CBS estimates for 1988 put the size of the population at 417,983. An analysis of the population structure of Kwale reveals its remarkable youthful character. The population under 15 in 1979 constituted 46% of the total population . The proportion of the elderly (over 60 years of age) on the other hand accounted for only 4% of the 1979 population.

The population census in 1979 recorded a population of 464,288 in Kitui District. Kitui District's overall population growth was lower than that of Eastern Province (3.4%). This can be partly explained by the net out-migration due to fragile ecological conditions of most parts of the districts. According to CBS estimates, Kitui's population is projected to be around 786,130 by 1993 (MPND,Kitui District Development Plan,1983-1993). An analysis of the population structure reveals that primary and secondary school age students combined account for 53% of the total number, thus implying a negative economic implication in terms of public and family expenditure on food, clothing, education and health.

According to the 1979 population census, Embu District had a total population of 263,173, with an annual growth rate of 4.18%. The 1988 population was estimated at 389,797 based on a growth rate of 3.9% per annum (CBS, 1983). This is projected to reach 472,059 by 1993. The age/sex structure of population in Embu District indicates that children aged less than 15 years constitute more than half of the total population. The labour force represented by the age group 15 - 59 accounts for 43.3% of the total population, while those aged 60 years and above account for only 3.7% of the population.

The population of Baringo District in the 1979 census was 203,792 people - 101,606 males and 102,186 females. By 1983, this population had increased to 242,856 at an estimated annual growth rate of 3.47% (Central Bureau of Statistics, Population Projections for Kenya, 1980 - 2000). In 1988, the total population reached 286,097 people using the same growth trends and assumptions. During the 1989/93 plan period, assuming a decline in both fertility and mortality and based on the new macro-economic assumptions of Governments sessional paper no. 1 of 1986, the population of Baringo will grow at an approximate rate of 3.1% to reach 355,674 people by 1993.

The population size of South Nyanza District in the 1979 census was 817,601, indicating a growth rate of 2.1% per annum, which is considered to be quite low and unrealistic. In 1983, the Central Bureau of statistics (CBS) published a revised growth rate for Kenya, based on a statistical evaluation of fertility and mortality rates. In this report, the estimated population growth rate between 1969 and 1979 for South Nyanza District was estimated at 3.3%. Thus the most likely population of the district in 1979 was 917,500.

## Table 1.1. Population Projections, South Nyanza District

| | 1988 | 1990 | 1993 |
|---|---|---|---|
| District | 1,226,070 | 1,304,736 | 1,429,929 |

*Source: South Nyanza District Development Plan, 1989 - 93.*

The population census of 1969 and 1979 reported figures of 247,073 and 341,148 respectively, for Mombasa District. This was an increase of 27.6% at an annual growth rate of 3.3%. On the other hand, estimates for the period 1979 and 1988 show a relatively higher incidence of 30.7% at an annual growth rate of 3.7% i.e. 341,148 in 1979 to 496,876 in 1988.

### Table 1.2. Population projections, Mombasa District

| | Census | Projection | Projection |
|---|---|---|---|
| | 1979 | 1988 | 1993 |
| District | 341,148 | 496,873 | 583,378 |

*Source: derived from CBS, population census, 1979*

In 1988, women aged between 15-49 years were estimated to be 112,043 and by the year 1993, this number is expected to be 137,787. The sex ratio for Mombasa is about 126/100 male to female respectively (CBS, population projections 1988 - 1993). This ratio is higher among the population in the working age group (15 - 49). However, the ratio of male to female is balanced at about one to one for the age groups 0 - 14, 14 - 17 and 60+.

- **Population density and distribution**

Population density and distribution in Kwale, are strongly influenced by topography and agro-ecological set-up. Significant variations in density occur at the divisional level. Kwale's population density varies from a minimum of 8 persons per sq.km to 315 persons per sq.km. The hinterland areas with semi-arid climatic conditions carry relatively low population densities as compared to the coastal areas (seasonality of the lowlands of Kenya, 1988).

The distribution of population in Kitui District follows the pattern of its ecological zones, with the highest densities found in the high potential agricultural areas located in Central and Mwingi Divisions. Moderate densities of between 20 and 40 people per sq.km are found in the medium potential agricultural regions. Only 2% of the population can be classified as urban.

Population distribution and density in Embu have a positive correlation with climate and land productivity. Runyejees Division which is a high potential agricultural area covers only 16.4% of the districts total land area, but is inhabited by 56.3% of the district's total population. Other divisions are of marginal agricultural potential and are inhabited by smaller populations.

In Baringo District, the distribution correlates with the land potential. 61% of the districts total population is found in the high and medium potential zones of Karbanet, Kabartonjo, Eldama Ravine and Tenges Divisions. Some areas in other divisions have a density as low as 2 persons per sq.km.

### 1.9.4. Administrative units

Administratively, Kwale District is divided into four units, officially referred to as `divisions'. These include Matuga, Kinango, Kubo and Msambweni. The divisions are further sub- divided into 24 locations and 69 sub-locations.

Kitui District is divided into five administrative divisions: Central, Mwingi[1], Kyuso, Southern (Mutomo) and Eastern (Mutito). These divisions are further sub-divided into 34 administrative locations and 160 sub-locations.

Embu District is divided into three divisions for administrative purposes. These are Siakago, Runyenjees and Gachoka. The divisions are further sub—divided into 19 locations and 73 sub-locations.

Baringo District is divided into seven divisions, that is, Karbanet, Kabartonjo, Ngiyang, Marigat, Eldama Ravine, Mogotio and Tenges. The divisions are further sub-divided into 42 locations and 115 sub-locations.

Mombasa is divided into four divisions, namely; Island, Changamwe, Kisauni and Likoni. There are twelve locations and fifteen sub-locations.

### 1.9.5. Mortality

- **Kwale District**

1 Mwingi is now a district on its own, having been carved out of Kitui District at the beginning of the decade.

Projected mortality figures indicate a slight decline in mortality in Kwale district. Although a steady decline was registered for both IMR and CDR, these are still far from the desired levels. Infectious and nutritional disorders still play an important role in morbidity and mortality of children in Kwale District. This was indicated by the high prevalence stunting (chronic malnutrition) at community level.

## Table 1.3. Projected mortality rates per 1000 people for Kwale District.

| | 1986 | 1987 | 1988 |
|---|---|---|---|
| Infant mortality rate (IMR) | 130.6 | 127.7 | 124.8 |
| Crude death rate (CDR) | 15.6 | 15.4 | 15.1 |

*Source: CBS. 1984.*

The major contributors to hospital admission of the under five's and their mortality are: anaemia, malaria, diarrhea, respiratory infections and malnutrition.

- **Kitui District**

In 1987, children formed the majority of hospital admissions and 42% of all deaths occurring in the 0-5 year age group. The infant mortality rates and crude death rates in the district indicated a slight drop in 1986, 1987 and 1988 respectively.

## Table 1.4. Infant mortality rates and crude death rates per 1000 individuals - Kitui District.

| Infant mortality rate | | | Crude death rate | | |
|---|---|---|---|---|---|
| 1986 | 1987 | 1988 | 1986 | 1987 | 1988 |
| 130.6 | 127.7 | 124.8 | 15.7 | 15.4 | 15.1 |

*Source: Kitui District Health Information System (HIS) annual report, 1987, 1988.*

- **Embu District**

The infant mortality rate (IMR) for Embu District fell from 60/1000 in 1983 to 55/1000 in 1987 (Embu District Development Plan). These rates are lower than the national IMR of 86.7 and 79.2 in 1983 and 1987 respectively. The child mortality rate (CMR) over the same period fell from 83/1000 to 46/1000.

## Table 1.5. Infant mortality, 1983 and 1987 (per 1000 infants born).

| | 1983 | 1987 |
|---|---|---|
| Embu | 60.0 | 55.0 |
| National | 86.7 | 79.2 |

*Source: Embu District Development Plan, 1989 - 83*

- Baringo District

According to population projections between 1986 and 1988, the general picture of mortality in Baringo is as follows.

## Table 1.6. Infant mortality and crude death rates/1000

| *Infant mortality rate* | | | *Crude death rate* | | |
|---|---|---|---|---|---|
| 1986 | 1987 | 1988 | 1986 | 1987 | 1988 |
| 115.4 | 112.8 | 110.2 | 15.5 | 15.2 | 15.0 |

- South Nyanza District

South Nyanza District has a crude death rate of 19/1000 population. According to hospital statistics, the commonest causes of death are: anaemia (37%), malaria (19%), diarrhea (15%), intestinal diseases (9%) and measles (7%).

The infant mortality rate (IMR) for the district is 133/1000 (national average is 80/1000). Most (30%) neonatal deaths occur during the first four weeks of life. The causes of neonatal deaths are not clear, but it is thought that these could be due to low birth-weight, birth trauma and neonatal infections.

The district ranks number one in childhood (0 - 2 years) deaths in the country. The early childhood mortality rate is estimated at a staggering 216/1000 against a national average of 125/1000. The leading cause of death in these toddlers and infants are malaria, diarrhoeal diseases, acute respiratory infection and anaemia.

# LOCATION OF THE DISTRICT

# 2.0. CHAPTER 2: METHODOLOGY ON DATA COLLECTION AND ANALYSIS

## 2.1. Introduction

In this chapter, a detailed description is given on the sources and measures of data for all the selected variables. The sources, quality, limitations and anomalies of the data are discussed in relevant sections of the chapter. An outline on the background of selected variables is given.

## 2.2. The sources of data

The sources of data used in this study are secondary sources that were obtained as raw data from the Ministry of Planning and National development (MPND), Government of Kenya. A survey by the name National Household Welfare Monitoring and Evaluation Survey (NHWMES) was designed to make vital information available to national policy makers and district level planners for the design of appropriate policies and programmes aimed at improving incomes and basic services for the Kenyan society in general and for the poor and the vulnerable groups in particular.

## 2.3. Type of data and method(s) of collection

Nine questionnaires have been used for collecting data in this survey. For questionnaires 1 to 7, the Central Bureau of Statistics (CBS) enumerators in the districts were used to interview selected household respondents, while for questionnaires 8 and 9 the head-teachers of Pre-schools and primary schools provided the required information on their respective schools.

The questionnaires have captured information on the following welfare dimensions:

- Household characteristics
- Household expenditure & land utilization
- Household incomes
- Housing, water and sanitation
- Immunization coverage

- Health and nutritional status of children
- Maternal health
- Primary education; and
- Pre-school education

In this study however, we shall limit ourselves to ; Household characteristics, incomes, housing, water and sanitation and maternal health.

## 2.4. Sampling procedure

The survey is been based on the Central Bureau of Statistics National Sample Surveys and Evaluation Programme, Phase II

(NASSEP II). The master frame is based on the population of enumeration areas in each district. Enumeration areas themselves are based on the latest population census results, and are updated from time to time to take account of changes taking place in population structure and distribution. The enumeration areas in each district have further been subdivided into clusters of between 100 and 200 households. They were selected on the basis of probability proportional to size, using population and number of households as measures of size, so that enumeration areas with larger populations have higher probabilities of being sampled for any given survey.

A 20% sample of listed households was drawn, covering all the rural clusters whose number varied depending on the district. The list frames used were for NASSEP II (1984-1989), relisted for rural clusters. Depending on the district, a certain number of households were sampled to represent all the rural clusters. The number of sampled households by district is shown in table 2.1. below.

Selection of households was based on systematic random sampling, which was recommended due to pattern of listing. The survey data has been desegregated to divisional level.

60-64. But the actual sex-ratios for those over 45 are rather higher, suggesting that women aged 30 and 35 years tend to underestimate their ages.

Table 2.1. Number of sampled and responding households

| District | Kwale | Embu | Mombasa | South Nyanza | Kitui | Baringo |
|---|---|---|---|---|---|---|
| No. of holds sampled | 589 | 472 | 834 | 707 | 545 | 571 |
| No. of responding holds | 518 | 399 | 773 | 583 | 469 | 486 |

## 2.5. Limitations of survey data

This section examines the age and sex distribution of the population by district as reported in the 1991 NHWMES. The survey reports of total numbers of live births tabulated by age of the mother can only be useful if the respondents age is reported with a reasonable degree of accuracy. Hence the analysis of the reliability of age and sex data is imperative.

### 2.5.1. Age reporting

Information on age obtained from developing country's survey have in many cases suffered from misreporting. In Kenya. this fact is related to several factors. Firstly. the low level of education in most parts of the country, hinders accurate reporting. Secondly, most Kenyan cultures do not give any importance to age. Another reason is that birth registration in Kenya occurs in a small scale and therefore few people have birth certificates which enable them to recall their birth date.

### 2.5.2. Accuracy of the regional age-sex data

Age specific sex-ratios provide the best indication of age misreporting only in the absence of extensive migration. Populations with poor age statement tend to exhibit sex ratios which change drastically from one age group to the next. Table 2.6 below exhibits the age specific sex ratios for all districts from the NHWMES data. The results show that there exists preponderance of women for most of the age groups.

A better picture of the actual situation is obtained by comparing the sex ratios (SR) observed per age categories with the African standard model. We would expect sex ratios of 94, 92 and 90 for age groups 50-54, 55-59 and

60-64. But the actual sex-ratios for those over 45 are rather higher, suggesting that women aged 30 and 35 years tend to underestimate their ages.

Table 2.2. Sex ratios by age groups (males per 100 females) of the regions compared with the sex ratios of an African standard distribution and sex ratio model: SR = 103.

| Age | Kwale | Embu | Mombasa | SNyanza | Kitui | Baringo | $SR_0=103$ | African std. |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 111 | 98 | 120 | 114 | 120 | 114 | 101 | 99 |
| 5-9 | 111 | 97 | 106 | 122 | 100 | 100 | 99.7 | 103 |
| 10-14 | 110 | 102 | 98 | 122 | 79 | 95 | 99.6 | 113 |
| 15-19 | 84 | 110 | 72 | 115 | 115 | 116 | 99.7 | 97 |
| 20-24 | 74 | 71 | 79 | 153 | 67 | 75 | 99.7 | 83 |
| 25-29 | 60 | 51 | 89 | 67 | 58 | 78 | 99.7 | 85 |
| 30-34 | 72 | 84 | 123 | 32 | 75 | 98 | 99.5 | 87 |
| 35-39 | 103 | 95 | 202 | 72 | 128 | 90 | 99.1 | 99 |
| 40-44 | 128 | 80 | 148 | 76 | 61 | 100 | 98.3 | 101 |
| 45-49 | 136 | 97 | 206 | 68 | 76 | 110 | 96.9 | 113 |
| 50-54 | 54 | 71 | 168 | 47 | 60 | 91 | 94.7 | 108 |
| 55-59 | 117 | 52 | 187 | 100 | 85 | 115 | 91.5 | 114 |
| 60-64 | 77 | 122 | 160 | 85 | 106 | 124 | 87.9 | 103 |
| 65+ | 151 | 132 | 67 | 101 | 100 | 136 | 84.2 | 106 |

Generally, one would infer from these results that there is an excess of women reported as aged 20 to 40 years except in Mombasa. Thus women were apparently transferred to the child bearing period from both under and above this age. This is consistent with the African pattern (Brass et al.,1968. p45). This fact tends to bias the mortality estimates which are based on the reports of women in the child bearing age groups.

The UN index (Shryock H.S and Siegel J.S, 1976. p125) has been used as a summary measure for comparing the accuracy of age-sex data for all the districts. As suggested by the UN, the age specific sex ratios can be summarized by finding the average value of change in the sex ratio from one age group to the next, irrespective of sign. If the age reporting is accurate, the sex ratios should change smoothly between age groups and the index should turn out to be small.

The 'age ratio' scores also suggested by the UN is another index of age-reporting. The age ratio equal 100 times the number of people in an age group divided by the average of the members in the two adjacent age groups. If the reporting is smooth, these ratios will all be close to 100. The age ratio score for a sex is the mean deviation from 100, irrespective of sign. In order to provide an overall index of age misreporting, the UN suggests an index based on the sex-ratio scores and the age ratio scores. The UN joint score is three times the sex ratio score plus the sum of the age ratio scores for the two sexes.

### Table 2.3. UN joint score for the 6 districts

| District | UN joint score |
|---|---|
| Kwale | 158.95 |
| Embu | 97.98 |
| Mombasa | 136.32 |
| Snyanza | 111.59 |
| Kitui | 143.28 |
| Baringo | 80.67 |

## 2.6. Introduction (background information on the variables selected)

### 2.6.1. Mortality data

One of the principal measures of infant and child mortality, q(2), the probability of dying before exact age 2, for each district is based on the 1991 National Household Welfare Monitoring and Evaluation Survey (NHWMES) data on parity and children dead to women in the reproductive age groups (questionnaire 7).

The 1991 NHWMES conducted inquiries about births and deaths in each household. These retrospective data were collected for all women of reproductive ages and beyond in single year age groups, at least throughout the childbearing years. From these data, estimates of q(2) for each district are obtained by the estimation technique described later. This method used the responses of women in different age groups about the numbers of children who are dead and the total number ever born to them.

If the survey data are accurate, then the resulting mortality estimates will also be accurate. However, reports on life-time births generally suffer from serious under-reporting, since older women, in particular, fail to report all the children born to them. Those children who died young many years before are especially likely to be overlooked. Another common deficiency of these data is the failure to distinguish clearly between women who did not report on the number of children they had born and those who reported having no children.

Obviously, any omission of dead children will bias our estimates. Evidence adduced from different sources shows that such data are subject to possibilities of considerable error, either in the direction of under-statement as a result of omissions or over-statement as a result of erroneous reporting of births and deaths which occurred outside the survey's period of reference. While reports on life time births by young women, say up to 25-30 years of age, have been found to be subject to relatively little understatement, for older women, the errors appear to increase with advancing age (W. Brass, 1968, p91). Thus mortality levels based on the reports of women aged 20-24 were considered the most reasonable estimates that can be obtained from these limited data.

Two principal measures of infant and child mortality levels for all the districts has been used in this study: The probability of dying before age two, q(2) and the ratio of observed to expected deaths, mortality index (MI). Other additional measures have been used for differential mortality studies. Such measures include crude death rate (W.H.O. 1979, p30 - 34) and life expectancy at birth ($e_0$) as used by Anker and Knowles, 1977. These measures have their limitations and are not used here.

Ten independent variables have been chosen for this study, namely;

- Female educational level
- Household income
- Marital status
- Age of the mother
- Type of main-house, number of rooms and people sleeping in the main house
- Treatment and reliability of water

- Distance to water source
- Type of toilet and bathroom.
- Women's education

Women's education has generally been considered an important factor which affects mortality of infants and young children. Maternal education obviously affects post-neonatal mortality for infants and young children, because the chances of survival at childhood are influenced by the social and educational conditions of the mother's, which determine their diet and child care. It is generally believed that women are the ones responsible for child care and that the more years a woman spends in school, the more aware she becomes of factors that determine her child's health.

The Household Welfare Monitoring and Evaluation Survey provides data on educational attainment. The survey asks for the highest level of education completed, regardless of grades `skipped' or `repeated'.

School enrollment in Kenya is classified by the following levels: primary, secondary and university. Since 1985, the primary level provides 8 years of education, each year classified as standards. Before 1985, this level provided 7 years of education, similarly classified as standards. The secondary level information includes 4 years of secondary education, classified as Forms.

Thus Form IV refers to the fourth year at this level. After attainment of minimum conditions Form IV leavers are admitted to university or college for undergraduate studies or diplomas. It is highly likely that most of the older respondents in this survey passed through the previous educational system that apart from 7 years of primary education, also included six years of secondary and higher education before admission to the university/college.

The percentage of women aged 15 years and over by educational attainment have been obtained for each district from the 1991 NHWMES data. A summary table showing the distribution of female adults literate is given in the Table 2.4 below. A literate person has been defined as one who has completed 5 or more standards of education (Anker and Knowles, 1977, p15).

## Table 2.4. Distribution of Female Population who are Literate

| District | No. of female adults | No. of female adults literate | % female adults literate |
|---|---|---|---|
| Kwale | 695 | 271 | 38.9 |
| Embu | 532 | 297 | 55.0 |
| Mombasa | 874 | 605 | 68.5 |
| South Nyanza | 530 | 179 | 33.7 |
| Kitui | 684 | 309 | 45.2 |
| Baringo | 612 | 230 | 37.0 |

- Households income

The potential role of income-related factors in child survival is complex, mainly due to the multi-faceted nature of income itself. Since the goal of this analysis is to examine factors impinging on the survival of children, it is clear that income should serve as an indicator of children's consumption of goods and services that affects their health, including among others, calories and nutrients, clothing and shelter, sanitary facilities, use of medical systems and adult supervision.

In addition to ambiguities of measurement, the interpretation of income's relationship with mortality is not straightforward. It is expected that a higher income household should experience lower childhood mortality risks; as it is presumed that it consumes more health enhancing goods and services, per capita than will children in lower income households. The question arising then is whether higher income is purchased at the expense of extra hours of work that have reduced time spent in child-care. If so, the effect of income on mortality could be adverse.

It is important to recognize that income can only affect child mortality 'through' other variables. To the extent that these variables are represented in the estimation equation used, the measured impact of income will be reduced.

The household income data were collected using questionnaire on household income.Total income for each household is derived as the sum of income from:

- Livestock sales, last month, last year
- Own consumption livestock, last month, last year
- Livestock products, last week, last month
- Sales of food crops and consumption of own produced food crops, short and long seasons
- Cash crops, last month, last year
- Wage employment, last month
- Self employment, last month
- Cash transfer, last year
- Rent, last month
- Other sources

Household incomes are underestimated since own consumed livestock products were not estimated. This is not the only source of underestimation in income data. The derivation of income groups involved the establishment of a poverty line, whereby those below and above this line are treated as separate income groups.

To establish the poverty line, we assumed that the bottom 30% of the households were poor and the rest non-poor. Of the poor, it was further assumed that the bottom 10% of the households were poorest and the rest of 20% poor. This method is clearly arbitrary, but it has the advantage of being easy to apply. It is in-fact the one that is widely used in studies of poverty. The distribution of income by district is shown in the table 2.5 below.

## Table 2.5. Number of households by income groups

| District | Poorest | Poor | Other | Total |
|---|---|---|---|---|
| Kwale | 55 | 112 | 373 | 540 |
| Embu | 37 | 75 | 261 | 373 |
| Mombasa | 77 | 178 | 518 | 773 |
| South Nyanza | 32 | 99 | 359 | 490 |
| Kitui | 46 | 91 | 321 | 458 |
| Baringo | 53 | 97 | 347 | 497 |

- Housing, water and sanitation

The majority of relevant studies of the impact of housing conditions on mortality have focused on the presence and type of water supply, the type of lavatory facilities, the power source and the type of building materials used to construct the house. The type of dwelling affects mortality mainly through the elements of exposure to disease.

Housing not only provides shelter, but also provides physical and psychological security. A good house is measured not only by the quality of materials used in its construction, but also by the status of the general surrounding environment, including availability of amenities such as water, lighting, sanitation and security.

The NHWMES sought the following information on housing quality:

- **Materials used in constructing the house**
- **Number of rooms in each house**
- **Number of persons sleeping in main house**
- **Main source of water during wet and dry seasons**
- **Distance to water source and its reliability**
- **Method of human waste disposal including bath facilities**

The study examines the relationship between infant and child mortality and three pertinent aspects of the dwelling place; lavatory facilities, water supply and housing materials. Data on all these variables is available from the NHWMES.

- Type of main house

Materials used for construction of a house determine its quality in terms of durability and comfort. The following table shows the proportion of households with main house constructed using various materials.

### Table 2.6. Type of wall, floor and roof

| | Floor | | | Wall | | | Roof | | |
|---|---|---|---|---|---|---|---|---|---|
| District | mud | wood/other | cement | mud | cement/block | wood | grass | iron sheet | tiles |
| Kwale | 78 | 2 | 20 | 79 | 15 | - | 81 | 14 | - |
| Embu | 79 | 1 | 20 | 73 | 14 | 13 | 24 | - | - |
| Mombasa | 22 | - | 78 | 37 | 63 | - | 31 | 61 | 8 |
| Snyanza | 89 | 2 | 9 | 89 | 9 | - | 64 | 33 | 3 |
| Kitui | 79 | 1 | 20 | 64 | 15 | 21 | 52 | 48 | 0 |
| Baringo | 88 | 4 | 8 | 81 | 3 | 16 | 77 | 23 | |

In all districts with the exception of Mombasa over 75% of the households had mud floors. Mud walls also predominated in over 70% of the households in all districts except Mombasa. The most common type of roof was the grass thatching.

The next table shows the distribution of rooms and persons who sleep in main house by district (%).

Table 2.7. Number of rooms and persons sleeping in the main house by district

| | Rooms | | | persons sleeping in main house | | | |
|---|---|---|---|---|---|---|---|
| District | 1 | 2 | 3+ | 1 - 2 | 3 - 4 | 5 - 6 | 7+ |
| Kwale | 25 | 30 | 45 | 27 | 29 | 24 | 20 |
| Embu | 21 | 23 | 56 | 26 | 33 | 23 | 18 |
| Mombasa | 25 | 30 | 45 | 27 | 29 | 24 | 20 |
| Snyanza | 18 | 50 | 32 | 56 | 29 | 10 | 5 |
| Kitui | 53 | 23 | 24 | 27 | 32 | 26 | 15 |
| Baringo | 76 | 13 | 11 | 32 | 36 | 22 | 10 |

- Water

Water is one of the most basic necessities for human survival. The availability of clean portable water within easy reach of the people not only helps to improve their welfare, but also releases their time and energy for engagement in other productive activities and leisure. Adequate sanitation is an important strategy for the reduction of environmental pollution. It is also a means of preventing water related and other infectious diseases.

- Sources of water

Depending on the district, the sample survey on housing, water and sanitation selected a given number of households.

- Distance to water source

The distance to the water sources is a good indicator of the time taken or the energy spent in the water fetching activity. The further the distance to the water source means less time is spent on other productive activities including child-care. Further due to the energy consuming nature of the activity, adequate supplies of water may not be sought, a fact which has negative implications on infant and child mortality.

- **Water treatment**

The manner in which water is treated has great impact on its purity or cleanliness. Of course if the source of water is piped, then treatment is guaranteed in most cases and the water is clean. The aspects of water treatment considered in this survey are; Boiling, filtering, chemicals and traditional methods

- **Type of toilet and bathroom**

The NHWME survey also has data on the types of toilet and bathroom. Categories of toilets considered were; pit latrines, water closets (W.C) and pour flush and lastly no toilets. Categories of bathrooms considered were: bath in the household and out, shower in and out of the house, makeshift bathroom, and none. Although categories of housing materials and water supply appear clear, a few remarks about categories of lavatory facilities are needed. Between the most advanced flush lavatory system and the least developed conditions in which bushes and fields are used, there are three main types of intermediate-level facilities: pit latrines, pan/bucket latrine and water seal.

First the conventional pit latrine consists of a squatting-slab, a pit (which is usually deep) and a superstructure, if provided, around the pit and slab, in order to provide some privacy. Excreta are directly dropped into the pit. Since the pits are not vented, strong odor and fly nuisance are found in most of them.

Next, the traditional pan/bucket latrine consists of a squatting-plate and a pan or metal bucket that is located in a small compartment immediately below the squatting plate. Excreta are deposited into the pan or bucket, which when full, is then carried to a night-soil collection deposit.

Lastly, the water-seal system is essentially a septic tank located immediately below the squatting-plate. Water is poured into the tank, usually everyday, in order to maintain a water seal, which reduces odor and fly and mosquito nuisances very considerably.

## 2.7. Methods of analysis

### 2.7.1. Demographic techniques

The types of techniques used depend largely on data available. One of the most difficult problems for a demographer in the developing countries, and particularly in the Sub-saharan Africa, is the estimation of mortality levels and life table functions (Clairin. R, 1968). It is therefore necessary to obtain the best possible approximations.

Indirect methods frequently use only one source of information, on the number of children ever born and children surviving by age of mother, orphans by age and other characteristics. These methods are valid especially for the estimation of child mortality between birth and the ages of two, three or five years.

### 2.7.2. Mortality index

Available data on child mortality differentials in developing countries are usually drawn from censuses and surveys. Death registration is unreliable in many developing countries, and even when reliable, death registration records include very little information on characteristics of decedents and their households. Censuses and surveys can readily and inexpensively include retrospective questions on mortality of children of respondents which can be analyzed in light of questions on individual and household characteristics that are included in the surveys. The most widely available type of data on child mortality therefore is reports by mothers on the number of children ever born to them and children still surviving.

Trussell and Preston (1982) have developed and tested a method for analyzing mortality differentials from such child survivorship data. This method will be employed in this study and is described here in some details.

The substantive focus of this study is on persons in infancy and early childhood, for whom high death rates are observed in many developing countries. However the data analyzed are on the survival of all children of women in reproductive ages; many of these children could be in early adulthood at the time of the survey. This apparent difficulty, however is not a serious problem, for several reasons. First, the majority of children of women in reproductive ages are very young; the data analyzed do not include information on very old women. Second, because of the age pattern of mortality risks universally observed, the vast majority of deaths recorded to children will have occurred at young ages. About three quarters of all deaths to persons under age 30 can be expected to occur under age 5. For these reasons, the data analyzed in the present study are deemed to reflect mostly mortality during infancy and early childhood.

The principle of the index construction rests on the idea that the proportion of children who have died can be used as a measure of the majority of children of women after adjusting for the effect of age or marital duration of the women. Adjustment is necessary because, if mothers are old or have been married for a long time, their children are older and are thus exposed to the risks of mortality for a longer period of time, resulting in a higher proportion of children who have died.

The index of child mortality for a woman of a certain age (or marital duration) is constructed as the ratio of the actual proportion of her children who have died to the proportion expected for an 'average' woman in the population, of the same age (or marital duration). Implementation of this basic idea is described below, more precisely.

For each woman, an index of her children's mortality is created. The index is equal to the number of her dead children (children ever born minus children surviving) divided by the expected number of dead children. This latter quantity is derived by multiplying her number of births by the expected proportion of children dead. This expected proportion is in turn based upon general mortality conditions in the population as well as upon the distribution of exposure times of her children to the risk of mortality, as measured by the mother's marital duration or age.

**NB:** In societies where childbearing is essentially confined to marriage, variation among women with respect to age at marriage introduces a source of variation that woman's age cannot account for. The index of child for woman i of age j, $M_{ij}$ is thus

**Mij=Di/ni*EPDj, where**

**Di ........................................= number of dead children for woman i**
**ni ........................................= number of births to woman i**
**EPDj ....................................= expected proportion dead for a woman of age category j**

NB: j can also refer to marital duration categories. The age categories used are : 15-19, 20-24,. . . . . .45-49. Similarly, marital duration categories used are 0-4 years, 5-9 years, . . . . . . . .30-34 years. Women above age 49 and of marital duration above age 34 will be excluded from this analysis because their births and child deaths occurred relatively far in the past. To derive $EPD_j$, the mortality estimation procedure originally developed by Brass (1968) is turned upside down. Brass developed a system based on simulation, for converting an observed proportion dead among women in category i into a life table measure of mortality. The equations are of the *form*

$$q(a) \ldots\ldots\ldots\ldots = \quad d(j)*G(j)$$

where q(a) = probability that a child will die before exact age a
d(j) = Proportion of dead children among children born to women in age group j
G(j) = multiplier suitable for women in age group j

The (a,j) correspondence suitable for mothers in age group j are (1, 15-19), (2, 20-24), (3, 25-29), (5, 30-34), (10, 35-39) . . . . . . . . .

The multiplier G(j) is a function of marital fertility in the population as indexed by ratios of cumulative parities for women in different marital duration groups. Equations for the multipliers used in this study are those derived by Trussell (U.N, 1983). To put the above equation to work on the problem at hand, we impose a `standard' mortality function $q_s(a)$ and convert that standard into an expected proportion by rewriting the previous equation for $q_s(a)$ as:

$$EPDj \ldots\ldots\ldots\ldots = \quad qs(a)/G(j)$$

To obtain the $q_s(a)$, first, a family of model life tables is chosen that is believed to be accurate as possible for the country. The north model (Coale and Demeny) will be employed. Second, a model life table in that system was found such that, for the population as a whole, actual child deaths were equal to expected child deaths. The $q_s(a)$ comes from this life table.

The final form of the child mortality index for woman i of age group j is thus

$$Mij = \ldots\ldots Di/(Ni*(qs(a)/G(j))).$$

The index of child mortality will be referred to as the child mortality ratio (CMR) because it is the ratio of observed deaths to expected deaths. The index is a standardized mortality ratio because it is standardized with respect to age or marital duration of mothers.

## 2.8. Application of the Trussell-Preston method

Mortality index is calculated for each woman and is then used as the dependent variable in our analysis.

In order to solve the estimated proportion of children born alive but are now dead, selected standards of mortality are supposed to be taken from the Coale and Demeny model life tables. Since the appropriate life tables for the rural set of six districts of Kenya under study are not available, another procedure to estimate the proportion of dead children was used.

Values of q(1), q(2), q(3), q(5), q(10), q(15) and q(20) for the districts were instead used. The values used were those obtained in the 1979 Kenya's population census.

Although these values are not accurate, they provide the best possible estimate available for this analysis. The index of mortality $M_{ij}$ used in this analysis for woman i in age group j can be represented as:

$$Mij ........................................ = \quad Di/Bi*EPDj$$

with the symbol representation being as before. The $EPD_j$ is then replaced by q(x).

The index of mortality above is also equivalent to the ratio of the proportion of children dead for woman i divided by the proportion of dead children for all women in the age group i.

## 2.9. The statistical method - Regression Model

They quantitatively describe the variability among the observations or responses, by partitioning an observation into two parts. The first part of these decomposition incorporates everything known about the magnitude of a response. The remaining portion, called the residual is the difference between the observed value and the predicted value, and has to be ascribed to unknown sources. The residual should be small relative to the predicted value and should display characteristics of random variability.

### 2.9.1. Model formulation and inference

If y is a function of several x variables, the value of y depends on the values of the x`s, but the x values are free to vary (within limits). Thus the y variables has historically been called the dependent variable and the x variables are called the independent variables.

Response variable y and the residual _ of our statistical model are random variables with a probability distribution, usually assumed to be a normal distribution. The x variables can be qualitative (categorical) or quantitative.

### 2.9.2. Categorical variables

These variables do not usually involve measurement. Each unit is classified, for example, type of education. Then a label is assigned to each category. Each category will be a variable in the regression format, constructed by assigning a code of zero to indicate that the unit has not been given that particular label and a code of one to indicate that it has. The basic interest in the analysis is usually to estimate linear contrasts among the mean responses for each category.

In the study we shall have one endogenous variable only - health status of the child population as measured by the mortality index. The corresponding reduced form equation (Goldberger, 1964) is

$$Y_t = b_o + b_{1t}X_{1t} + b_{2t}X_{2t} + \ldots\ldots\ldots\ldots + b_{rt}X_{rt} + e_t$$

$$t = 1, 2, 3, \ldots\ldots\ldots, n$$

Where $Y_t$ is the mortality index,

$(X_{1t}, X_{2t}, \ldots\ldots\ldots, X_{rt})$ are the predictor variables,

$b_i$ = regression coefficient

$e_t$ = error term

For n observations the model under consideration becomes

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \cdot \\ \cdot \\ \cdot \\ Y_n \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{bmatrix} + \begin{bmatrix} X_{11} \\ X_{12} \\ \cdot \\ \cdot \\ \cdot \\ X_{1n} \end{bmatrix} + \begin{bmatrix} X_{21} \\ X_{22} \\ \cdot \\ \cdot \\ \cdot \\ X_{2n} \end{bmatrix} + \begin{bmatrix} X_{r1} \\ X_{r2} \\ \cdot \\ \cdot \\ \cdot \\ X_{rn} \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ \cdot \\ \cdot \\ \cdot \\ e_n \end{bmatrix} \quad e_n$$

By the use of OLS method, one can compute for each value of `Y' the regression curve corresponding to each of the socio-economic, demographic and environmental variables. ICL package program SPSS (statistical package for social scientists) can be used to obtain the regression coefficients and the partial correlation coefficients (Nie N.H , et al 1975)

In constructing the regression equation, it is assumed that all variables (criterion and predictors ) jointly follow a multivariate normal distribution. No real data follow such a distribution exactly, strictly speaking, but this is a mathematical tool for prediction. The predictors in this case shall be socio-economic, environmental and demographic which are available from every district and there are reasonable measures for these variables.

Multiple regression analysis gives the values of the estimates of the regression weights and also their standard error. Hence the predicted criterion (Y), can be obtained and the relationship between the predicted value and the actual value gives the multiple correlation coefficient R. This is obtained from the relation

$$R^2 = 1 - \frac{\Sigma (Y_i - Y_i)^2}{\Sigma (Y_i - Y_i)^2}$$

Where $R^2$ is the coefficient of determination.

## 2.9.3. Testing of significance

The significance of a multiple correlation may be tested by calculating a variance ratio (F). It can also be tested by using the t-distribution whereby the t-value is found from.

$$t^2 = \frac{R^2}{\frac{(1-R)^2}{n-2}}$$

and this is compared with the table value of t found in the normal manner for (n-2) d.f

Another alternative is to calculate a Chi-square using an L criterion given by

$L = 1 - R^2$ and

$$C^2(rdf) = -n - 1 - ½(r + 2)logeL$$

Where r is the number of independent variables.

The variance ratio F is preferred to the t or the $C^2$ - test.

It is the ratio of the predicted to non predicted variance. The predicted variable has degrees of freedom r and non predicted variance has n - r - 1 d.f.

$$F^{n-r-1} = \frac{R^2/r}{1-R^2/n-r-1}$$

The F- distribution is used to test the equality of two estimated variances. It suggests that there exists a relationship between multivariate analysis of variance and multiple regression methods.

### 2.9.4. Some problems of multiple regression

There is a problem of the intercorrelation of the independent variables (multicollinearity). It arises when independent variables overlap. Their individual influences and effects on the dependent variable as should be measured by the regression coefficient becomes unreliable. The greater the overlap of the explanatory variables, the lower the reliability of the regression coefficient.

The intercorrelation of the explanatory variables is measured by the simple correlation coefficient between these variables.

To avoid this problem in the analysis, variables showing high correlation between each other were either re-adjusted or removed from the analysis.

Another problem is that the degree of sophistication of this statistical model may be reduced by the fact that mortality data in Kenya is still far from satisfactory. Hence it is necessary that one remains cautious when interpreting any statistical results from an analysis using this model.

### 2.9.5. Application of the trussell-preston method in regression analysis

In the method, mortality index is calculated for each woman, and this is used as the dependent variable in the regression analysis. Mortality index used relates both the observed mortality experience of a woman and her expected mortality experience (Trussell and Preston, 1982).

The index of mortality $M_{ij}$ used in this analysis for woman i in age group j can be represented by

$$Mij \quad = \quad Di/Bi*EPDj$$

where $D_i$ = reported number of children dead for each woman i
$B_i$ = reported number of children ever born for woman i
$EPD_j$ = expected proportion of children dead for women in age group j (which has been substituted for by q(x) values of the 1979 census).

The most adequate values that could have been used were those of the 1989 census, but these results were yet to be released officially by the time of writing up the Theses.

For all women, this mortality ratio is used as the dependent variable in the regression equation;

$$Mij= b0+b1X1t+b2X2t+\ldots\ldots+biXit+\ldots\ldots+bnXnt+ et$$

$e_t$ is the difference between the true mortality ratio and the estimated mortality ratio of woman i.

Unfortunately, the variance of the mortality index, $M_{ij}$ is known to differ over age, because younger women have fewer births than older women. On average, the number of births result in larger variances for the proportion dead for the younger women. This consistent change in the variance over age means that when all women are included in the regression equation, the assumption of equal variances for the residuals $e_t$ does not hold. Infact, the variances of each individual is a function of the common variance and the variance of the mortality index.

If all variables in the regression equation are divided by the standard error (S.E) of the mortality of each women (i), the inequality of the variances of the residuals should be removed. Thus we have the following equation:

$$Mij/S.E= b0/S.E+b1X1t/S.E+.......+bnXnt/S.E+ et/S.E$$

By denoting $Y_i=M_{ij}/S.E$, $Z_{ij}=X_{it}/S.E$ and $e_t/S.E=e_i$

we can reconstitute the equation as follows:

$$Yi=b0+b1Z1j+......+biZij+.....+bnZnj + ei$$

and

$$Var (ei)= Var(ei/S.E)= 1/(S.E)^2(var(ei))$$

since the variance of $e_i$ is known to be related to the index, this weighing has the effect of removing the inequality.

### 2.9.6. Dummy variable technique

The independent or exploratory variables used in this study consist of scaled continuous variables (for example age), variables with some ordering between different categories (for example education), and some with no ordering between categories (for example roofing materials). The categorical variables are introduced into the regression by means of dummy variables. A dummy variable is any variable in an equation that takes on a finite number of values for the purpose of identifying different categories of a nominal variable (Kleibaum and Kupper, 1978).

## 2.9.7. Application of this technique

For a k-category variable, one category is selected and called the reference category. For each of the (k-1) other categories, a dummy or indicator variable is defined taking the value 1 for individuals falling in that category and zero otherwise (R.A. Little, 1980). Let us for example, choose the 'NONE' category of the education variable as the reference category, and define the remaining k-1=4 categories as follows.

| | | |
|---|---|---|
| std 1-4 | = 1 | 1-4 years education |
| (educ1) | 0 | otherwise |
| std 5-8 | = 1 | 5-8 years education |
| (educ2) | 0 | otherwise |
| form 1-2 | = 1 | 8-9 years education |
| (educ3) | = 0 | otherwise |
| form 3-4 | = 1 | 10-11 years education |
| (educ4) | 0 | otherwise |

The variable maternal education is represented in the regression analysis by a set of dummies, defined as: educ1, educ2, educ3 and educ4.

For effect, the fitted values from this regression are:

$$Yi = b0+b1educ1i+b2educ2i+b3educ3i+b4educ4i$$

where values educ1i, educ2i, educ3i and educ4i are values of educ1, educ2, educ3 and educ4 respectively for woman i.

Therefore for individuals with no education (NONE), educ1 = educ2 = educ3 = educ4 = 0, hence the predicted mean

$$(Y/educ=1) \ldots\ldots\ldots\ldots = \quad b0,$$

is the intercept of the regression.

For individuals with 1-4 years of education, i.e. educ1 = 1 and educ2 = educ3 = educ4 = 0, and the predicted mean is;

$$(Yi/educ=2) \ldots\ldots\ldots\ldots = \quad b0 + b1$$

For other categories the predicted means are:

$$(Yi/educ=3) \ldots\ldots\ldots\ldots = \quad b0 + b2$$

$$(Yi/educ=4) \ldots\ldots\ldots\ldots = \quad b0 + b3$$

$$(Yi/educ=5) \ldots\ldots\ldots\ldots = \quad b0 + b4$$

Hence the intercept $b_0$ is the fitted mean for the reference category and the slope $b_j$ is the difference in the fitted mean between category j+1 and the reference category. Two or more factors can be included with each factor having a reference category.

The standardization procedure was achieved in the SPSS run by dividing each of the dummy variables by the standard error of the mortality of each woman. Individual district standard errors are given in the next chapter.

# 3.0. CHAPTER 3: FINDINGS

## 3.1. INDEPENDENT VARIABLES

Three main broad categories of variables expected to be related to the mortality index were considered. This included socioeconomic, demographic and environmental factors.

### 3.1.1. Socioeconomic factors

Under this category, the variables considered are; the level of education of the women at the time of the survey. This variables will be considered for analysis in the multiple regression model later. As has been noted in other studies, actual level of education of mothers is expected to be negatively related with child survival. In this study of individual women, it will be interesting to find out whether education still maintains a strong economic influence on its own right when considered with other economic and environmental factors.

Educational level was grouped under the following categories; none, Primary (std 1-8), secondary and above. We shall examine the simple association between the levels of education and number of children dead per individual woman in this chapter. Level of education is expected to be reliable because it is a characteristic a woman has had since the start of her child bearing years. Other variables may have been characteristics of the household that existed only at during the time of the of the survey and may have been different during the earlier years.

### 3.1.2. Demographic factors

Demographic factors considered in this study include the age of the mother and her marital status.

- Age of the mother

- Marital status

This refers to whether a woman who was interviewed was single had ever been married, divorced, separated or widowed. Divorced and separated women were pooled together because of their small numbers.

### 3.1.3. Environmental factors

The main thrust of the study lies on these factors and as such a number of micro-environmental variables are considered. Variables considered are; types of floor and roofing, number of rooms,and people in the main house, source and reliability of water during the wet and dry seasons, distance to the water source during the wet and dry seasons and time taken to fetch it, treatment of water and types of toilet and bathrooms available.

Actual materials used for building the house in which the women live were considered. The sources of water considered were condensed into two categories; safe and unsafe sources. The safe sources comprised of: piped water, boreholes, protected wells and springs, and roof catchment. The unsafe sources composed of: rivers, lakes/ponds/dams, and unprotected wells and springs. The reliability of water during both the wet and dry seasons was also considered, and here categories looked into were whether the water was reliable all the time or just most of the time. Other categories had too few numbers to be of any relevance.

## 3.2. DEPENDENT VARIABLE

Mortality index (MI) or the ratio of the observed to the expected number of children dead per individual mother. The synthesis of this index is described in chapter two. The average computed value of the mortality index of each district are shown below.

### Table 3.1.

| | MI |
|---|---|
| Kwale | 0.52 |
| Embu | 0.26 |
| Mombasa | 0.41 |
| Kitui | 0.27 |
| Baringo | 0.59 |
| South Nyanza | 0.89 |

## 3.3. CROSSTABULATION

Cross tabulation is a first useful step in studying the association and distribution of two variables. This study utilizes cross tabulations for the purpose of showing how the women in the sample are distributed in the various categories of the variables under study.

Mombasa District had the largest sample size. The number of responding households were 773. Due to manipulations introduced in the analysis stage, which included matching of different files for the same district, with different data sets, a number of cases were lost or missing and the effective response numbered at 660.

In Kitui district the number of responding households were 469. The effective response numbered at 440. For most variables, a certain percentage of the data was lost because some categories which were supposed to have value labels, did not have the actual labels themselves, and it could not therefore be verified what those categories implied. This could be attributed to poor data entry at the source of entry.

Baringo District had a fairly large sample size. The number of responding households were 486. The effective response numbered at 452. Also of importance to note was the initial absence of one important data set, Baringo4, which contained the environmental variables. This data had to be re-entered into the computer again from data sheet with the subsequent loss of much information.

South Nyanza District too had a fairly large sample size. The number of responding households were 583. After manipulations of the data set at the analysis stage, their resulted a loss of a number of cases or missing and the effective response numbered at 452. One important file, SNyanza4, that contained environmental variables was missing from the initial set of data. Subsequently, data entry had to be redone effectively costing loss more data. The effective response turned out to be 372, with 68 cases turning out as missing when matching was done. The effective number of useful cases was thus 302. These are the women for whom the complete set of information is available after matching.

NB: The socioeconomic and demographic variables show a response rate of 370 while the response rate when analyzing the environmental variables is 302. The 68 missing cases in the pack of environmental variables were not considered in the regression analysis in order to maintain uniformity.

### 3.3.1. Age

The table below shows how the numbers of children dead per individual mothers in different age groups are distributed.

**Table 3.2. Age and Mortality Index by District**

| | 15 -24 | 25 -34 | 35 - 49 |
|---|---|---|---|
| Kwale | 0.52 | 0.51 | 0.54 |
| Embu | 0.14 | 0.26 | 0.44 |
| Mombasa | 0.31 | 0.55 | 0.35 |
| Kitui | 0.24 | 0.45 | 0.36 |
| Baringo | 0.54 | 0.80 | 0.53 |
| South Nyanza | 0.65 | 1.11 | 0.99 |

Cross tabulation of age and mortality index revealed that with the exception of Kwale, the mortality index increases with increasing age of the mother especially those in their prime childbearing age. The above grouping was selected to maintain a fairly large sample size in the different age groups categories which otherwise was small when the conventional five year age grouping was used. These results confirm the well researched fact that there is higher risk of child mortality among the older mother.

### 3.3.2. Marital status

**Table 3.3. Marital status and mortality index by district**

| | Single | Married | Divorced | Widowed |
|---|---|---|---|---|
| Kwale | 0.16 | 0.54 | 0.88 | 0.42 |
| Embu | 0.13 | 0.26 | - | 1.63 |
| Mombasa | 0.41 | 0.39 | 0.61 | 0.34 |
| Kitui | 0.07 | 0.39 | 0.66 | 0.34 |
| Baringo | 0.45 | 0.70 | 0.37 | 0.53 |
| South Nyanza | 0.54 | 0.98 | 1.18 | 1.17 |

In Embu and South Nyanza, single and married women had lower mortality index than the divorced and widowed women. In al the districts, with the exception of Baringo, divorced women had higher mortality than single and married women. Only in Kwale and Baringo did married women depict a higher mortality for than children than widowed women. In almost all districts, the largesr percentage of women were married. Unexpected results could therefore not be avoided due to small samples in the categories of divorced and widowed.

The relationship between marital status and mortality can be attributed to the degree of stress and levels of child care periods. Widowhood is associated with stress and as such it is expected to depict a higher index of mortality than other categories except perhaps divorce.

### 3.3.3. Education

**Table 3.4. Level of education and mortality index by district**

| | None | Primary | Sec+ |
|---|---|---|---|
| Kwale | 0.42 | 0.47 | 0.70 |
| Embu | 0.68 | 0.20 | 0.23 |
| Mombasa | 0.34 | 0.36 | 0.52 |
| Kitui | 0.35 | 0.23 | 0.26 |
| Baringo | 0.64 | 0.61 | 0.71 |
| South Nyanza | 0.96 | 0.87 | 0.71 |

The mortality index here to adhered to the common wisdom that education is negatively correlated with mortality level. However, in Kwale and Mombasa, an increase was observed in mortality index as there was a change to higher educational categories. However respondents with primary education depicted a lower index of mortality than those with higher education.

### 3.3.4. Housing conditions

- **Wall material**

Cross tabulation of number of mortality index and type of floor material showed that those women living in houses with floors of mud had the highest mortality index with the exception of Baringo District. Those staying in houses whose floors are made of cement had the lowest average mortality index. Since the quality of housing does reflect on the degree of environmental exposure and the socioeconomic status, it is evident that the higher the quality of materials used for the floors, the lower the mortality index. Benjamin (1965) contends that the most important effect of housing on child mortality work through their impact on the incidence of infectious diseases. It is expected that better quality materials reduces this impact.

Tables 3.5 shows the relationship between floor materials to the mortality index.

**Table 3.5. Type of floor and mortality index by district**

| | Mud | Cement |
|---|---|---|
| Kwale | 0.53 | 0.28 |
| Embu | 0.30 | 0.12 |
| Mombasa | 0.60 | 0.36 |
| Kitui | 0.30 | 0.26 |
| Baringo | 0.53 | 1.16 |
| South Nyanza | 1.02 | 0.59 |

Unexpectedly, mud floored houses had, lower index of mortality than households made of cemented floors. Most of the floors in Baringo are made of mud (at the time of the survey). The mortality index depicted by the mud floors was almost twice as low as that of the cement floors.

- Roofing material

Table 3.6. Type of roofing material and mortality index by district

| | Grass/makuti | Iron sheets |
|---|---|---|
| Kwale | 0.47 | 0.50 |
| Embu | 0.44 | 0.23 |
| Mombasa | 0.58 | 0.33 |
| Kitui | 0.35 | 0.23 |
| Baringo | 0.59 | 0.59 |
| South Nyanza | 1.08 | 0.76 |

Analysis of the average mortality index and roofing materials by cross tabulation shows that those living in houses that are thatched with grass/makuti depict a lower mortality index than those living in houses with iron sheets as roofing material in Kwale District. Roofing material may reflect a higher socioeconomic status, hence the higher the quality of roofing material, the lower the mortality index should be. But the results obtained here are inconsistent with this expectations. Table 3.6 shows the distribution of women according to the children dead to them. Benjamin (1965) calls attention to the difficulty of separating the effects of housing characteristics from other determinants of child mortality with which they were highly correlated, such as, social class, income and urban rural residence. Hence while interpreting the above result for Kwale, one should note that other factors may be acting, with for example, the income of those living in grass thatched house, having a more favourable relationship with the mortality index, than that of those living in houses with iron sheet roofs. However, for the other districts, iron sheets which reflect a higher quality material reveal a lower mortality index than roofs made of grass/makuti.

- **Number of rooms and people in a household**

Cross tabulation of number of rooms and the mortality index revealed some interesting results. There was a general decrease in the value of the mortality index as the number of rooms increased. The pattern was not clearly discernible when mortality index was viewed against number of people in main house. Clearly, some categories like `NONE' had too small a sample to discern any useful results. Nevertheless it is expected that mortality index is positively correlated with number of people in the main house, a fact that is confirmed by the multivariate analysis. It is important to note that the incidence of infectious diseases, particularly diarrhoeal diseases, are found to increase with the incidence of crowding. Particularly problematic are where rooms are used for day to day living and sleeping as well. Nevertheless it is important to note that the incidence of crowding cannot be discerned from the number of rooms alone, but a good indication can be obtained from the relationship between the number of rooms in a household and the number of people in the same household.

Table 3.7. Number of rooms and mortality index by district

| | None | 1-2 | 3-4 | 5+ |
|---|---|---|---|---|
| Kwale | 2.78 | 0.59 | 0.33 | 0.44 |
| Embu | 0.20 | 0.24 | 0.28 | 0.26 |
| Mombasa | 0.30 | 0.39 | 0.50 | 0.25 |
| Kitui | 0.54 | 0.33 | 0.27 | 0.22 |
| Baringo | 0.62 | 0.58 | 0.71 | - |
| South Nyanza | 1.28 | 1.14 | 0.57 | 0.13 |

Table 3.8. **Number of people in the household and mortality index by district**

| | 1-2 | 3-4 | 5+ |
|---|---|---|---|
| Kwale | 0.34 | 0.65 | 0.42 |
| Embu | 0.65 | 0.26 | 0.20 |
| Mombasa | 0.53 | 0.31 | 0.41 |
| Kitui | 0.33 | 0.32 | 0.26 |
| Baringo | 0.83 | 0.53 | 0.48 |
| South Nyanza | 1.11 | 0.83 | 0.78 |

According to this results the more the number of people in the main house, the lower the mortality index. Highest mortality index is depicted when number of people in main house is between one and two. This gives a confounding picture of the effect of crowding. The belief as evidenced from these results is that the less the crowding, the higher the mortality index. There must be other factors working through these variable to bring about the confounding effect. Speculatively perhaps these were not the real numbers of people who may be found in a household at any particular time except, on the day of the survey and this may be considered as a drawback of the lack of a time frame (period over which a particular condition existed) when the particular variable information were collected.

It may be important to note the association between number of people in a household and number of rooms in a household. This would give an indication of the space available despite the number of people and thus the degree of crowding.

### 3.3.5. Water and sanitation

- **Source of water during the wet and dry season**

Most of the women interviewed indicated that they obtained their water from piped sources, boreholes and ponds in that order during both the wet and the dry seasons. During the dry season there was a greater tendency to use rivers and bore holes. The highest mortality index was observed among those using the river as a source of water. The water sources were further condensed into the categories of safe and unsafe sources, as defined in the beginning of the chapter. Investigations revealed that the unsafe sources had a higher average mortality index.

**Table 3.9. Sources of water during the wet and dry season and mortality index by district**

| | WET SEASON | | DRY SEASON | |
|---|---|---|---|---|
| | Safe | unsafe | Safe | Unsafe |
| Kwale | 0.35 | 0.59 | 0.34 | 0.59 |
| Embu | 0.16 | 0.36 | 0.21 | 0.32 |
| Mombasa | 0.42 | - | 0.41 | 0.95 |
| Kitui | 0.26 | 0.29 | 0.36 | 0.29 |
| Baringo | 0.55 | 0.60 | 0.67 | 0.57 |
| South Nyanza | 0.75 | 1.02 | 0.58 | 0.96 |

According to Robert E. Black, (1983), diarrhoeal pathogens are transmitted via weaning foods to young children. The food may become faecaly contaminated from impure water, unhygienic utensils or food handling. Black (1983) proposes interventions such as protection of water supplies from contamination. Interestingly, in Kitui and Baringo, during the dry season, the opposite effect is observed with unsafe sources showing a lower mortality index of 0.29, as compared to an index of 0.36 for the safe sources and 0.67 compared to 0.57 for safe sources, respectively. Apart from the fact that women using safe sources during the dry season are few, a measure of contamination of the water, not considered in this study may perhaps indicate how 'safe' the safe sources actually are.

- **Reliability of water during the wet and dry seasons**

Women were interviewed as to whether water availability was reliable all the time or most of the time.

Women reporting reliability of water all the time showed a lower mortality index than those who reported a reliability of water most of the time. The table below shows the distribution of children dead to these women according to reliability of water. Water supply is directly related to morbidity, mortality and hence working capacity of a population (Ramachandra, 1971: 171).

**Table 3.10. Reliability of water during the wet and dry season and mortality index by district**

| | Most time | All time | most time | all time |
|---|---|---|---|---|
| Kwale | 0.68 | 0.41 | 0.62 | 0.42 |
| Embu | 0.46 | 0.20 | 0.47 | 0.21 |
| Mombasa | 0.38 | 0.40 | 0.38 | 0.37 |
| Kitui | 0.37 | 0.27 | 0.47 | 0.26 |
| Baringo | 0.58 | 0.59 | 0.58 | 0.61 |
| South Nyanza | 1.10 | 0.91 | 0.91 | 1.00 |

During the dry season there is a tendency for water to be less available to the responding women than during the wet season.

A study of the level of contamination of the water may shed more light on the inconsistencies observed during the both season in Kitui and Baringo.

- **Distance to water source during the wet and dry seasons**

The general trend was towards a decrease in mortality with shorter distances to sources of water in Embu, Mombasa and Kitui. However, the pattern is not very clearcut in the remaining districts where distances of over one kilometre to sources of water fetched lower mortality. However, given that the sample in the 3+ kilometre distance were relatively small would mean that results obtained here are likely to be unreliable. It is therefore safe to say that the hypothesised relationship are confirmed.

## Table 3.11. Distance to water source during the wet season and mortality index by district

| | < 1km | 1-2 km | 3+ km | < 1km | 1-2 km | 3+ km |
|---|---|---|---|---|---|---|
| Kwale | 0.47 | 0.43 | 0.52 | 0.44 | 0.39 | 0.66 |
| Embu | 0.14 | 0.34 | - | 0.16 | 0.33 | 0.33 |
| Mombasa | 0.36 | 1.30 | - | 0.36 | 1.30 | - |
| Kitui | 0.27 | 0.32 | 0.40 | 0.26 | 0.22 | 0.38 |
| Baringo | 0.56 | 0.62 | 0.48 | 0.50 | 0.56 | 0.82 |
| South Nyanza | 0.96 | 1.01 | 0.47 | 1.00 | 0.87 | 0.77 |

In essence, shorter distances travelled to fetch water means more time is available for important child care practices such as feeding and washing the child. Further, water may be obtained in abundance since distances travelled are short.

- **Time taken to fetch water and mortality index by district**

Time taken to fetch water can give us a good indication of how much time one can give attention towards child care. By observing the first two categories, which have appreciable sample sizes, we observe that mortality index tend0s to increase as the time taken to fetch water increases. Lower the mortality index in Embu and Kitui and South Nyanza in the 3+ hours category when observed as a whole.

**Table 3.12. Time taken to fetch water and mortality index by district**

| | < 1 hr | 1-2 hrs | 3+ hrs |
|---|---|---|---|
| Kwale | 0.37 | 0.53 | 0.89 |
| Embu | 0.27 | 0.32 | 0.17 |
| Mombasa | 0.37 | 1.35 | 5.19 |
| Kitui | 0.28 | 0.33 | 0.25 |
| Baringo | 0.55 | 0.61 | 0.65 |
| South Nyanza | 0.94 | 1.00 | 0.38 |

The later observation may have been effected by the sample size in the 3+ category being too small.

The central demand of good water and sanitary facilities to man's health is too well known to demand emphasis. People who have inadequate sources of water and sanitary facilities normally suffer and die from cholera, typhoid, and other gastro-intestinal diseases. These variables gives an indication of the relationship between adequacy of water supply and mortality.

Time required to fetch water can give an indication of how much time is available for child health care practices. The more time used on this activity, the less the time available for attention to children.

- **Type of water treatment**

On this variable, the options presented were very limited. Those women who did nothing to treat their water constituted well over 90% of the sample leaving very small sample sizes for the other categories of treatment. As such, the results are bound not to give a good representation of the mortality picture.

**Table 3.13. Type of water treatment and mortality index by district**

| | Nothing | boiling/chemicals |
|---|---|---|
| Kwale | 0.45 | 0.72 |
| Embu | 0.26 | 0.35 |
| Mombasa | 0.42 | 0.19 |
| Kitui | 0.35 | 0.29 |
| Baringo | 0.62 | 0.31 |
| South Nyanza | 1.00 | 0.79 |

When water was treated through boiling/chemicals, the mortality index observed was very low, much smaller than the index observed when no treatment was served on the water . This result is as expected since treatment is bound to minimize contamination effects of untreated water. In Kwale and Embu Districts, treatment did not have any reducing effect on the value of the mortality index. In Baringo, though, it is observed above that safe sources had a higher index than unsafe sources during the dry season. If most of the respondents do rely on this so called `safe sources'. then the treatment of water from these sources is bound to have a positive effect of reducing the value of the mortality index. It is apparent then, that in the districts which utilise safe sources of water, treatment of water will not have a reducing effect as already, the safe sources of water depicted a low index of mortality.

- **Type of toilet**

Again, in this category, only two categories had sample numbers which could be expected to give useful results. This were the pit latrines and the no toilet category. Here there was a significant difference between those who use pit latrines and those not having any toilet. Meegama (1980), on examining deaths per thousand by type of lavatory facilities in the dwelling place found that the lowest mortality as expected is associated with presence of flush lavatory system or a water seal system and the highest, with the absence of no system at all. The introduction of sanitary toilets has been found to reduce infant mortality in the Philippines (Martin et al. 1983) and in Malaysia (Peterson et al. 1986).

## 3.4 SUMMARY

In Kwale therefore we have observed both confounding and consistent results. Most of the environmental variables consistently agree with the expected convention, in their relationship towards mortality. Confounding effects were observed in the relationship between education, type of roofing and water treatment to mortality. Standardization which was thought to be the culprit behind the inconsistencies, did not change the nature of behaviour of this variables and was henceforth aborted. It will be interesting to observe how these variables behave in the multivariate analysis.

In Embu District several variables showed consistency with conventional knowledge, though a few of the variables continued showing confounding effects with mortality. Women's age continues to depict a low mortality for the 15-19 year age group, while single mothers continue to dominate the marital status scene with the lowest mortality. Our results also indicate that the more the number of people in a household, the lower the mortality index. Treatment of water still retains the dubious result that mortality is lower when water is untreated. This results indicate the possibility of the interplay of confounding factors, irrelevancy of small sample sizes in particular categories among other factors. The results obtained should be treated with caution.

In Mombasa District, the following observations were made: As usual there existed several variables behaving in the manner least expected. for example. education and number of rooms. Educational results are particularly disturbing because they show a consistency of secondary educated women continuously depicting higher mortality than lower level categories. Widowed women also showed a lower index than married women, an unprecedented finding. Number of rooms as indicated before would not mean much without indicating how much of the available space is occupied, thus the confounding effects observed. Lastly, it is surprising that the reliability of water should depict a higher index when water is more available than when it is not during the wet season.

In Baringo District, the following observations were made: As usual there existed several variables behaving in the manner least expected, for example age, education, marital status, type of floor, number of people, water sources during the dry season, reliability of water during the wet and dry season, distance to water sources during the wet season, type of toilet and type of bathroom. Educational results are still particularly disturbing ause they show a consistency of secondary educated women continuously depicting higher mortality than er level categories. Widowed women also showed a lower index than married women, an unprecedented ing. Number of people as indicated before would not mean much without indicating how much of the ilable space is occupied, thus the confounding effects observed. Lastly, it is surprising that the pit latrines ıld depict a higher index than when no toilets are available.

South Nyanza District, the following observations were made: As usual there existed several variables aving in the manner least expected, for example age, income, number of people and reliability of water ng the dry season. Number of people as indicated before would not mean much without indicating how ch of the available space is occupied, thus the confounding effects observed. Lastly, it is surprising that the ability of water should depict a higher index when water is more available than when it is available only etimes.

# 4.0.CHAPTER 4

# 4.1. REGRESSION ANALYSIS

## 4.2. REGRESSION ANALYSIS RESULTS

The following categories of variables were found to affect the mortality index (ratio of observed to expected deaths per individual woman) when considered with reference categories.

### Demographic

- DIVO: This refers to women in the marital status category of divorced. The reference category was considered as that of women in the marital status category of `single'.
- MARRIED: This refers to women in the marital status category of married. The reference category was considered as that of women in the marital status category of single.
- AGE3: This refers to those women aged between 35-49. The category `AGE1' or women aged between 15-19 was considered as the reference category with dummy variable equal to zero.
- AGE2: These refers to those women aged between 25-34. The category `AGE1' or women aged between 15-19 was considered as the reference category with dummy variable equal to zero.
- SEC2: This refers to women with two years of secondary education and above (form3+). The reference category was considered as that for women with no education.
- PRI2: This refers to women with primary education, known as std 5-8. The reference category was considered as that for women with no education.
- INC4: This refers to those women whose household income ranges from kshs 50000 and above annually for the year previous to the survey. The reference category was considered as that for women whose income ranged between 0 and 1000 kenya shillings per annum, for the year prior to the survey.

- INC2: This refers to those women whose household income ranges from between kshs 1000 to 2000 annually for the year previous to the survey. The reference category was considered as that for women whose income ranged between 0 and 1000 kenya shillings per annum, for the year prior to the survey.

## Environmental

- FCEM: These refers to the houses made of cement floors The reference category was considered as the households' floors were made of MUD.

- DISTDRY2: Indicates that the distance travelled in search of water is more than 1 km. The reference category 'DISTDRY1' indicating a distance travelled of less than one kilometre took dummy variable zero.

- DISTDRY3: This refers to a distance of three or more kilometres travelled in search of water. The reference category was considered as a distance of less than one kilometre travelled in search of water.

- PEOP1: Refers to number of people sharing main house. PEOP 1 indicates a number of between 1-2 people per household. The reference category is PEOP3 referring to five or more people sharing the main house.

- PIT: This is the category of toilets classified as pit latrines. 'TNONE' or no toilets was considered as the reference category taking dummy variable 0.

- BNONE: These is the category of bathrooms classified as 'no bathrooms'. The reference category was considered as that of women with bathrooms available.

- MAKESHFT: Indicates a makeshift type of bathroom in a household. The reference category 'BATH' indicates an availability of a bath in the household and it took a dummy variable zero.

- MOSTTIME: refers to reliability of water most of the time during the wet season. ALLTIME referring to availability of water all the time during the wet season took the reference category with dummy variable zero.

- SHOWER: These is the category of bathrooms classified as `showers'. The reference category was considered as that of women with bathrooms available.

## Table 4.1: Mean of the dummy variables affecting mortality index in the various districts

### Demographic & Socioeconoic

| Dummy variable | Mean | | | | | |
|---|---|---|---|---|---|---|
| | Kwale | Embu | Mombasa | Kitui | Baringo | South Nyanza |
| Age2 | | | 0.394 | 0.227 | 0.306 | 0.297 |
| Age3 | | 0.272 | | 0.238 | | |
| Divo | 0.089 | 0.036 | | | | |
| Married | 0.624 | | | 0.575 | 0.616 | |
| Inc4 | | | 0.014 | | | |
| Pri2 | | | 0.074 | | | |
| SEC2 | | | 0.000 | | | |

### Environmental

| Dummy variable | Mean | | | | | |
|---|---|---|---|---|---|---|
| | Kwale | Embu | Mombasa | Baringo | Kitui | South Nyanza |
| FCEM | | | | 0.091 | | |
| PEOP1 | | | 0.240 | | | |
| DISTDRY2 | | | 0.045 | | | |
| DISTRY3 | | | | | | 0.546 |
| MOSTTIME | | 0.239 | | | | |
| PIT | | 0.837 | | | | 0.341 |
| BNONE | 0.251 | 0.243 | | | | |
| MAKESHFT | | 0.308 | 0.069 | | | 0.566 |
| SHOWER | | | | | 0.071 | |
| MI | 0.466 | 0.260 | 0.410 | 0.591 | 0.270 | 0.893 |

Table 4.2: **Standard deviation of the dummy variables affecting mortality index in the various districts**

Demographic & Socioeconomic

| Dummy variable | Standard deviation | | | | | |
|---|---|---|---|---|---|---|
| | Kwale | Embu | Mombasa | Kitui | Baringo | South Nyanza |
| Age2 | | | 0.489 | 0.419 | 0.462 | 0.458 |
| Age3 | | 0.446 | | 0.426 | | |
| Divo | 0.285 | 0.186 | | | | |
| Married | 0.485 | | | 0.495 | 0.487 | |
| Inc4 | | | 0.116 | | | |
| Pri2 | | | 0.262 | | | |
| SEC2 | | | 0.445 | | | |

Environmental

| Dummy variable | Standard deviation | | | | | |
|---|---|---|---|---|---|---|
| | Kwale | Embu | Mombasa | Baringo | Kitui | South Nyanza |
| FCEM | | | | 0.289 | | |
| PEOP1 | | | 0.489 | | | |
| DISTDRY2 | | | 0.211 | | | |
| DISTRY3 | | | | | | 0.499 |
| MOSTTIME | | 0.427 | | | | |
| PIT | | 0.370 | | | | |
| BNONE | 0.434 | 0.439 | | | | 0.475 |
| MAKESHFT | | 0.462 | 0.254 | | | 0.496 |
| SHOWER | | | | | 0.495 | |
| MI | 1.331 | 0.957 | 1.264 | 1.104 | 0.257 | 1.238 |

Table 4.3 gives the basic results of the multivariate regression analysis for Kwale District. The mean and standard deviations are shown in tables 4.1 and 4.2. Stepwise regression was used to the analyze data, and every variable was put into the equation in sequence. The order of inclusion into the equation was determined by the computer. Each of the additional variables was brought into the equation on the merits of the amount of unexplained variation on mortality it accounted for. At each stage of the regression analysis, the SPSS package printed an analysis of the variance table, giving the regression coefficients, residual sum of squares together with associated degrees of freedom, mean-squares and the t-statistics.

- KWALE

There is only one major equation: in the equation, only one variable was included, that is BNONE, as a category of the types of bathroom. The results obtained are indicated in table 4.3.

## Table 4.3. Multivariate regression analysis for Kwale district depicting the effect of environmental variables on mortality

| Variable | 1 |
|---|---|
| 1.BNONEb | 0.489 |
| sign t | 0.0001 |
| 4.constantb | 6.22 |
| sigf t | 0.000 |

$R^2$=0.02543

The equation finally obtained can be summarized as

**MI= 6.22+0.489(BNONE)**

The only significant variable was BNONE, thus no bathroom is the only environmental variable affecting mortality (positively) in the absence of control variables, given the pre-selected level of $p<0.05$.

Lack of a bathroom in a household was found to have a positive and significant predictive ability on mortality. $R^2$=0.02543. The findings show that this independent variable explains 2.5% of the variation in mortality. Lack of bathroom in a household positively affected mortality as inferred in the hypothesis. A regression coefficient of (b=0.489) was computed. A unit change in the value of BNONE will account for an increase in the level of mortality.

- EMBU

Table 4.4 gives the basic results of the multivariate analysis for Embu District. There are three major equations; in the first equation only one variable, PIT, was included. Equation two and the subsequent equations contain variables in the previous equation and an additional variable as indicated in the table below.

## Table 4.4. Multivariate regression analysis with no control variable

| variable | | 1 | 2 | 3 |
|---|---|---|---|---|
| 1.PITb | | -0.331 | -0.349 | -0.485 |
| sigf t | | 0.0110 | 0.0072 | 0.0006 |
| 2.MOSTTIMEb | | | 0.281 | 0.327 |
| sigf t | | | 0.0122 | 0.0039 |
| 3.DISTWET3b | | | | 0.269 |
| sigf t | | | | 0.0150 |
| 4.constantb | 1 | 1.174 | 10.081 | 8.51 |
| sigf t | | 0.0110 | 0.0001 | 0.0009 |

$R=0.21627$
$R^2=0.04677$
$F=6.36229$
sigf $F=0.0003$

The regression equation can thus be summarized as

**$MI= 8.51-0.485(PIT)+0.327(DISTWET3)+0.269(MOSTTIME)$**

This equation shall be considered as the original or reference model for Embu District. The value of $F= 6.36$ was found to be significant at sigf $F=0.0003$ when $p<0.05$. This demonstrates the goodness of fit of the model. The strength of association between mortality and environmental variables was by an R value of 0.216. The findings show that the independent variables collectively explain 4.7% variation in mortality. Pit latrines and distance to water source were significant at the pre-selected level of $p<0.05$ in predicting the dependent variable. Availability of pit latrines was negatively related to child mortality. A regression coefficient of $b=-0.485$ was computed. A positive relationship existed between a distance of 3+ kilometres to the water source during the wet season and child mortality. This relation yielded a regression coefficient of 0.327. A positive relation also existed between mortality and availability of water most of the time ($b=0.269$) as compared to the reference category classified as ALLTIME. A unit change in the value of PIT will account for a decrease in mortality while the opposite would be the case when there is a unit change in the value of the other two variables. It is important to note that availability of pit latrines was found to have a highly significant predictive ability on mortality in Embu District.

- MOMBASA

Table 4.5 gives the basic results of the multivariate analysis for Mombasa District. There are three major equations; in the first equation only one variable, DISTDRY2, was included. Equation two and the subsequent equations contain variables in the previous equation and additional variable as indicated in the table below.

## Table 4.5. Multivariate regression analysis with no control variable included (environmental variables only)

| variable | 1 | 2 | 3 |
|---|---|---|---|
| 1.DISTDRY2 b | 0.937 | 0.737 | 0.804 |
| 2.MAKESHFT b | | 0.762 | 0.529 |
| 3.PEOP1 b | | | 0.236 |
| 4.Constant b | 7.46 | 6.92 | 5.68 |

| | |
|---|---|
| R= | 0.19856 |
| $R^2$= | 0.03943 |
| F= | 9.00252 |
| sigf F = | 0.0000 |

The value of F=9.00252 was found to be significant at sigf F=0.0000 when $p<0.05$. The strength of association between environmental variables and mortality was measured by an R value of 0.19856. The findings show that the independent variables examined collectively explain 3.9% variation in mortality. A distance of 1 kilometre to water source during the dry season (DISTDRY2). makeshift toilet (MAKESHFT) and 1-2 people in a household (PEOP1) showed a positive association with mortality The computed regression coefficients for DISTDRY2, MAKESHFT and PEOP1 were 0.804. 0.529 and 0.236. A one unit change in the value of any of these variables will cause an increase in the value of mortality. The equation obtained is as follows;

**MI= 5.68+0.804(DISTDRY2)+0.0.529(MAKESHFT)+0.236(PEOP1)**

- KITUI

Table 4.6 gives the basic results of the multivariate analysis for Kitui District. There are three major equations; in the first equation only one variable, MOSTTIME, was included. Equation two contains the variable in the previous equation and an additional variable as indicated in the table below.

## Table 4.6. Multivariate regression analysis with no control variable included (environmental variables only)

| variable | 1 | 2 | 3 |
|---|---|---|---|
| 1.MOSTTIME b | 0.223 | 0.231 | 0.231 |
| 2.SHOWER b | | 0.263 | 0.307 |
| 3.BNONE b | | | 0.162 |
| 4.constant b | 7.58 | 6.96 | 5.58 |

$R=0.16200$
$R^2=0.02624$
$F=4.90517$ sigf $F=0.0023$

The value of $F=4.91$ was found to be significant at sigf $F= 0.0023$ when $p<0.05$. The strength of association between environmental variables and mortality was measured by an R value of 0.16200. The findings show that the independent variables examined collectively explain 2.6% variation in mortality. Availability of water most of the time (MOSTTIME), shower type of bathroom and no bath facility (BNONE) showed a positive association with mortality. The computed regression coefficients for MOSTTIME, SHOWER and BNONE were 0.231, 0.307 and 0.162. A one unit change in the value of any of these variables will cause an increase in the value of mortality. The equation obtained is as follows

**MI=5.58+0.231(MOSTTIME)+0.307(SHOWER)+0.162(BNONE)**

- **BARINGO**

Table 4.7 gives the basic results of the multivariate analysis for Baringo District. There is one major equation; in the equation only one variable, FCEM. or cemented type of floor, was included.

## Table 4.7: Multivariate regression analysis for Baringo District with no control variables

Variable 1

| | |
|---|---|
| 1.FCEM b | 0.623 |
| sigf t | 0.0016 |
| 6.constant b | 9.33 |
| sigf t | 0.0000 |

R=0.16282
$R^2$=0.02651
F=10.07656
sigf F=0.0016

The value of F=10.07656 was found to be significant at sigf F=0.0016 when $p<0.05$. The strength of association between environmental variables and mortality was measured by an R value of 0.16282. The findings show that the independent variable examined explained 2.7 % variation in mortality. A house made of cemented floor (FCEM) showed a positive association with mortality. The computed regression coefficients for FCEM was 0.623. A one unit change in the value of FCEM will cause an increase in the value of mortality.

The equation finally obtained can be summarized as

**MI= 9.33+0.623(FCEM)**

It is evident from the equation that the environmental factor (type of floor) has a significant effect on the ratio of observed to expected deaths. The coefficient above is significant at $p<0.05$. We can thus conclude that the environmental factors in Baringo have a significant effect on child survival. It is however important to note that the results obtained above are by no means what had been expected. Cement floors were expected to depict a negative relationship with mortality.

After the above analysis, the next step was built up on finding what would happen if socio-economic and demographic variables were controlled for. This was done by introducing the socioeconomic and demographic variables into the equation separately. The impact of a particular variable on the environmental variables could thus be observed. The following variables were introduced at each turn.

Demographic: age and marital status

socio-economic: education and income of the household

- SOUTH NYANZA

Table 4.8 gives the basic results of the multivariate analysis for South Nyanza District. There are three major equations; in equation one only one variable, MAKESHFT, or makeshift type of bathroom, was included. Equation two and the subsequent equations contain variables in the previous equation and an additional variable as indicated in the table below.

### Table 4.8. Multivariate regression analysis for South Nyanza District with no control variables

| Variable | 1 | 2 | 3 |
|---|---|---|---|
| 1.MAKESHFT b | 0.407 | 0.357 | 0.277 |
| sigf t | 0.0017 | 0.0058 | 0.0373 |
| 2.PITS | | -0.360 | -0.465 |
| sigf t | | 0.0078 | 0.0011 |
| 3.DISTDRY3 | | | 0.306 |
| sigf t | | | 0.0256 |
| 6.constant b | 10.31 | 12.65 | 11.31 |
| sigf t | 0.0000 | 0.0000 | 0.0000 |

$R=0.24111$
$R^2=0.05813$
$F=7.52985$
sigf $F=0.0001$

The value of $F=7.52985$ was found to be significant at sigf $F=0.0001$ when $p<0.05$. The strength of association between environmental variables and mortality was measured by an R value of 0.24111. The findings show that the independent variable examined explained 5.8% variation in mortality. A makeshift type of bathroom (MAKESHFT) and a distance of three or more kilometres to the water source, during the dry season, (DISTDRY3) showed a positive association with mortality. The computed regression coefficients for MAKESHFT was 0.277 while that for DISTDRY3 was 0.306. Pit latrines depicted a negative association with mortality with a regression coefficient b= -0.465. A one unit change in the value of MAKESHFT and DISTDRY3 will cause an increase in the value of mortality, while a unit change in the value of PIT will cause a decrease in mortality.

The equation finally obtained can be summarized as

MI= 11.31+0.277(MAKESHFT)-0.465(PITS)+0.306(DISTDRY3)

It is evident from the equation that the environmental factor (type of bathroom, type of toilet and distance to water source) have a significant effect on the ratio of observed to expected deaths.

After the above analysis, the next step was built up on finding what would happen if socio-economic and demographic variables were controlled for. This was done by introducing the socioeconomic and demographic variables into the equation one by one in turn. The impact of a particular variable on the environmental variables could thus be observed. The following variables were introduced at each turn.

Demographic: age and marital status

socio-economic: education and income of the household

## 4.3. The relationship between environmental factors and mortality controlled for age

The explanation to the variation in mortality accounted for by the independent variables did not change from $R^2$=0.02543. The equation describing the fitted model was of the form similar to that obtained when the effect of environmental variables only was assessed. The association between lack of bathroom and mortality remained strong. Thus no age group of women is at a such a high risk (or low risk) as to sideline the influence of no bathrooms on mortality.

- EMBU

Table 3.105 gives the results obtained. AGE3 referring to the women's age group of between 35-49 appeared in the equation as a variable, positively affecting mortality, in addition to the now dominant environmental variables, pit and mosttime. It was found that age as a control variable was less significant in determining mortality than the environmental variables. Women aged 35-49 had a positive relationship with mortality (beta=0.234), thus these women are more likely to have their offsprings dying than women in the 15-19 years age group. The association between pit latrines and mortality was negative. A b-value of -0.452 was computed. This concurs with the hypothesis. The control effect of age decreased the negative effect of PIT from b=-0.485 to -0.452, thus decreasing the chances of survival of offsprings for respondents who have pit latrines available to them. On the other hand, introduction of age was found to decrease the positive effect of availability of water most of the time and the distance of 3+ kilometres to water source, to mortality. The changes were from 0.327 to 0.226 for MOSTTIME and 0.269 to 0.255 for DISTWET3 respectively. Thus age had a depressive effect on the relationship between MOSTTIME and DISTWET3 and mortality.

**Table 4.9. Multivariate regression analysis with age as a control variable**

| variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.PIT b | -0.331 | -0.349 | -0.484 | -0.452 |
| 2.MOSTTIME b | | 0.281 | 0.327 | 0.226 |
| 3.DISTWET3 b | | | 0.269 | 0.255 |
| 4.AGE3 b | | | | 0.234 |
| 5.const b | 11.174 | 10.081 | 8.51 | 7.28 |

The resulting equation can be written as

**MI=7.28- 0.452 (PIT) +0.226 (MOSTTIME)+ 0.255 (DISTWET1) + 0.234 (AGE3)**

Original model:

**MI=8.51-0.485(PIT)+0.327(MOSTTIME)+0.269(DISTWET3)**

- MOMBASA

In the next step, age was introduced into the regression as the only demographic control variable. Age as a control variable had a similar impact as that observed in the relationship between environmental variables and mortality. There were no changes in the values of beta's. Age as a control variable was insignificant in determining the influence between environmental variables and mortality.

## Table 4.10: Multivariate regression with age as a control variable

| variable | 1 | 2 | 3 |
|---|---|---|---|
| 1.DISTDRY2 b | 0.937 | 0.777 | 0.804 |
| 2.MAKESHFT b | | 0.480 | 0.529 |
| 3.PEOP1 b | | | 0.236 |
| 6.constant b | 7.45 | 6.93 | 5.68 |

R=0.19856
$R^2$=0.03943
F=9.00252
sigf F=0.0000

The regression equation can be written as follows

MI=5.68+0.804(DISTDRY2)+0.529(MAKESHFT)+0.236(PEOP1).

- KITUI

The inclusion of age into the stepwise regression had two impacts; It caused the inclusion of AGE2 and AGE3 with AGE2 being introduced a step earlier than AGE2. Table 4.10 gives the results of the multivariate analysis. The obtained equation can be expressed in the form.

I= 4.04+0.290(AGE2)+0.207(AGE3)+0.208(MOSTTIME)

riginal model:

I=5.68+0.804(MOSTTIME)+0.529(MAKESHFT)+0.236(PEOP1).

was found that with the inclusion of age into the model the explanation to the variation in mortality accounted r by the independent variables increased from 2.6 % in the original model to 3.8 % in the model containing e. The association between the dependent and independent variables was strong as shown by an F value of 20258 which was highly significant at $p<0.05$. The equation describing the fitted model is shown above. Age a control variable was more significant in determining mortality than the environmental variable, OSTTIME. Age was positively related to mortality with a regression coefficient of 0.290 for AGE2 and 207 for AGE3. The association between the environmental variable and mortality remained positive. A beta lue of 0.208 was computed for MOSTTIME. AGE as a control variable had the effect of making the eviously significant variables in the no control model ineffective, except for MOSTTIME. It had a depressing fect on availability of water most of the time (MOSTTIME) with the beta values changing from 0.231 in the odel containing environmental variables only to 0.208 in the model controlled for age. The variation in ortality explained by this model is larger than the variation in mortality explained by the original model.

## able 4.11. Multivariate regression with age as a control variable

| ariables | 1 | 2 | 3 |
|---|---|---|---|
| AGE2 b | 0.235 | 0.299 | 0.290 |
| AGE3 b | | 0.207 | 0.207 |
| MOSTTIME b | | | 0.208 |
| constant b | 6.76 | 4.76 | 4.04 |

=0.19511
=0.03807
=7.20258
gf F=0.0001

From these observation, we can conclude the an age of the mother of between 25-34 and to a lesser extent, an age of between 35-49, has a dampening effect on the association between BNONE (no bathroom) and shower availability, and mortality in Kitui District. MOSTTIME retains significance but with its importance being overshadowed by the control demographic variables.

- **BARINGO**

Table 4.12 gives the results obtained. AGE2 referring to the women's age group of between 25-34 appeared in the equation as a significant variable, positively affecting mortality, in addition to the now dominant environmental variables, FCEM. The significance of AGE2 however was less than that of FCEM. Not to escape attention also is the fact that by controlling for age, decreases the positive significance of FCEM, the type of floor.

## Table 4.12. Multivariate regression analysis with age as a control variable

| variable | 1 | 2 |
|---|---|---|
| 1.FCEM b | -0.623 | 0.608 |
| 2.AGE2 b | | 0.229 |
| 5.const b | 9.334 | 7.814 |

$R=0.20263$
$R^2=0.04106$
$F=7.89939$
sigf $F=0.0004$

The resulting equation can be written as

**MI=7.814-0.608(FCEM)+0.229(AGE2)**

The explanation to the variation in mortality by these combined independent variables was 4.1 %.

- **SOUTH NYANZA**

The inclusion of age into the stepwise regression had the impact of causing the inclusion of AGE2 into the regression model. Table 4.12 gives the results of the multivariate analysis. The obtained equation can be expressed in the form.

The resulting equation can be written as

**MI=10.06+0.273(MAKESHFT)-0.473(PIT)+0.300(DISTDRY2) + 0.300 (AGE2)**

Original model:

**MI= 11.31+0.277(MAKESHFT)-0.465(PITS)+0.306(DISTDRY3)**

It was found that with the inclusion of age into the model the explanation to the variation in mortality accounted for by the independent variables increased from 5.8 % in the original model to 7.4% in the model containing age. The association between the dependent and independent variables was strong as shown by an F value of 6.91013 which was highly significant at $p<0.05$. The equation describing the fitted model is shown above. Age as a control variable was less significant in determining mortality than the environmental variables,. Age was positively related to mortality with a regression coefficient of 0.300 for AGE2. The association between the environmental variable and mortality remained positive except for pit latrines. A beta value of 0.273 was computed for MAKESHFT, while a value of 0.300 was computed for DISTDRY3. A beta value of -0.473 was computed for PIT. AGE as a control variable had the effect of decreasing the positive value of the beta of MAKESHFT and DISTDRY3 and the negative beta value of PIT in comparison to the model containing environmental variables only. It thus had a depressing effect on MAKESHFT and DISTDRY3 and an enhancing effect on PIT, with the beta values changing from 0.277, -0.465 and 0.306 in the model containing environmental variables only to 0.273. -0.473 and 0.300 for MAKESHFT, PIT and DISTDRY3 respectively in the model controlled for age. Table 4.13 gives the results obtained.

## Table 4.13. Multivariate regression analysis with age as a control variable

| variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.MAKESHFT | 0.407 | 0.357 | 0.277 | 0.273 |
| sigf t | 0.0017 | 0.0058 | 0.0373 | 0.0398 |
| 2.PIT | | -0.360 | -0.465 | -0.473 |
| sigf t | | 0.0078 | 0.0011 | 0.0009 |
| 3.DISTDRY3 | | | 0.306 | 0.300 |
| sigf t | | | 0.0256 | 0.0280 |
| 4.AGE2 | | | | 0.300 |
| sigf t | | | | 0.0288 |
| 5.constant | 10.31 | 12.65 | 11.31 | 10.06 |
| sigf t | 0.000 | 0.000 | 0.000 | 0.000 |

## 4.4. The relationship between environmental variables and mortality controlled for Marital status

The explanation to the variation in mortality accounted for by the independent variables did not change from 2.5 % as in the original model. The equation describing the fitted model is expressed in the form:

**MI=1.66+0.479(BNONE)+0.704(DIVO)+0.307(MARRIED)**

It was found that marital status as a control variable was less significant in determining mortality than the environmental variables. Being married was positively related to mortality with a regression coefficient of 0.307. Thus those women who are married are more likely to have their offsprings dying than single mothers. In a similar turn out, those who are divorced are more likely to have their offsprings dying than single women. Divorced women had a regression coefficient of 0.704. The beta value for BNONE in this model was 0.479 as compared to 0.489 in the original model. The depressing effect of lack of bathroom was noted. The results show that the effect of marital status decreases the likelihood of respondents who lack bathrooms of having their offsprings dying in Kwale District and hence it can be considered as a confounder of the relationship between the environmental variables and mortality.

- **EMBU**

Table 4.14 gives the results obtained when marital status was controlled for.

## Table 4.14. Multivariate analysis with marital status as a control variable

| ariable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| .DIVO b | 29.47 | 29.62 | 29.26 | 29.44 | 30.36 |
| .MOSTTIME b | | 0.272 | 0.287 | 0.273 | 0.227 |
| .PIT b | | | -0.330 | -0.391 | -0.437 |
| .BNONE b | | | | 0.212 | 0.314 |
| .MAKESHFT b | | | | | 0.511 |
| .Constant b | 4.37 | 3.02 | 8.69 | 7.35 | 6.335 |

$=0.36954$
$^2=0.13656$
$=12.24$
igf F=0.0000

he resulting equation is

I=6.335+30.36(DIVO)+0.227(MOSTTIME)-0.437(PIT) +0.314 (BNONE) +0.511(MAKESHFT).

riginal model:

**II=8.51-0.485(PIT)+0.327(MOSTTIME)+0.269(DISTWET3)**

t was found that marital status as a control variable was more significant in determining mortality than the nvironmental variables. Divorced women had a positive relationship with mortality (beta=30.36), thus these omen are more likely to have their offsprings dying than single women.

he beta value for divorced women was quite high and was highly significant at sigf t = 0.0000 given a level of $<0.05$.

he explanation to the variation in mortality accounted for by the independent variables increased from 4.7 % the original model to 13.7% in the model containing marital status and the predictive ability of this model is argely attributable to marital status (divorce). The association between the dependent and independent ariables was strong as shown by an F value of 12.24 which was highly significant at $p<0.05$.

he beta value for MOSTTIME and PIT in this model were 0.227 and -0.437 as compared to 0.0.327 and -.485 in the original model. BNONE and MAKESHFT were introduced into the model as new variables ssociated with mortality. Marital status as a control variable decreased the positive effect of MOSTTIME and e negative effect of PIT latrines. The enhancing by marital status control variable of the positive effect of lack of no bathrooms (BNONE) and makeshift bathroom (MAKESHFT) was noted. The divorce findings can be explained by the fact that divorce is associated with substantial stress, which may in turn affect child health. By depriving the mother of a principal means of support for her child rearing activities, divorce may also have a calamitous effect on her financial situation (cf. Taubman and Rosen, 1981).

- MOMBASA

When marital status was introduced in the equation as the only demographic control variable, the results obtained were similar to those obtained when the relationship between environmental variables and mortality was assessed. There was no change in the values of beta, hence the presence of marital status as a control variable did not have any effect on the influence of environmental variables on mortality.

- KITUI

## Table 4.15. Multivariate regression analysis for Kitui District controlled for marital status

| Variable | 1 | 2 |
|---|---|---|
| 1.MARRIED b | 0.427 | 0.424 |
| 2.MOSTTIME b | | 0.216 |
| 3.constant b | 3.42 | 2.64 |

R=0.20671
$R^2$=0.04273
F=12.20815
sigf F=0.0000

thus

**MI=2.64+0.276(MARRIED)+0.216(MOSTTIME)**

It was found that marital status as a control variable was more significant in determining mortality than the environmental variable MOSTTIME. The regression coefficient of 0.424 indicated a positive association indicating that those who are married are more likely to have their offsprings dying than those who are single. The association between the environmental variable and mortality remained positive. The control effect of marital status decreased the positive effect of MOSTTIME on mortality from a b=0.231 to b=0.216. The results show that controlling for marital status decreases the likelihood of the respondents who have water available most of the time of having their offsprings dying. This model explained a larger variation in mortality than either the model controlled for age or the no control model.

- BARINGO

Table 4.16 gives the results obtained when marital status was controlled for. Being married showed a lesser significance with mortality than the environmental variable FCEM. This time MARRIED was introduced into the equation as a significant variable and at the same time, marital status decreased the positivety of the beta value of FCEM thus slightly weakening the positive influence of type of floor on mortality

## Table 4.16. Multivariate analysis with marital status as a control variable

| variable | 1 | 2 |
|---|---|---|
| 1.FCEM b | .0623 | 0.604 |
| 2.MARRIED b | | 0.274 |
| 6.constant b | 9.34 | 6.42 |

R=0.20212
$R^2$=0.04110
F=7.90739
sigf F=0.0004

The resulting equation is

**MI=6.42+0.604(FCEM)+0.274(MARRIED)**

Of interest to note is that marital status caused a more depressing effect on the positive relationship between FCEM and mortality than age had. When marital status was used as a control variable the beta decrease in FCEM was from 0.623 to 0.604, while the decrease caused by introducing age as a control variable was b=0.623 to b=0.608.

- SOUTH NYANZA

In this case the results obtained are similar to those obtained with the relationship between environmental variables and mortality was evaluated. There was no change in the values of the beta when compared to the original model. This indicates the insignificance of these variable in explaining the relationship between environmental variables and mortality in South Nyanza District.

## 4.5. The relationship between environmental variables and mortality controlled for Education and income

- KWALE

When both education and income were introduced in the equation, separately, as the only control variables, the results were similar to those obtained when no control was used, that is, as in the original model. The status quo obtained when no control variable was present was maintained. Hence education and income have no significant effect on the influence of environmental factors on mortality.

- EMBU

These two variables have been taken together because they share the same effect. In both cases the results obtained are similar to those obtained with no control variable, indicating the insignificance of these variables in explaining the relationship between environmental variables and mortality in Embu District. Table 4.17 shows the resulting beta values.

### Table 4.17. Multivariate regression with education (income) as control variables

| variable | 1 | 2 | 3 |
|---|---|---|---|
| 1. PIT b | -0.332 | -0.349 | -0.485 |
| 2.MOSTTIME b | | 0.281 | 0.327 |
| 3.DISTWET3 b | | | 0.269 |
| 5.constant b 1 | 1.174 | 10.08 | 8.51 |

The resulting equation can be written as

MI= 8.51-0.485(PIT)+0.327(MOSTTIME)+0.269(DISTWET3)

This is a perplexing result when compared to other studies which show the influence of education as being of importance.

It is also clear that income should serve as an indicator of children's consumption of goods and services that affects their health, including among others, clothing and shelter, sanitary facilities, use of medical systems and adult supervision. In addition to ambiguities of measurement, the interpretation of income's relationship with mortality is not straightforward. This study thus reveals that there may be a changing focus of the influence of certain variables on mortality in a perspective different from that traditionally understood.

- MOMBASA

The next step involved the inclusion of the levels of education as the only socio-economic variable. The results obtained were similar to those obtained with no control variable present, with the addition of PRI2 as a significant educational variable associated mortality as measured by mortality index. Table 4.18 shows the multivariate analysis results obtained.

## Table 4.18. Multivariate analysis results with education as a control variable

| variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.DISTDRY2 b | 0.937 | 0.777 | 0.804 | 0.809 |
| 2.MAKESHFT b | | 0.480 | 0.529 | 0.533 |
| 3.PEOP1 b | | | -0.236 | 0.236 |
| 4.PRI2 b | | | | -0.196 |
| 4.constant b | 7.45 | 6.93 | 5.68 | 7.20 |

R=0.21240
$R^2$=0.04511
F=7.75994
sigf F=0.0000

The resulting equation is

MI= 7.20+0.809(DISTDRY2)+0.533(MAKESHFT)+0.236(PEOP1)-0.196(PRI2)

Original model:

**MI=5.68+0.804(DISTDRY2)+0.529(MAKESHFT)+0.236(PEOP1).**

It was found that level of educational attainment as a control variable was less significant in determining mortality than environmental variables DISTDRY2, MAKESHFT and PEOP1. The regression coefficient of -0.196 indicated a negative association indicating that those with std 5-8 level of education are more likely to have their offsprings surviving than those with no education. The association between environmental variables and mortality remained positive. The control effect of education increased the positive effect of DISTDRY2 on mortality from a b=0.804 to b=0.809. It also decreased the positive value of MAKESHFT from b=0.529 to b=0.533. There was no change in the value of beta for PEOP1. The results show that controlling for education increases the likelihood of the respondents who travel a distance of more than one kilometre in search of water of having their offsprings dying, and similarly for respondents who only have makeshift toilets available to them.

- MOMBASA

The last step involved the inclusion of income into the equation as the only socioeconomic variable. The inclusion of income into the stepwise regression had two impacts; It caused the inclusion of INC4 and INC2 with INC4 being introduced a step earlier than PEOP1, a previously significant environmental variable. Table 4.19 gives the results of the multivariate analysis

## Table 4.19. Multivariate analysis results with income as a control variable

| variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1.DISTDRY2 b | 0.937 | 0.737 | 0.942 | 0.857 | 0.901 |
| 2.MAKESHFT b | | 0.762 | 0.687 | 0.548 | 0.519 |
| 3.INC4 b | | | -0.979 | -1.242 | -1.303 |
| 4.PEOP1 b | | | | 0.514 | 0.574 |
| 5.INC2 b | | | | | -0.245 |
| 6.constant b | 0.366 | 0.344 | 0.351 | 0.329 | 0.266 |

R=0.24759
$R^2$=0.06130
F=8.56806
sigf F=0.0000

The regression equation can thus be written as

**MI= 0.266+0.901(DISTDRY2)+0.519(MAKESHFT)-1.303(INC4) +0.574(PEOP1)-0.245(INC2)**

Original model:

**MI=5.68+0.804(DISTDRY2)+0.529(MAKESHFT)+0.236(PEOP1).**

It was found that with the inclusion of income into the model the explanation to the variation in mortality accounted for by the independent variables increased from 3.9 % in the original model to 6.1% in the model containing income. This increase was more than that obtained by controlling for education. The association between the dependent and independent variables was strong as shown by an F value of 8.57 which was highly significant at sign F=0.0000 when $p<0.05$. The equation describing the fitted model is shown above. Levels of income as a control variable was less significant in determining mortality than the environmental variables, DISTSRY2 and MAKESHFT, though more significant than PEOP1. Income was negatively related to mortality with a regression coefficient of -1.303 for INC4 and -0.245 for INC2. The association between environmental variables and mortality remained positive . Beta values of 0.901, 0.519 and 0.574 were computed for DISTDRY2, MAKESHFT and PEOP1 respectively. Income as a control variable had a depressing effect on the association between makeshift bathroom (b=0.529 to b=0.519). and enhanced the association between DISTDRY2 and PEOP1, and mortality. The beta values changed from 0.804 to 0.901 (DISTDRY2) and from 0.236 to 0.574 (MAKESHFT). Thus a change in income has conflicting influence on the relationship between the environmental factors and mortality.

- KITUI

The results obtained were similar to those obtained with no control variable present hence presence of education levels did not have any effect on the influence of environmental variables on mortality. The beta value remained the same.

The last step involved the inclusion of income into the equation as the only socioeconomic variable. The inclusion of income into the stepwise regression gave similar results as those obtained when no control variable was present, hence presence of income did not have any effect on the influence of environmental variables on mortality. The beta value remained the same.

- **BARINGO**

These two variables have been taken together because they share the same effect. In both cases the results obtained are similar to those obtained with no control variable, indicating the insignificance of these variables in explaining the relationship between environmental variables and mortality in Embu District.

When all the control (extraneous) variables were put into the model, the results were similar to those obtained when marital status was controlled for.

- **SOUTH NYANZA**

Similarly in these cases the results obtained are similar to those obtained with no control variable, indicating the insignificance of this variables in explaining the relationship between environmental variables and mortality in South Nyanza District.

# 5.0 CHAPTER 5

## 5.1. SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to investigate the influence of micro-environmental factors on infant and child mortality. It is important here to qualify the use of the word micro. The environmental risks that a newborn child is exposed to may be classified into three levels. The child's micro-environment does not extend beyond the mother and the room they inhabit. The environmental threats at this level are poor sanitation, over crowding and poor ventilation. At the meso-environmental level, a child is threatened by water pollution, air pollution, chemical misuse, and deforestation, while the macro-environment is beset by such hazards as global warming, ozone depletion and a rise in the sea level. The micro-environment level is primarily the responsibility of the individual household and this study has dealt with mortality at this level.

Through cross-tabulations, the relationship between selected environmental, demographic and socioeconomic factors on the one hand and mortality on the other was observed. The investigation also involved the utilization of multivariate regression to determine to what extent environmental factors such as type of housing, degree of crowding, availability and accessibility of water, and sanitation are significant predictors when they are considered in combination. This technique was also utilised in exposing what influence extraneous variables- considered here as age, marital status, income and education- have on the relationship between environmental variables and mortality.

A review of the relevant literature revealed that most of these factors have, in fact, been found to influence infant and child mortality in many situations. The findings agreed with the hypotheses. To test the hypotheses, six districts were covered in the investigation. The 1991 National Household Welfare Monitoring and Evaluation survey (NHWMES) data was utilized. The six districts covered were; Kwale, Embu, Mombasa, Kitui, Baringo and South Nyanza.

As regards the techniques used for the estimation of the level of infant and child mortality, from the data, it was pointed out that it is highly likely to underestimate the level of mortality because of possible under-reporting on infant and child deaths by the mothers. In the light of this, one can therefore accept these estimates based on the 1991 NHWMES results as fairly accurate conservative estimates.

The t-test and the F-tests were the major statistical techniques used for testing the significance of the micro-factors, and to assess the differences in the effectiveness of the control factors on the micro-factors. As stated in the interpretation of results in this study, and in other relevant chapters, this study was beset by a number of limitations. In brief, these limitations were:

(i). The unfamiliar file management format. The data files were initially preserved under desegregated headings such as household characteristics, household income, housing water and sanitation, and maternal history. Each file had a certain number of variables that were of interest to the investigation. For investigator to make use of the computer package, to analyze the data, it was vital that all files be combined into one unit. The end result was the loss of a substantial amount of important data culminating in a lower response than should have been the case.

- The unreliability of mortality data.
- The lack of measures for other micro-level factors such as household degree of crowding, water contamination and others.

The reader might have realized that some important aspects which should have been covered by a study of this nature have been omitted. For example, the author appreciates that the study would have had more weight, if it had provided information on diseases connected to various shortcomings in the household environmental conditions. Additional knowledge on the contribution of such diseases to the total incidence of mortality within the period would have highly valuable. It is also apparent that coverage of housing conditions would have been enhanced by considering density of occupancy (Number of people per room), and for water and sanitation conditions, by considering the level of contamination of water from different sources. All these were inevitable gaps necessitated by circumstances, but are highly regretted. Notwithstanding all this however, we feel that our study has achieved its objective of contributing to bridge the wide gap existing in the knowledge about housing, water and sanitation conditions, particularly in the rural areas and how they are related to mortality and also how this relationship is affected by demographic and socioeconomic conditions.

## 5.2. CONCLUSIONS AND RECOMMENDATIONS

Within these limitations of the study, the following conclusions can be drawn.

(i) In view of the child mortality estimate based on the results of the 1991 NHWMES, the level of child mortality, represented by q(2) varied from a high 111/1000[1] in Baringo Districts in the sample fell in the following order: Embu, with a mortality rate of 64/1000, Kwale with a rate of 67/1000, Kitui with a rate of 90/1000, Baringo with a rate of ...

In general, these estimates indicate that child mortality levels are lowest in urban towns, and high potential agricultural zones as compared to areas and the Lake basin area. Several reasons have been put forward to explain this geographical clustering of high and low mortality regions.

(ii) Levels of mortality index (MI), or the ratio of observed to expected deaths also served as good indicators of mortality levels in these district. The level of mortality index, (MI); varied from a low 0.26 in Embu District to a high 0.89 in South Nyanza District. The trend in mortality index is slightly different from that observed for q(2) due to the fundamental differences in the derivation of these indices but again, areas of high and medium potential are favoured with lower indices than areas of marginal agriculture potential and the Lake basin region and the area towards the Indian Ocean Coast.

(iii) Environmental factors, that is, housing, water and sanitation showed a consistency in their relationship to mortality. Poor environmental conditions constantly showed higher threats of mortality than more improved environmental conditions. Multivariate analysis also showed a significant relationship between environmental variables and mortality. This significance surpassed that observed for extraneous socioeconomic and demographic variables, in most cases.

## 5.3. Some important specific observations:

### 5.3.1. Housing Conditions

Actual material used for building the house in which women live were considered. The type of material used in constructing roofs and floors were considered. The study revealed that an undesirably large proportion of housing units in the study area were wholly constructed with temporary materials, that is, mud for floors and grass/makuti for roofs. These materials consistently showed a higher index of mortality than the move permanent cement floor materials and iron sheet roofs. The exception was Kitui District where mud floors depicted a lower index of mortality than floors constructed of cement. This was probably due to the poor nature of data.

Considering the health implications of such structures, the study mentioned their susceptibility to harbouring all sorts of house pests and insects, and accordingly alluded to the sorts of possible diseases that can be a product of such conditions.

In terms of significance to mortality, housing conditions were less significant in their relation to mortality as compared to factors of water and sanitation in almost all the study districts. Only in Baringo, did type of floor material show a highly significant negative relationship with mortality for the cement floors. These results were really encouraging.

The only extraneous factors found to confound this relationship were age and marital status of the respondents. This demonstrates the importance of considering the age of women and their marital status when attempting to study their housing living conditions. It is likely for old and married people to have neglected the conditions of their houses than young and perhaps single women, whose housing units are likely to have been recently constructed and perhaps were in a better state. No doubt too, age of the mother-the older the mother -is positively related to the mortality of their offsprings and it was observed that this relationship did not affect the relationship between type of housing conditions and mortality. Socioeconomic conditions were found to be of no consequence.

### 5.3.2. Availability and accessibility of water

#### i. Sources of water

The sources of water considered in this investigation were whether the respondents utilized safe or unsafe sources of water. The use of these sources depended on the district under investigation. In Embu, Kitui, Baringo and South Nyanza Districts, unsafe sources were more utilized than safe sources. In Kwale and Mombasa Districts the reverse situation was observed. Generally, safe sources showed a lower index of mortality than unsafe sources with a few exceptions. Poor sources of water have been linked to aggravation of health problems in any population. Improved sources of water are likely to be related to lesser incidence of diarrhoea and contamination of food through impure water.

In this investigation, sources of water were not significant predictors of mortality.

#### ii. Reliability of water

This study investigated whether water was available all the time or simply most of the time. Reliability of water was generally related to lower mortality with a few exceptions. In terms of significance, reliability of water was found to be a significant predictor of mortality, with a lower reliability showing a positive relationship with mortality in some districts. Reliability of water was a significant determinant of mortality in Embu and Kitui Districts.

#### iii. Distance to the Sources of water

The study investigated the relationship between distance to the sources of water and mortality. This distances were considered for both the wet and the dry seasons. Large distances to water sources have been linked to a higher utilization of unsafe water and this aggravates the health problems of a population. In this study the general observation was that, the shorter the distances to sources of water the lower the mortality index. The exception was to be found in South Nyanza District where longer distances to water source fetched lower index of mortality. In terms of significance, distance to the source of water was found to be a predictor of mortality in Embu, during the wet season, Mombasa during the dry season, and South Nyanza during the dry season. In all areas, the results suggested that larger distances to water sources were positively and significantly related to mortality.

### iv. Time taken to fetch water

This was another factor considered in this investigation time was considered in periods of; less than hour, between one and two hours and the three hours while fetching for water. Cross-tabulation revealed a general tendency for lower mortality for shorter intervals of time. Kitui and South Nyanza Districts were the only exceptions with longer intervals of time fetching lower indices of mortality. This was probably due to the poor nature of the data. In terms of significance in predicting mortality, time taken in fetching water was found not to be significant in any of the districts investigated.

### v. Treatment of water

Two types of treatment were considered. No treatment and boiling/chemicals were the two types of treatment considered. The general observation from cross-tabulations highlighted the importance of treating water in an effort to improve the mortality situation. This was especially observable in districts reporting many respondents who utilized unsafe sources of water as their main sources. However, in Kwale and Embu, the findings were in disagreement with this expectation. However, it is to be noted that in Kwale, a larger percentage of respondents utilized safe sources if water, and it is no wonder that boiling and/or using chemicals has no effect on the purity of water. These findings also highlight the importance of incorporating levels of water contamination in the investigation. This would help disclose whether or not unsafe sources of water are a potential risk in spreading disease, and therefore, whether or not treatment of water would change any risk related to sources of water. In terms of significance in predicting mortality, treatment of water did not show any significance in the districts studied.

### 5.3.3. Sanitation

#### i. Types of toilet

In all districts excluding Mombasa, only two types of toilets were covered; pit latrines and no toilets at all. In Mombasa, an additional type, the water closets were also considered. The general observation for the types of toilets was that better quality of toilet facility were related to lower mortality. In terms of significance, pit latrines were significantly and negatively related to mortality in Embu and South Nyanza Districts. This demonstrates the importance of such interventions as the safe disposal of human faeces in reducing mortality.

#### ii. Types of bathroom

The relationship between types of bathroom facility and mortality also followed a similar trend as that observed for types of toilet facility. Generally, availability of good bathing facility was related to lower mortality and vice versa. Lack of bath facilities and makeshift types of bath facilities were found to be positive and significant predictors of mortality in Kwale, Embu and Kitui.

This study also endeavoured to examine the effect of some socioeconomic and demographic factors on the relationship, considered in combination, and mortality. This factors were considered as extraneous or control variables in that they were expected to affect the relationship but were of no intrinsic interest to the study. The variables considered were: Age of the mother, her marital status, her level of education and income of the household.

### 5.3.4. Age

Age was found to have a confounding influence on he variables of housing, water and sanitation in Embu, Kitui, Baring, and South Nyanza. In most cases, introduction of age was accompanied by an increase in the explanation to variation in mortality by the independent variables in the model. Also observed was the depressed positive and negative values of beta of the independent variables in this model. In South Nyanza though, inclusion of age in the model enhanced the negative value of beta of the pit latrines.

These findings demonstrate the importance of considering the influence of age of respondents when attempting to assess their utilization of various facilities within their communities. For example, older women are likely to have a difficulty of utilizing a water source situated three or more kilometres from their households than younger women.

### 5.3.5. Marital status

This variable acted as a covariate of variables of housing water and sanitation in Kwale, Embu, Kitui and Baringo. Extraneous variables of marital status namely divorce and being married depicted a positive relationship with mortality. Further, the inclusion of this variable was also related to an increased explanation to the variation in mortality by the independent variables, implying the importance of marital status in determining levels of mortality. The beta values of environmental variables were depressed by controlling for marital status. The marital status is a significant confounder of the variables of housing, water and sanitation and should be considered in such investigations.

### 5.3.6. Education and Income

The influence of these two extraneous variables was minimal their effect was only significant in the basically urban town of Mombasa. Variables such as a distance of between one to two kilometres in search of water during the dry season were even more significant in predicting mortality when age was controlled for. It is argued that educational attainment is not likely to effect factors beyond the control of household and thus only amendable by public authorities such as sources of water. It was however note worthy to observe a decrease in the positive predictive ability of makeshift type of bathroom, which are ably controlled through households level of awareness and disposal incomes.

In the following sections, we attempt to suggest some possible measures that can help in reducing problems related to poor environmental conditions. We also consider requirements for further research.

## 5.4. Policy measures for improving environmental conditions

A work of this nature would be incomplete if it ended without considering some of the possible measures that can be taken to deal with the various problems identified with environmental conditions, and their implications to the general well being of the people. It will be of necessity for policy makers to pay serious attention to the problem of improving housing conditions, particularly in the rural areas. Priorities will have to be defined regarding appropriate housing conditions. Much too, has to be done to improve water sources and sanitary facilities in the rural areas. This study also finds that, the use of various services is related to the age of the respondents, and their marital status, and this will have to be taken into consideration when providing the services. Improvement of socioeconomic services like education and alleviation of poverty in some areas will also be useful in reducing levels of mortality in these areas.

There is therefore an urgent need on the side of planners to draw a comprehensive housing conditions development plan which will take into consideration both urban and rural needs. In this respect, rural areas should command priority consideration since the biggest part of the population lives there, and they form the backbone of the national economy in terms of production and consumption. This development plan has also got to put more effort in tackling the water and sanitary problem. Our findings highlight the importance of availability and accessibility of water and good sanitary features in reducing mortality. These factors play a big role in determining the health conditions of any given society.

## APPENDIX

## RESULTS OF BRASS TECHNIQUE FOR COMPUTING MORTALITY AND REFERENCE PERIODS

### Kwale District, West model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 105 | 190 | 21 | 0.001600 | 3.665547 |
| 20-24 | 85 | 210 | 26 | 0.079158 | 5.563449 |
| 25-29 | 100 | 336 | 45 | 0.123735 | 6.982743 |
| 30-34 | 98 | 310 | 45 | 0.149185 | 7.906718 |
| 35-39 | 61 | 199 | 36 | 0.195848 | 8.560250 |
| 40-44 | 37 | 131 | 28 | 0.231146 | 9.590559 |
| 45-49 | 36 | 145 | 19 | 0.140106 | 11.93872 |

### Kwale District, North model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 105 | 190 | 21 | -0.04522 | 3.616523 |
| 20-24 | 85 | 210 | 26 | 0.066745 | 5.377259 |
| 25-29 | 100 | 336 | 45 | 0.112476 | 6.718693 |
| 30-34 | 98 | 310 | 45 | 0.146476 | 7.699674 |
| 35-39 | 61 | 199 | 36 | 0.204829 | 8.426757 |
| 40-44 | 37 | 131 | 28 | 0.241342 | 9.411508 |
| 45-49 | 36 | 145 | 19 | 0.142842 | 11.54092 |

### Embu District, West model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 83 | 128 | 7 | 0.034455 | 2.373001 |
| 20-24 | 66 | 197 | 19 | 0.071742 | 4.420036 |
| 25-29 | 77 | 287 | 17 | 0.052321 | 6.770383 |
| 30-34 | 60 | 260 | 18 | 0.065827 | 9.096657 |
| 35-39 | 41 | 180 | 30 | 0.164851 | 11.37596 |
| 40-44 | 40 | 165 | 16 | 0.095272 | 13.67991 |
| 45-49 | 26 | 145 | 12 | 0.080570 | 16.21611 |

### Embu District, North model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 83 | 128 | 7 | 0.014464 | 1.239939 |
| 20-24 | 66 | 197 | 19 | 0.064087 | 3.183826 |
| 25-29 | 77 | 287 | 17 | 0.047224 | 5.926262 |
| 30-34 | 60 | 260 | 18 | 0.062901 | 9.051811 |
| 35-39 | 41 | 180 | 30 | 0.167523 | 12.41976 |
| 40-44 | 40 | 165 | 16 | 0.097475 | 15.70036 |
| 45-49 | 26 | 145 | 12 | 0.081683 | 18.56322 |

### Mombasa District, North model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 74 | 53 | 6 | -0.01665 | 55.80753 |
| 20-24 | 120 | 153 | 10 | 0.047275 | 55.98102 |
| 25-29 | 136 | 366 | 33 | 0.087258 | 54.71610 |
| 30-34 | 98 | 334 | 43 | 0.142548 | 52.71286 |
| 35-39 | 59 | 260 | 35 | 0.163843 | 50.28810 |
| 40-44 | 38 | 168 | 26 | 0.186128 | 48.91456 |
| 45-49 | 25 | 140 | 22 | 0.181335 | 50.78878 |

### Mombasa District, West model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 74 | 53 | 6 | 0.029142 | 55.86276 |
| 20-24 | 120 | 153 | 10 | 0.052537 | 56.07471 |
| 25-29 | 136 | 366 | 33 | 0.092216 | 54.60543 |
| 30-34 | 98 | 334 | 43 | 0.141759 | 52.27719 |
| 35-39 | 59 | 260 | 35 | 0.154618 | 49.58187 |
| 40-44 | 38 | 168 | 26 | 0.177327 | 48.54829 |
| 45-49 | 25 | 140 | 22 | 0.178039 | 51.18772 |

### Kitui District, West model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 95 | 155 | 8 | 0.038554 | 2.121717 |
| 20-24 | 89 | 302 | 40 | 0.100382 | 4.228221 |
| 25-29 | 77 | 316 | 47 | 0.129423 | 6.806324 |
| 30-34 | 48 | 229 | 21 | 0.080970 | |
| 35-39 | 44 | 191 | 12 | 0.061232 | |
| 40-44 | 46 | 188 | 30 | 0.155726 | |
| 45-49 | 41 | 222 | 24 | 0.104052 | |

### Kitui District, North model

| Age | FP | CEB | CD | q(x) | t(x) |
|---|---|---|---|---|---|
| 15-19 | 95 | 155 | 8 | 0.020266 | |
| 20-24 | 89 | 302 | 40 | 0.090323 | |
| 25-29 | 77 | 316 | 47 | 0.116358 | |
| 30-34 | 48 | 229 | 21 | 0.080970 | |
| 35-39 | 44 | 191 | 12 | 0.061232 | |
| 40-44 | 46 | 188 | 30 | 0.155726 | |
| 45-49 | 41 | 222 | 24 | 0.104052 | |

## Baringo District, West model

| Age | FP | CEB | CD | q(x) | t(x) | |
|---|---|---|---|---|---|---|
| 15-19 | 44 | 15 | 7 | 0.689094 | | 0.729282 |
| 20-24 | 55 | 133 | 15 | 0.115213 | | 2.262096 |
| 25-29 | 72 | 301 | 29 | 0.091760 | | 4.716678 |
| 30-34 | 70 | 375 | 51 | 0.130273 | | 7.676670 |
| 35-39 | 62 | 404 | 72 | 0.173299 | | 10.91710 |
| 40-44 | 37 | 270 | 40 | 0.142056 | | 14.13946 |
| 45-49 | 33 | 252 | 68 | 0.256979 | | 17.07633 |

## Baringo District, North model

| Age | FP | CEB | CD | q(x) | t(x) | |
|---|---|---|---|---|---|---|
| 15-19 | 44 | 15 | 7 | 0.553870 | | 0.725797 |
| 20-24 | 55 | 133 | 15 | 0.110914 | | 2.201845 |
| 25-29 | 72 | 301 | 29 | 0.086334 | | 4.497737 |
| 30-34 | 70 | 375 | 51 | 0.125154 | | 7.270015 |
| 35-39 | 62 | 404 | 72 | 0.174146 | | 10.37472 |
| 40-44 | 37 | 270 | 40 | 0.143396 | | 13.55190 |
| 45-49 | 33 | 252 | 68 | 0.258744 | | 16.54537 |

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