

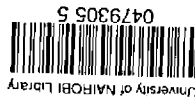
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**INFANT AND CHILD MORTALITY: LEVELS, TRENDS AND
DIFFERENTIALS IN MOMBASA DISTRICT, KENYA.**

BY

✓ **MAKOKHA, JOHN MAGERO**

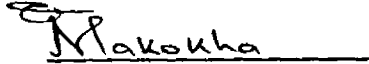
*A thesis submitted in partial fulfilment of the requirements for
the degree of Master of Arts in population studies at the
Population Studies and Research Institute, University of Nairobi.*

November 1993



DECLARATION.


This thesis is my original work and has not been presented for the award of a degree in any other university.



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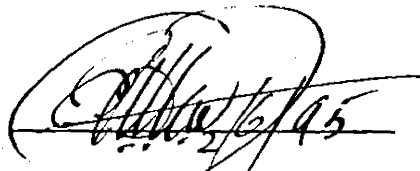
Date: 2nd June 1995

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Date:

DEDICATION

TO

MY LATE FATHER

JEREMIAH MAKOKHA MAGERO

ACKNOWLEDGEMENTS

The completion of this study is a result of valuable guidance and assistance from many people. It is not possible to name all of them here. However, to them all, I am greatly indebted.

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ABSTRACT.

Man's prime concern is the sustenance of good and long life. Although death at any age deals a major blow to the realization of this goal, the death of infants and children is much more agonizing because it represents the destruction of both hope and immense potential for the future.

This study analyses infant and child mortality in Mombasa district. These target groups were selected for this study because they reflect the success level of the health care programmes. The main objective of the study was to estimate and describe infant and child mortality levels, trends and differentials in Mombasa district by divisions. Specifically the impact of the educational level of the mothers as well as the marital status on infant and child mortality have been measured. The database for this study was extracted from the 1979 National population census in Kenya. The Brass-Trussell indirect analytical technique has been used to estimate mortality levels and generate life table functions.

Mombasa district being predominantly urban, it would be expected to experience comparatively low mortality because of the availability of many medical facilities and services. However this study has revealed fairly high infant and child mortality in Mombasa. The mother's division of residence affect both mortality and life expectancy. The Island division with better facilities and services experience low mortality with consequent high life expectancy. In all the divisions, mortality was found to decrease

with the increase in the level of education of the mothers. This relationship can be explained by the associated higher incomes of the mother's of higher education and their higher levels of awareness especially about medical care and nutrition. Analyzed by marital status, infant and child mortality was found to be highest among the widowed. For all the differentials and in all the divisions, mortality during infancy was found to be higher than mortality occurring between ages one and five.

Policy programmes aiming at the reduction of infant and child mortality in the district should focus on increasing and making more accessible health facilities, services and general infrastructure. Both formal and informal education are quite useful too especially for females. The socio-cultural dimension and it's effect on infant and child mortality requires a more detailed study.

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CHAPTER ONE

GENERAL INTRODUCTION, BACKGROUND INFORMATION AND PROBLEM STATEMENT.

1.1 General Introduction

Demographic studies in Kenya have revealed a declining infant and child mortality trend. For instance, the 1948 Census estimate of infant mortality in Kenya was 184 per 1000 live births. In 1969, it was estimated to be 94 per 1000 live births. By 1979, it had dropped to 83 per 1000 live births and by 1989, it had further dropped to 74 per 1000 live births. The child mortality rate has also been declining over time. While in 1979, it was estimated to be about 142 per 1000 live births, by 1989, it was estimated to have dropped to 105 per 1000 live births.

The above trend, however, conforms to the general situation in most developing countries. Past studies have a consensus on the positive role of widespread application of Western medical technology, public health intervention programmes such as immunization and general socio-economic advances in the decline.

However, the rates during the 1980's and into the 1990's, show a reduction which is much lower than in the pre-1980 phase. This is bound to be a reflection of the deteriorating standards of living, steep rises in the prices of essential commodities beyond the reach of many ordinary people, low remuneration packages for health staff lowering their morale, a declining ability of the state to establish additional infrastructure and service existing ones. Projections taking into account the effect of the much

dreaded Acquired Immune Deficiency Syndrome (AIDS) place the child mortality rate for Kenya to be about 189 per 1000 live births by the year 2000.

Overall estimates of infant and child mortality mask major regional variations and even variations among mothers of differing characteristics. Maternal income level, educational level, marital status, place of residence and the availability and accessibility of medical facilities and services are among the major factors which account for different levels of infant and child mortality in different localities.

The ever-increasing population along with shortage in food supply arising from poor harvests and a weak purchasing power, perennial water shortage, poor sanitation and growing disease resistance militate against further steep declines in infant and child mortality. Indeed, the problems of water scarcity, malnutrition and the malaria menace are acute at the Coast generally and Mombasa in particular. Although Mombasa like most other urban centres enjoys more facilities than the rural areas, the above problems worsened by the harsh tropical ecological conditions lead to high infant and child mortality rates.

The current study examines the effect of various differentials on infant and child mortality in Mombasa. The levels will be estimated and the trend will be analysed both at divisional and district levels in a bid to fill the gaps which are often masked by the National and Provincial analysis. The Brass-Trussel technique is used in the data analysis and the data base for the study is the

1979 Census data.

1.2 Background information of the study area.

1.2.1 Geographical characteristics.

Mombasa District borders Kilifi District to the North, Kwale District to the South and West and the Indian Ocean to the East. It occupies an area of 275 sq. Km. Figure 1.0 shows the location of Mombasa District in Kenya.

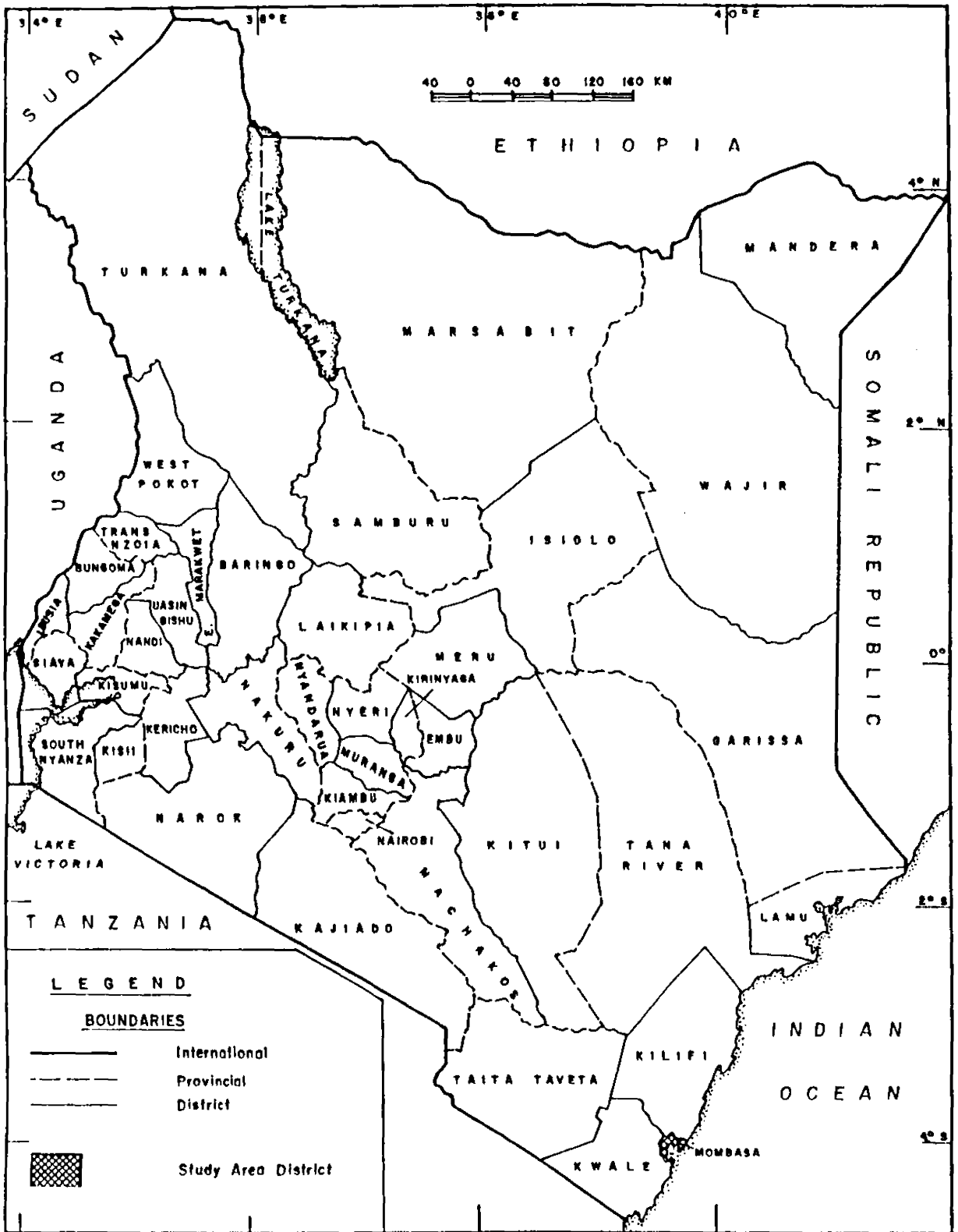


Fig.1.0: LOCATION OF MOMBASA DISTRICT IN KENYA

Mombasa town is Kenya's second principal urban center after Nairobi. It is the headquarters for the provincial administration and performs an increasingly important role as a regional service center. It has the largest harbour on the East African Coast. Mombasa town is the oldest city in Eastern Africa and has for centuries been the center of a thriving maritime trade in the Indian Ocean and the Persian Gulf.

Mombasa is a coastal lowland with extensive flat areas. It records a mean annual rainfall of 1038 mm. The district generally has very high temperature throughout the year. The lowest recorded temperature rarely drops to 27 degrees centigrade and below. The norm is for the temperature to remain between 27 degrees centigrade for the cool months of June, July and August and 31 degrees centigrade for the hottest period of december, January and February. This temperature range is conducive for the survival of mosquitoes and the subsequent spread of malaria. The effect on mortality is hence catastrophic especially on infants and children who have not yet developed effective immunity. The temperatures are also not favourable for hardwork, both mental and on the fields. Productivity, especially agricultural, is consequently low. Available food is therefore often inadequate to feed the population. This leads to under-nourishment especially among the children and therefore render them more vulnerable to death. The mean relative humidity at 12.00 hours is 65 percent and at 9.00 hours it is 82 percent. Soils include the sodic and saline type mainly in Kisauni where there are a lot of swamps and at Junda and

Jomvu kuu.

1.2.2 Administrative units

Administratively, Mombasa is divided into four divisions, namely, Island, Kisauni, Changamwe and Likoni. The divisions are sub-divided into twelve locations which are further sub-divided into fifteen sub-locations.

Politically, the district is sub-divided into four constituencies and twenty three municipal wards. Table 1.1.1 below lists the divisions and the distribution of electoral areas (Municipal Wards). Although administrative divisions and political constituencies in Mombasa District share names, their boundaries do not coincide. Changamwe, Kisauni and Likoni are larger as constituencies than as divisions due to the shifting of some locations from Island division as electoral wards to the other three constituencies. As a result, Island constituency boundary is smaller than Island division.

The main units of study in this thesis were the divisions as shown in Figure 1.1.

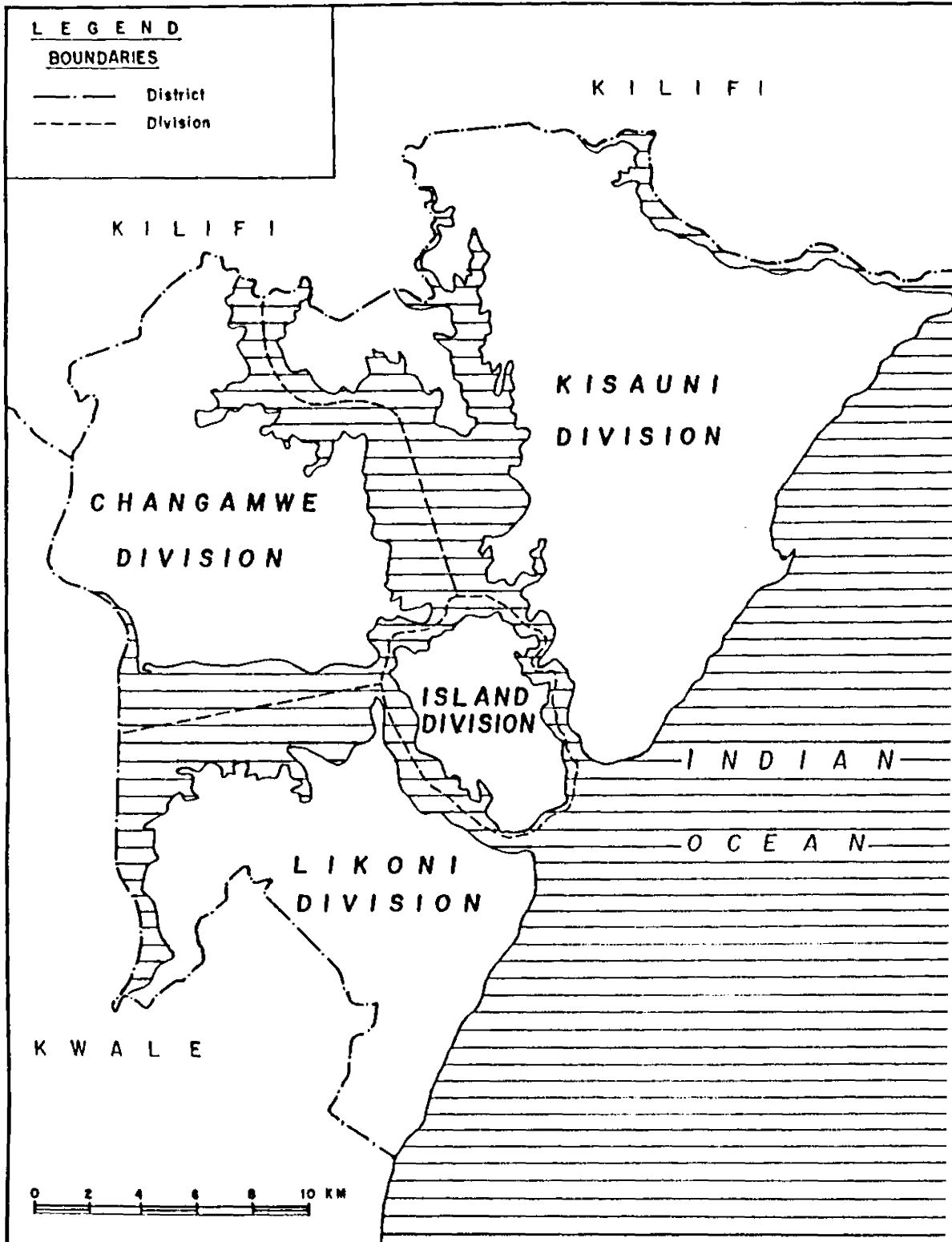


Fig.1.1 : MOMBASA DISTRICT — ADMINISTRATIVE BOUNDARIE

Table 1.1.1 Locations, Sub-locations and Electoral Areas by Division

Division	Location	Sub-location	Electoral Area
Likoni	Likoni Mtongwe	Likoni Mtongwe	Likoni Mtongwe Shika Adabu Ganjoni
Kisauni	Kisauni Bamburi	Kisauni Kongowea Bamburi Mwakirunga	Kisauni Bamburi Kongowea Mwakirunga Makadara Kizingo Mji Wa Kale
Changamwe	Changamwe Miritini	Changamwe Port Reitz Miritini	Changamwe Port Reitz Miritini Kipevu Tudor
Island	Tudor Tononoka Old Town Majengo Railways Ganjoni	Tudor Tononoka Old Town Majengo Railways Ganjoni	Tononoka Kingarani Kilindini Mwembe Tayari Bondeni Shimanzi Majengo
Total	4	12	15
			23

Source: Mombasa District Development Plan 1989/1993, P.11.

1.2.3 Infrastructure (Roads)

Mombasa has a 176 km network of roads. Many of them, however, are in poor conditions. In Kisauni division, in particular, access to inner residential plots from the main roads is limited. Mwakirunge, Kizingo and Mji Wa Kale wards are poorly served with road network and other basic social facilities. The inhabitants have to travel long distances to avail themselves necessary services.

1.2.4 Water resources and supply.

Mombasa district receives its water supply from neighbouring districts as shown below.

1. Mzima springs in Taita Taveta,
2. Marere river and Tiwi boreholes in Kwale district and
3. Sabaki river in Kilifi district. (The Baricho waterworks).

Apart from these, there are also a few wells mostly run by women groups.

All these, so far, have proved inadequate in serving the general population, hospitals, schools and industries. A report by the Kenya National Water Conservation and Pipeline Corporation (1993) confirmed that the amount of water being produced by all the sources is 85,000 m-cubic. Indeed this is inadequate as it is only 42.5 percent of the total demand which is 200,000 m-cubic serving about 50,000 households daily.

In addition, Baricho waterworks has several problems which contribute more to the water shortage in Mombasa. Being close to the mouth of Sabaki River, the amount of siltation is quite high and this increases operational costs. A large amount of chemicals is also required for water treatment. Given the generally undulating coastal topography, a high amount of electricity is required for water pumping.

The water inadequacy and general operational problems lead to water rationing. This exacerbates sanitation problems and would be a causal factor to high mortality especially among infants and children (the most vulnerable group).

1.2.5 Demographic profile.

Between 1969 and 1979, Mombasa's population increased by 27.6 percent growing at an annual growth rate of 3.3 percent, the total population size increasing from 247073 to 341148 respectively. By 1989 Mombasa district had a population of 467000 giving an intercensal growth rate of 3.14 percent between 1979 and 1989 (Economic survey, 1991).

Table 1.1.2. below shows the population projections by division in Mombasa district. The projections are based on the 1989 census provisional results shown in the second column. The provisional results indicate that likoni division is the least populated and the growth rate is relatively low as well. The Island division had the highest population in 1989 and had the highest projected value for 1993. The division also had the highest growth rate.

Table 1.1.2 : Divisional population projections Mombasa District.

DIVISIONS	1979 POPULATION	1989 POPULATION	1993 PROJECTIONS
LIKONI	40180	68182	76746
ISLAND	138312	155044	174518
CHANGAMWE	82353	129359	145606
KISAUNI	80299	114415	128786
TOTAL	341148	467000	525655

Source: CBS 1979 Population Census and the 1991 Economic Survey.

The information in table 1.1.2 can be contrasted with the information in table 1.1.3 showing the population density in the respective divisions. Although Island division had the highest population in 1989 as well as the projection for 1993, it has the smallest area in square kilometers. It therefore has the highest population density estimates. Kisauni division is the one with the lowest population density.

The district population density is also quite high. By 1979 (census year), the district had a population density of 1624 persons per sq.km. The density is estimated to be 2503 persons per sq.km. in 1993. This makes Mombasa to be one of the most densely populated districts in the country. The high density strains the available resources and may in part explain mortality levels.

Table 1.1.3 Mombasa District, population density per division.

DIVISION	AREA (sq. km)	1979	1989	1993
LIKONI	46	874	1482	1668
ISLAND	13	10639	11926	13424
CHANGAMWE	49	1661	2640	2972
KISAUNI	100	802	1144	1288
DISTRICT	210	1624	2224	2503

Source: CBS 1979 Population Census.

1.2.6 Health facilities.

Most of the health centres and hospitals in Mombasa district are located in island and Changamwe divisions. The most poorly provided for area as far as health services are concerned is Likoni division. In addition, the ferry crossing is not conducive in dealing with emergency cases to be treated in the Island hospitals. By 1987 the division had only three dispensaries and three health centres.

Table 1.1.4 below shows the divisional allocation of health facilities in the district. In 1987 the district had a total of sixty six health facilities. Most of the facilities were dispensaries. There were only two nursing homes both situated in the Island division. Most of the health centres and hospitals are located in Island division.

Table 1.1.4 Divisional allocation of health facilities in Mombasa, 1987.

DIVISION	No. of Hospitals	No. of H/Centres	No. of Dispensaries	No. of Nursing homes	No. of Clinics
ISLAND	6	1	15	2	12
LIKONI	-	3	3	-	-
CHANGAMWE	2	5	4	-	1
KISAUNI	-	6	5	-	1
TOTAL	8	15	27	2	14

Source: Mombasa District Development Plan, 1989-1983 pg 25

Table 1.1.5 : The district infant mortality rates:

YEAR	1969	1979	1986	1987	1993
IMR	94	83	85.8	98.8	81.8

Source:Mombasa District Development Plan, 1989-1993 Pg 37

Table 1.1.5 above shows infant mortality rates in the district for 1969, 1979, 1986, 1987 and the projected value for 1993. Although it is expected to decline slightly by 1993, the values for 1986 and 1987 place Mombasa among those districts with fairly high IMR.

The most notable cause of infant deaths, as documented in the 1989-1993 Mombasa district development plan, has been bronchi-pneumonia (36 percent) and prematurity (32 percent).

All the above physical, climatic and environmental factors influence the productivity of the region and morbidity conditions.

1.2.7 Cultural background.

Mombasa has a heterogeneous population comprising of more than six racial communities. The main communities are Arabs, Asians, Europeans and Africans. The Africans are basically the coastal bantu comprising of the Mijikenda, Wadigo, Pokomo, Taita, Bajun, Boni and the Swahili. Other communities living in Mombasa include the Kikuyu, Luo, Kamba and the Luhya, all of whom are immigrants of a comparatively recent era.

Although there is a cultural diversity in Mombasa just as there are many ethnic groups, a majority of the residents of practice a largely Swahili/Moslem culture. Their culture is

basically a reflection of the Islamic faith. The culture stresses both formal and informal education but emphasis is placed on learning the precepts of Islam. Hardwork is also regarded as essential for all. However, the weather at the coast, more often than not, militates against manual work especially for many hours. The hardwork is required for material development of both the individual and the society. Such development is regarded as a religious obligation.

Generally a wide range of foodstuffs is consumed in Mombasa, with the exception of a few prohibited by Islam for the moslem majority. Such a notable exception is pork. there is very little food wastage as throwing food is considered a sin and an indication of contempt for God. The attitude of the Moslems towards modern medical care is fairly positive. Through Islamic teachings people are encouraged to seek and use medicines and other modern health facilities and services necessary. There are variations in terms of accessibility because of unequal income.

Divorce in Mombasa and especially among moslems is common. Although re-marriage and polygamy are common, there are still many mothers who are single as a result of divorce. This reduces their capacities to provide essentials such as high quality food, enough clothing, good shelter and a clean environment. Marriage also tends to be among families of equal status. This perpetuates poverty among poor families. Poor couples have a low ability to care for their children and mortality hence remains a major risk.

1.3 Problem statement.

Mombasa district has high infant and child mortality. A life table derived from the 1979 Census shows that the estimated child mortality rate for Mombasa district was 118 deaths per 1000 live births.

The climatic conditions of Mombasa District (hot and humid) are ideal for the perpetual existence of the anophlene mosquito and the malaria parasite (plasmodia). Thus malaria is endemic in the district and its contribution to mortality is highest especially during rainy seasons and the period just after the rains.

Mombasa as a town is faced with a high population growth rate due to rural-urban migration, in addition to the natural increase. This influx has led to the mushrooming of shanties which are usually without the basic health facilities. The same influx has led to high demand for water, medical facilities and other services. Given the high and ever-increasing costs of establishing and maintaining infrastructure, the supply has always been below the demand in Mombasa. The resultant inadequacy translates into high morbidity and subsequent mortality in the district. This is felt most among infants and children whose resistance to disease causing pathogens is lowest. Bronchi-pneumonia, which is associated with congestion, is a major killer especially of those vulnerable ages (Ministry of Health Annual Report, Mombasa District, 1988).

Malnutrition is markedly high in the district especially the mainland. This is mainly due to low agricultural productivity,

poor agricultural patterns, traditional socio-cultural beliefs and ignorance regarding balanced diet.

A lot of research on mortality in Kenya has been done investigating determinants and levels. Such studies have been carried out both on the National level and in various specific regions. Micro-level studies of urban centres have been focused on Nairobi. The ecological, epidemiological, demographic and socio-economic characteristics of Mombasa district differ markedly from those of the other inland urban centres. Although Mombasa, like most of the other urban centres generally contain the largest share of the country's well educated, high income population and the best medical facilities, its estimated infant mortality rate is close to the National average (1979 Census Analytical Report).

No study on infant and child mortality has been done in Mombasa at divisional level. It has therefore been difficult to establish and account for divisional variations which may be observed. Other than overall coverage of mortality studies, there is need too for such studies to be done regularly even for the same places to observe trends, patterns and even levels. These three depend on numerous determinants which change with time and hence underscoring the need for periodic studies. They also differ according to different social classes and religious affiliation, with some classes being more responsive to modern mortality reduction measures than others.

Albeit it's being predominantly urban, Mombasa district has a very high infant and child mortality. The tropical climate contributes

to high morbidity and hence high mortality of the vulnerable ages. Immigration strains the available resources. Inadequate health facilities is a contributory factor to the high mortality. Apart from the Island division, there is evidence of malnutrition in the district. Literacy level is also still low in the district especially among females. None or low levels of education also militate against awareness about preventive and curative measures. Since education can be used as a proxy to income level, a sizeable majority are therefore unable to avail enough provisions for their children including medical care. Divorce/separation also lead to more single parents with less ability to provide for their children.

All the above human and ecological factors predispose infants and children to high mortality risks and reduce chances of their survival in Mombasa District.

1.4 Justification for the study

Results of the National surveys such as the Kenya Demographic and Health Survey and various individual studies indicate that coast province is a high mortality area. Mombasa district is predominantly urban and has many health facilities compared to many other regions in the country especially the rural ones. None of the other studies in the past has sought to investigate whether there is any difference between the mortality levels in Mombasa and the other outlying predominantly rural areas. This study seeks to establish the levels and trends of infant and child mortality in

the district as per the differentials of education, marital status and division of residence. All the differentials are analysed at the divisional level in this study because the results yield valuable information unique to each division. The general district estimates often submerge certain differentials at divisional level. Effective strategies aimed at reducing mortality should be based on estimates at the lower levels such as the division.

The location of Mombasa, in the low lying humid coastal plain and the oceanic touch is expected to have a significant effect on the morbidity of the residents. The adverse effect of morbidity is bound to be felt more by the infants and children whose resistance to disease causing pathogens is still low.

The study of infant and child mortality provides a useful index of the status of health and also the standard of living of a people. It reflects not simply per capita stocks of food, clean water, medical care and so on, but the actual availability of such amenities to all segments of a population. Prevention of mortality at this level has been a major pre-occupation of the health authorities and the degree of success of health programmes can be ascertained on the basis of the observable decline. In addition, the human resource is by far the most important of all resources in terms of both productivity as well as psychological and social satisfaction. The death of an infant or child is one of the most costly issues of human experiences.

The above reasons, therefore, underscore the importance of repeated studies on infant and child mortality in the country and

hence the current analysis on Mombasa. It is hoped that the study will also be useful for comparison with other coastal regions as well as other urban regions.

At the coast, generally, the mean age at marriage is reportedly lower than other parts of the country. This study will analyze mortality levels by age groups of mothers and subsequently seek to establish the effect of this early marriage on infant and child mortality.

1.5 Scope and limitations of the study

The study is confined to Mombasa District as delineated by the administrative boundary - Geographically, this is a small area and so the information derived from the analysis may not appear to contribute a significant percentage to the National information bank on mortality.

Mombasa is also cosmopolitan and is also a gateway for many immigrants, immigrants and tourists alike. This mix may also influence both child and maternal morbidity and subsequently mortality levels.

In this study, however, the level and differential analysis is not subdivided according to races. Probably this would have yielded exciting results for comparison. This limitation is a result of lack of enough data coded according to races.

Kenya, like other developing countries, suffers from lack of good statistical data base. This is bound to affect this study. The study, however, uses relevant demographic techniques with an

effort to enhance the accuracy of the estimates.

1.6 Objectives.

1.6.1 General objective

To estimate and describe infant and child mortality levels, trends and differentials in Mombasa district, using the 1979 census data. The effect of socio-economic, demographic and environmental factors on the levels will be discussed.

1.6.2 Specific objectives

1. To estimate levels of infant and child deaths at the district and divisional levels.
2. To ascertain the effect of mothers educational level on infant and child deaths.
3. To investigate the effect of mothers marital status on infant and child deaths.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK.

2.1 Literature Review.

Although consensus has it that in the post World War II period most developing countries have experienced a dramatic decrease in mortality rates, reports from several researchers reveal the fact that infant and child mortality levels are still high. These high levels are an outcome of various socio-economic, demographic and environmental factors. In this study therefore, mortality is analysed according to the above differentials.

A lot of documentation has been done on infant and child mortality in many countries of the developing world. Analysing the causes and levels of infant and child mortality in Colombia, Samoza (1980) found that infant mortality was higher among the children of women with lower education compared with those having higher education. He also found out that there was relatively high infant mortality for mothers below 25 years old and for older mothers especially after age 35. Older mothers are more susceptible to anaemic conditions and diseases such as diabetes, cardiovascular complications etc. Such conditions affect the health of the unborn child.

In Africa, infant and child mortality levels are still notably high. The 1979 population Reference Bureau estimates for all African countries indicated that infant mortality for the whole world was 95 per 1000 live births. The Bureau estimated the average infant mortality for Africa to be above 140 per 1000 live births.

The World Health Organisation (W.H.O, 1980) reported that Child deaths account for about 50 percent of all deaths in Africa. Blacker (1988) has noted that mortality differentials in Africa are as a result of differences in socio-economic development among the different regions. He adds that the dominance of tropical diseases like malaria have worsened the situation. Kichamu (1988) put the infant mortality in Africa at 114 per 1000 live births. Kichamu concurred with Blacker on accounting for this level. He attributed this persistent high mortality to low socio-economic development, strong cultural barriers, lack of sufficient medical facilities and services, and the dominance of tropical diseases like malaria.

A historical overview indicates that child and infant mortality in Kenya has been declining since the earliest traces of demographic statistics. The 1948 census estimate of infant mortality in Kenya was 184 per 1000 live births. This was considerably lower than estimates from earlier surveys which placed this values to be between 400 and 500 per 1000 live births. Although the statistics then may have been quite inaccurate, they are a fair indicator of what the situation was like.

A World Bank (1980) study shows that infant and child mortality accounts for 80 percent of the total deaths in Kenya. Although the situation now could be different, the level is still high enough to justify indepth analysis of some of the determinants. The Kenya demographic and health survey (K.D.H.S.) revealed that between 1984 and 1989, the infant mortality rate in

Kenya was 32 per 1000.

Using the 1979 census data, Kibet (1981) found that infant and child mortality levels were lowest in the highland areas of Kenya and that as one moved towards the Indian Ocean to the East, the levels of early childhood mortality increased.

Nyanza and coast provinces of Kenya have been categorised as high infant and child mortality zones (Mott and Henin, in 1979). Whereas it may be true to generalise and conclude that this is mainly a function of ecological conditions, there are also factors which expose residents of these zones more to risk factors culminating into deaths and especially 'early' deaths. The intensity of these factors vary from locality to locality and also between rural and urban areas. While analysing socio-economic determinants of infant and child mortality in Kenya using 1984 Kenya Contraceptives prevalence survey data, Ondimu, (1987) found that the rate was lowest in the urban areas and highest in the rural areas.

The present study focuses on Mombasa district, which is predominantly urban, but even within this urban area there are expected differences since not everybody has equal access to the relevant information, wealth and facilities. This fact has also been underscored by Nyamwange (1982) when he argued that for any given level of income, life expectancy could be increased significantly if there was a fair share of the national cake. He also indicated that further studies on mortality differentials carried out among individuals by social or economic class in

countries like India by Validanathan (1972) and the U.S.A. by Hauser (1972) have consistently revealed lower mortality rates among the upper classes. A World Health Organization (1980) report estimated 57 percent of the people in the developing countries as lacking safe drinking water and 75 percent as not having good sanitation. Further emphasis on the same point has been noted by Lado Ruzicka (1989) when he observed that chances of a child surviving through infancy and early childhood are primarily determined by the resources available in the child's family and the general level of sanitation.

Morbidity levels therefore owe their differences to other intervening variables such as education, medical care, and availability of clean water. There is a consensus that increasing educational attainment is associated with declines in mortality among infants and young children - Kibet (1981), Caldwell (1979), Brass (1979), Mott (1979), Anker and Knowles (1977).

The inverse relationship between educational attainment and infant and child mortality has been attributed to many causes. These include the likelihood that higher education is linked to a break with traditional family care practices and to more effective child care and medical alternatives. This has been the contention of Caldwell (1979) and Mott (1979). An additional observation by Mott (1979) was that increasing education has a much more substantial effect on reducing infant mortality than does urbanization.

While attempting to qualify the above relationship, Meegama

(1980) contended that the educational level of the mother was a guide to indicate whether she had the understanding to attend a maternity and child welfare clinic. A pregnant mother attending such a clinic would be given supplementary foods, such as iron tablets if she was anaemic.

Generalizations, however, hold when variables in question are subjected to empirical tests. Mosley and Chen (1984) noted that although most biomedical and social scientists identify such conditions as infectious diseases and malnutrition as the main causes of high infant and child mortality in poor populations, a fruitful approach to the study of the causes of mortality is to define and measure bio-social interactions.

In this study, availability of medical facilities and services is considered to be one of the determinants of infant and child mortality. This availability however, is a function of the general level of development. Emphasising the role of development in lowering infant and child mortality, Kuznets (1975), and Coale and Hoover (1958) have argued that development itself strengthens the nation state, improves communication and hence facilitates the transfer of medical technology. Available facilities should also be effectively utilised for mortality to decline. Infant and child mortality may be high in the neighbourhood of modern hospitals because parents cannot afford to pay for them.

Maternal age is one of the key variables to be analysed in this study. Most scholars concur about higher infant and child mortality levels among young and old mothers. Many studies have

shown the classic U-shaped relationship between age of the mother and mortality. Gaisie S.K. (1975) contends that the children born to women at successive ages are exposed to the risk of death for various lengths of time, and length of exposure depends on whether child bearing starts very early or very late. If child bearing starts very early, the children would be exposed to a much longer period of mortality risk and the proportion dead would tend to be higher for each age group of mothers than when child-bearing starts at a later age.

The above observation may put the coast province of Kenya in the high mortality zone given the fact that the mean age at first marriage is lower than most of the rest of the country. This is made worse by the fact that the general mortality situation in Africa is still disturbingly bad especially early age mortality. Gordon et al, (1967) have documented that for all the tropical African countries, the second year death rate is between 25 and 49 per 1000 children which is regarded as high.

Many scholars blame the environment as being a key player in infant and childhood mortality. This subject has been documented in detail by Merrick (1970) and Rodgers (1972). They have cited the grave contribution of water, environmental factors such as housing and sanitation to child mortality in Brazil.

It has been argued by Meegama (1980) that a search for the causes of neonatal mortality should take into account not only variables describing the condition of the mother during pregnancy and the quality of the medical care received during delivery but

also environmental conditions surrounding the mother and child which lead to the spread of infections. A parallel argument could be drawn from Mott (1982) who has contended that the highest parity women have on average inferior living conditions and are less able to provide their children with appropriate medical care and adequate nutrition. On the same note, Wyon and Gordon (1971) found that the risk of infection increased with increased family size. This, they argued, was due to the sharing of small quantities of the available food for the family.

Using the Brass technique to estimate demographic parameters, Kibet (1981) found out that malaria and mother's education were the two major factors that influence child mortality levels. The findings of Kibet (1981) compare well with those of Sivamurthy and Ma'ayta (1982) who, using the 1972 Jordan household survey in the study of infant and child mortality, found that the level of mortality was inversely related to mother's education.

In terms of causes of death in the developing world, infectious and parasitic diseases bear almost exclusive responsibility for shortening life expectancy. In a study by Preston, Keyfitz and Schoen (1973) it was documented that when the aggregate of infectious and parasitic diseases was hypothetically eliminated and life expectancy recalculated, the result was an improved life expectancy of between 65 and 75 regardless of the populations initial mortality level. Recent studies in Latin America have indicated nearly 30 percent of deaths in the first year of life and 50 percent in ages between 1 and 4 years are

directly or indirectly due to malnutrition. It is logical to make similar assumptions about Africa.

An interesting observation was noted by Kichamu (1986) when he came up with a finding which is contrary to the general rule of higher infant and child mortality in rural than in urban areas. In some parts of the Rift Valley and Central provinces, the urban areas have higher infant child mortality than the rural areas. The plausible explanation to this, as argued by Omurundo (1989), could be that poverty in these urban areas is more severe than that experienced in the rural areas. Whereas the urban dwellers depend on cash income for the purchase of various items, including foodstuffs, the rural poor do not have to buy most of their foodstuffs as these can be obtained directly from their farms. The quality of such foodstuffs is also likely to be higher leading to better nutrition.

The $q(2)$ values for Kericho district at locational level estimated by Mutai (1987) revealed that infant mortality was higher in the urban centres, a phenomenon he attributes to the high agricultural potential of the rural locations and consequently better nutrition of the rural population.

A useful summary of the state of infant mortality in Africa has been given by McNamara (1977). He observed that average rates of infant mortality are 142 in Africa. He asserted that this was largely because of low nutritional standards, poor hygienic conditions and inadequate health services. In most developing countries health expenditures have been excessively devoted to

supplying a small urban elite with expensive curative health care systems - highly skilled doctors and elaborate hospitals - that fail to reach 90 percent of the people.

On education, Chase (1973) has stressed that education is the basis upon which other socio-economic indicators are based. It often determines the kind of occupation for which an individual is suited and in turn often determines his income. Such socio-economic considerations have a strong influence on health care for it is those families with the fewest resources who have the greatest difficulty in financing health care. If education is limited, other resources relating to health matters are often also limited, (e.g. nutrition, recognition of important symptoms, importance of preventive care, finances to purchase medical care, etc.). Cox (1975) has pointed out that infant mortality varies greatly by the education, occupation and area of residence of the parents.

In addition, children whose fathers are dead have an additional strike against them. Their mothers bear the entire burden of child care as well as having the sole responsibility for the family's economic welfare.

2.1.1 A summary of the literature review

From the above literature review, it is evident that infant and child mortality is directly or indirectly related to a number of variables. Such variables include the maternal education level,

a subject discussed extensively by authors such as Chase (1973), Cox (1975), Caldwell (1979), Meegama (1980) and Samoza (1980). All of them point out the inverse relationship between maternal education level and infant and child mortality.

Maternal age is another important variable which operating through biological and environmental factors influence infant and child mortality. A relatively high infant and child mortality has been noted for mothers below 25 years old and for older mothers above 35 years old (Samoza, 1980).

Ecological conditions have also been found to affect infant and child mortality rates. The rates are lowest in the highland areas and increase towards the low altitude areas where malaria is prevalent. Studies done by Kibet (1981) and Mott and Henin (1979) confirm this observation.

Availability and accessibility to social amenities including adequate nutritious food, safe drinking water and uncontaminated air have all been found to determine the rates of infant and child mortality. Overcrowding and poor sanitation have been noted to play a major role in mitigating against child survival in this regard. These views have been emphasized by Mosley and Chen (1984).

It has also been argued that the overriding factor in infant and child mortality is the level of income of the household. Kuznets, (1975) and Coale and Hoover, (1958) are among those authors who have discussed this subject in detail.

Age at marriage has also been noted to influence infant and

child mortality depending on how early childbearing starts. The earlier the onset of childbearing, the higher the proportion dead among infants and children (Gaizie, 1975).

Many of the above factors relate directly or indirectly to the environment. What are classified as environmental factors are regarded as fundamental to infant and child mortality by Merrick (1970) and Meegama (1980).

The assertion that infant and child mortality is usually higher in rural than in urban areas has been challenged by Kichamu (1986), Omurundo (1989) and Mutai (1987) as not being universal. Differences occur even in the same urban area.

Education is one of the socio-economic factors which has been widely documented as affecting infant and child mortality. Chase (1973), Cox (1975), Caldwell (1979) and Mott (1979) have all underscored the fact that it is the basis upon which other indicators are based.

Although this study utilizes a theoretical framework derived from Mosley and Chen (1984), the operational model identifies specific variables from the above literature review namely maternal education level, marital status, and division of residence. The specific variables are analysed at divisional level, unlike most of the studies quoted in the review. The concept of trend does not appear in the above researches either, especially at micro-level. The variables in the operational model are designed to assist in measuring the intra-relationship of the various socio-economic, demographic and environmental factors and to gauge their combined

effect on infant and child mortality in Mombasa.

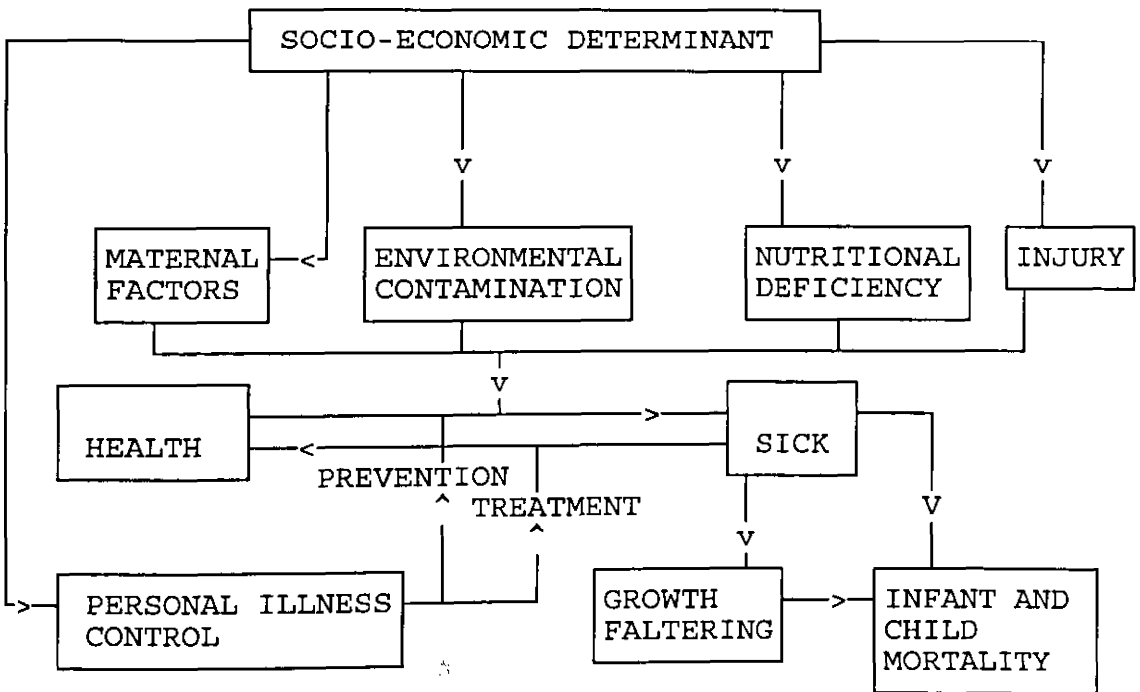
2.2 Theoretical framework.

2.2.1 Theoretical statement

In addition to demographic factors, environmental and socio/economic factors, operating through intermediate variables are likely to affect infant and child mortality of any given region jointly or independently.

Figure 2.1 Conceptual framework:

Operation of the five groups of proximate determinants on the health dynamics of a population



Source: Mosley W.H. & Chen L.C. (1984). Population and Development Review. A Supplement to Vol. 10: Pg.29.

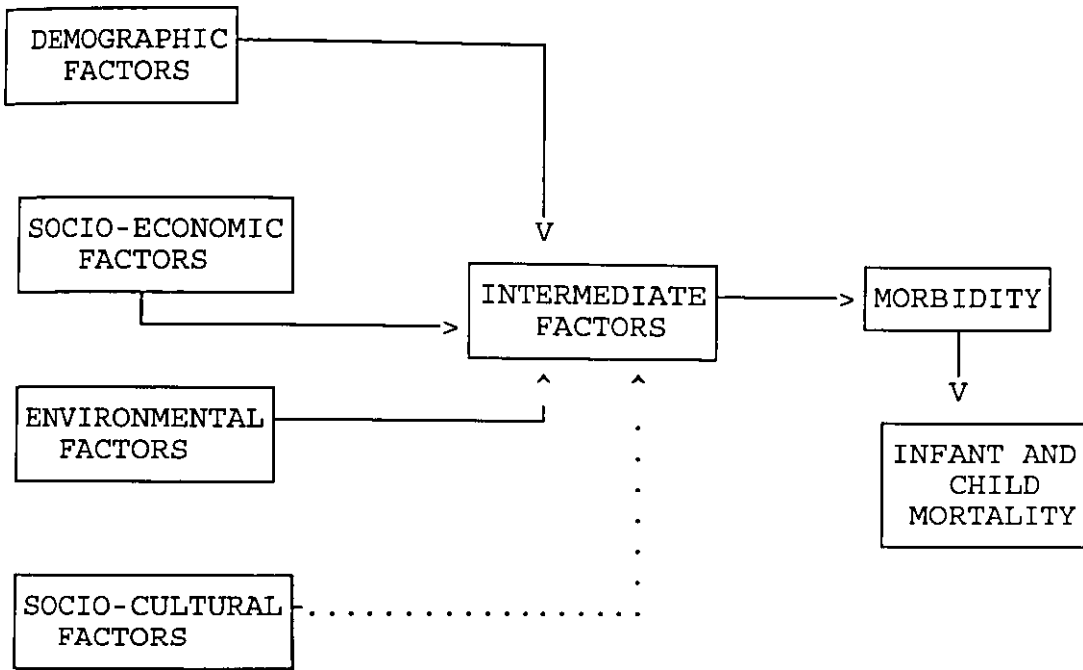
Figure 2.1. is the Mosley and Chen Model which portrays the relationship between the socio-economic determinants as background factors operating through the proximate determinants to determine health dynamics and therefore the likelihood of mortality.

All proximate determinants in the first four groups influence the rate of morbidity. These four groups are maternal factors, environmental contamination, nutrient deficiency and injury. All the four lead to sickness of the body. As illustrated in figure 1.2 above, the sick child or infant may either recover back to a healthy state or may continue deteriorating physically. The physical deterioration process may be through growth faltering and subsequent death or may be direct to death.

Socio-economic determinants also influence personal illness control factors forming the fifth proximate determinants in the model (Figure 1.2). Such factors include both curative and preventive measures. Preventive measures are aimed at preventing a healthy body from falling sick while the curative measures treat the already sick body with the aim of eliminating the sickness and hence restore full health. From the fifth group of proximate determinants, an individual either recovers or ends up dying. This end result may be direct after recovery failure or may occur after a gradual process of growth faltering.

Figure 2.2: Conceptual model.

Modified version of the Mosley and Chen Model
(1984) pg.29.



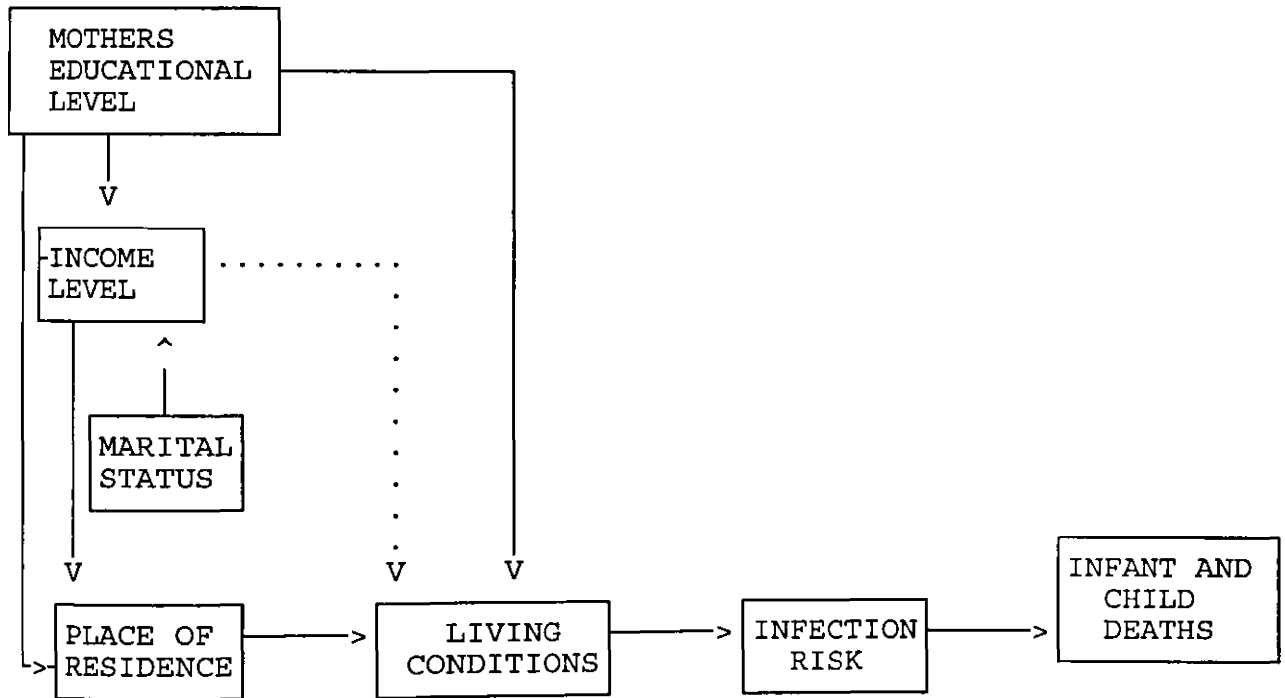
Source: Mosley and chen (1984).

Figure 2.2 above, shows the conceptual model for the study adapted from the Mosley and Chen Model. Background factors are divided into four groups namely demographic, socio-economic, environmental and socio-cultural. The socio-cultural factors will, however, not be measured in this study because of inadequate related data from the 1979 census. They consist of the independent variables which influence the dependent variable (mortality) through intermediate variables. The specific factors operating from the first group to the last (mortality) are shown in figure 2.3 which is the operational model for the study and explained further in the text below the model.

2.2.2 Conceptual hypotheses

1. Place of residence is likely to affect infant and child mortality rates.
2. Mother's educational level is likely to affect infant and child mortality rate.
3. Mother's marital status is likely to affect infant and child mortality rates.

Figure 2.3. Operational Model



The above operational model consists of three broad categories of variables derived from the conceptual model. The first category of variables can also be termed as background factors. They are mothers educational level as socio-economic factors, place of residence as an

environmental factor and marital status as a demographic factor.

Among the four variables, mothers education also influence her choice of the place of residence. Mothers who have attained higher levels of education are likely to prefer living in high class residential divisions which generally have more and better facilities. They are also likely to be employed and therefore more able to afford housing in such divisions. The maternal education level acts as proxy to the level of income, which in turn determines the place of residence. The fourth variable namely marital status influences income level as couples often supplement each others income and therefore raise it above the income level of the single, widowed or divorced/separated.

The four influence infant and child mortality through the second category of variables referred to in the conceptual model as intermediate factors. Intermediate factors are the conditions under which the infants and children live, which may predispose them to infection risk. Maternal education level, marital status, income level and the place of residence determine these living conditions. These conditions include such factors as availability of adequate fresh food, clean/treated water, spacious room, availability and accessibility to medical facilities. These factors predispose the infants and children to infection risk factors which include exposure to disease causing organisms such as tetani, infrequent and irregular washing/bathing, poor sewage connections, dirty house surfaces difficult to clean and unsterilized utensils. It is these infection risk factors which may culminate into sickness and lead to the final category of the variables in the model namely infant and child mortality.

2.2.3 Operational hypotheses

1. Maternal educational level is inversely related to the number of infant and child deaths.
2. The number of infant and child deaths experienced by the single, widowed and divorced/separated is higher than that experienced by married mothers.
3. Mothers residing in low class divisions experience higher infant and child deaths than their counterparts in the medium and high class divisions.

2.2.4. Definitions of key concepts:

1. Mortality.

It is the process by which a population is depleted. Death, which is the permanent disappearance of all evidence of life after birth has taken place, is therefore the process by which a population is depleted.

2.(a) Infant mortality.

Refers to deaths occurring before the first birthday.

2.(b) Infant mortality rate (IMR).

Refers to the number of deaths occurring to infants under one year of age per 1000 live births. This ratio is computed thus:-

$$\frac{\text{Number of deaths to infants under one year}}{\text{Total live births}} \times 1000$$

3.(a) Child mortality.

Refers to deaths occurring to children of ages one to four years.

3.(b) Child mortality rate.

Refers to the number of deaths occurring to children of ages one to four years per 1000. This ratio is computed thus:- Number of deaths to children 1 to 4 years

Total live births in the 4 year period * 1000

4. Environmental factors.

Entails what is in the surrounding of a given area or circumstances under which certain processes occur. This may include disease prevalence, sanitation, housing etc.

5. Socio/Economic factors.

Entails the prevailing conditions of communal relevance such as educational matters, Income, health and so on.

6. Marital Status

Refers to whether a woman enumerated during the census had ever been married, was single, divorced, separated or widowed.

CHAPTER THREE

DATA AND METHOD OF ANALYSIS.

3.1 Introduction

In this chapter, the source of data used in this thesis is identified. The quality of the data is also examined and the method of data analysis is also discussed. Estimates of infant and child mortality levels are then made.

3.1.1 Data source

Data used in this thesis is obtained from the fourth National Population census in Kenya conducted in August 1979. The specific data sought from this census is on Mombasa district by divisions. In the census schedule, questions were put to all women in child bearing ages (respondents) to solicit information related to death within the household. The respondents were asked to state the number of live-births they had had, the number surviving and the number dead. The data has been classified by education level, marital status and place of residence of the respondent. The education level has been categorised into three groups based on the years of schooling the respondents had spent. These are: those with no education, those with primary education, and finally those with secondary education and above. As far as marital status is concerned, there were four such categories in the 1979 census data set namely single, married, widowed and divorced/separated. The place of residence distinguishes whether the respondent was residing in an urban or a rural area. The entire Mombasa district is classified as urban although there are many places such as

the extreme south coast and the northern parts of kisauni where rural characteristics predominate. In this thesis, the entire district is treated as urban. Intra-divisional mortality variations which are bound to occur will be discussed in the next chapter. The above information has been used to estimate infant and child mortality.

3.1.2. Quality of data

A lot of effort is being made to improve the collection and handling of demographic statistics. The 1979 (Kenya) census questionnaire was not only broad in coverage but also detailed. This is an example of such effort. However, many african countries, Kenya included, still lack accurate demographic data. The degree of inaccuracy is bound to be higher when using data collected before the 1980's because the improvement in quality has been as years progress. This scarcity of good data is attributed to a number of factors. These include lack of adequate financial resources for carrying out detailed surveys, and lack of adequately trained manpower to carry out the surveys and handle the collected data.

Generally Census data are usually not of very high quality as they are subject to several content and coverage errors. These errors include:-

- i) Under-reporting and misreporting of infant and children deaths.
- ii) Inclusion of still births in the number of children dead.
- iii) Under-reporting of actual number of children ever born.
- iv) Age mis-reporting for both children and mothers.
- v) Age heaping due to age mis-reporting.

vi) Omission of certain areas.

vii) Non-reporting of births and subsequent deaths.

These errors greatly affect the results of estimation of certain population parameters when such results are wholly based on the census data. Analysing the 1979 census, a report from the Central Bureau of Statistics - Kenya Government conceded that the recorded ages were not necessarily correct. The report noted that the reported age-sex distribution was distorted both by selective under-enumeration and by the mis-reporting of ages. Many people did not know their ages precisely and therefore the entries made for them on the census schedules were based largely on guesswork, sometimes assisted by the use of calendar events. As a result, the recorded age-sex distribution exhibits characteristic features of age mis-reporting. Among these features, the following two are particularly notable as they directly affect infant and child mortality, which is the basic concern of this study:-

1. A marked heaping on round numbers ending in 0 and 5. This pattern leads to unrealistic ${}_1q_0$ and $q(5)$ values.
2. An over-statement of ages of young children which, when combined with the under-enumeration at these ages, results in an appreciable shortfall in the numbers reported as under five years of age.

Various indices have been devised to measure the accuracy of age data. Two such indices have been calculated for Kenya. Whipple's index, which measures the degree of heaping on ages ending in 0 and 5 and United Nations index which measures the irregularities in age and sex ratios, calculated for five year age groups. For Whipple's index,

the following scale has been drawn up:

<u>Quality of Data</u>	<u>Whipple's Index</u>
Highly accurate	Less than 105
Fairly accurate	105 - 109.9
Approximate	110 - 124.9
Rough	125 - 174.9
Very rough	175 and above

The U.N. index can vary from values of under 10 for highly accurate data, to over 100 for very inaccurate data.

When both indices were calculated for Kenya from the 1979 Census data, the values using Whipple's index were males 146.2 and females 162.9. The U.N. index was 28.6. Both indices lead to a conclusion that the 1979 Kenya Population Census data was rough.

Although the data was subjected later to smoothing to correct both for effects of under-enumeration and for those of age mis-reporting, the results cannot be taken as very accurate. This is because the corrections were based on speculative assumptions and the graduating procedure may well have smoothed out genuine irregularities.

However, in an attempt to improve such results, demographers have evolved certain indirect techniques which can be used to estimate these parameters.

3.1.3 Methodology of data analysis.

The low quality data available for developing countries, makes it difficult to use direct demographic techniques to estimate mortality

levels. This study therefore utilises an indirect technique - the Brass-Trussell technique, to estimate mortality levels and generate life table functions. The technique will be used to estimate infant and child mortality per division and for the whole district.

The infant mortality rates are measured in terms of the probability of dying between age 0 and 1. This probability is denoted by ${}_1q_0$ in the life table or simply as IMR. Child mortality is denoted by q_x which is the probability of dying at age x . The values of x are 1, 2, 5, 10, 15 and 20. Another child mortality index is ${}_4q_1$ which is the probability of dying between ages 1 and 5. This can be obtained directly from the life table. In this thesis the mortality estimates are expressed in terms of $q_2, q_0, {}_4q_1$ and $q_{(5)}$ based on trussell's west model coefficients.

3.1.4 The Brass method

Brass (1968) developed a method of transforming proportions dead of children ever born (CEB) into estimates of the probability of dying before attaining certain exact childhood ages. Brass recognised that multiplying the proportions of children dead, $D(i)$, of women in a standard age group (i) by a factor, $K(i)$, would yield the $q(x)$ values of a life table.

The basic form of the equation is:

$$q(x) = K(i) \times D(i)$$

Where:

- $q(x)$ = the probability of dying before attaining an exact age x .
- $K(i)$ = a multiplier meant to adjust for non-mortality factors determining the value of $D(i)$.

- $D(i)$ = the proportion dead among children ever born to women in successive 5-year age groups.
- (i) = a standard age group such that
- $i=1$ denotes age group 15-19;
 - $i=2$ denotes age group 20-24;
 - $i=3$ denotes age group 25-29; etc.

3.1.5 Trussell's refinement

The original Brass method, explained in section 2.1.4 above, was later modified by Trussell in 1975. Trussell, using data generated from the model fertility schedules which he had developed along with Coale, derived multipliers which incorporate both $P(1)/P(2)$ and $P(2)/P(3)$ values. The result was therefore a more complete description of the fertility schedule.

$P(1)$ denotes the average parity or average number of children ever born reported by women in a standard age group (i) . $P(1)$, $P(2)$ and $P(3)$ therefore refer to the average parities of women in the age groups 15-19, 20-24 and 25-29 respectively.

3.1.6 The Brass-Trussell technique

The technique requires the following information:

- i) The number of children ever born (CEB) classified by five year age group of mother.
- ii) The number of children dead (CD) classified by five year age group of mother.

iii) The total number of women (FPOP) (irrespective of marital status), classified by five year age group.

In this study use is made of the data for mombasa district totals (Table 3.0.) to illustrate each computational procedure.

Table 3.0. Infant and child mortality totals in Mombasa, 1979.

Age grp.	Index.	FPOP.	C.E.B.	C.D.
15-19	1	18456	6885	815
20-24	2	19835	31613	3781
25-29	3	15485	45100	5897
30-34	4	10005	40005	6052
35-39	5	6896	31102	5176
40-44	6	5172	23630	4435
45-49	7	4071	18763	3826

Source: CBS 1979 Kenya population census data sheet.

The technique's computational procedure entails the following steps:-

Step 1:

Calculation of average parity per woman.

The formula used is:

$$P(i) = \text{CEB}(i) / \text{FPOP}(i)$$

Where:

$P(i)$ = The average parity per woman in age group (i).

$CEB(i)$ = The number of children ever born by women in age group (i).

$FPOP(i)$ = The total number of women in age group (i).

For mombasa district therefore:-

$$P(i) = CEB / FPOP(i)$$

$$P(1) = CEB(1) / FPOP(1)$$

$$= 6885 / 18456$$

$$= 0.373049$$

$$P(2) = CEB(2) / FPOP(2)$$

$$= 31613 / 19835$$

$$= 1.593798$$

$$P(3) = CEB(3) / FPOP(3)$$

$$= 45100 / 15485$$

$$= 2.912495$$

$$P(7) = CEB(7) / FPOP(7)$$

$$= 18763 / 4071$$

$$= 4.608941$$

Step 2:

Calculation of the proportion of children dead for each age group

of mother.

The formula used is:

$$D(i) = CD(i) / CEB(i).$$

Where:

$D(i)$ = The ratio of reported children dead to reported children ever born in age group (i).

$CD(i)$ = The number of children dead reported by women in age group (i).

$CEB(i)$ = The number of children ever born by women in age group (i).

The $D(i)$ values for mombasa district therefore are computed thus:-

$$D(i) = CD(i) / CEB(i)$$

$$D(1) = CD(1) / CEB(1)$$

$$= 815 / 6885$$

$$= 0.118373$$

$$D(2) = CD(2) / CEB(2)$$

$$= 3781 / 31613$$

$$= 0.119602$$

$$D(3) = CD(3) / CEB(3)$$

$$= 5897 / 45100$$

$$= 0.130753$$

$$D(7) = CD(7) / CEB(7)$$

$$= 3826 / 18763$$

=0.203911

step 3:

Calculation of multipliers.

The formula used is:

$$K(i) = a(i) + b(i) [P(1)/P(2)] + c(i) [P(2)/P(3)].$$

Where:

$K(i)$ = The multipliers.

$a(i)$, $b(i)$ and $c(i)$ = The coefficients for estimating child mortality.

The table below presents the necessary coefficients for the west mortality model to estimate the multipliers ($K(i)$), according to the Trussell variant of the original Brass method.

Table 3.1. Coefficients for estimating multipliers, west mortality model.

Agegr	index	Mort.Ratio	a(i)	b(i)	c(i)
15-19	1	q(1)/D(1)	1.1415	-2.7070	0.7663
20-24	2	q(2)/D(2)	1.2563	-0.5381	-0.2637
25-29	3	q(3)/D(3)	1.1851	0.0633	-0.4177
30-34	4	q(5)/D(4)	1.1720	0.3241	-0.4272
35-39	5	q(10)/D(5)	1.1865	0.3080	-0.4452
40-44	6	q(15)/D(6)	1.1746	0.3314	-0.4537
45-49	7	q(20)/D(7)	1.1639	0.3190	-0.4435

Source: U.N. Manual X. Pg 77.

The multipliers for the data in table 3.1. are computed as shown below.

$$\begin{aligned}
 K(1) &= a(1) + b(1) * P(1) / P(2) + c(1) * P(2) / P(3) \\
 &= 1.1415 + (-2.7070 * 0.234063) + 0.7663 * 0.547227 \\
 &= 1.1415 - 0.6336085 + 0.41934 \\
 &= 0.9272314
 \end{aligned}$$

$$\begin{aligned}
 K(2) &= a(2) + b(2) * P(1) / P(2) + c(2) * P(2) / P(3) \\
 &= 1.2563 + (-0.5381 * 0.234063) + -0.2637 * 0.547227 \\
 &= 1.2563 - 0.1259493 - 0.1443037 \\
 &= 1.1303507 - 0.1443037
 \end{aligned}$$

$$=0.986047$$

$$\begin{aligned} K(3) &= a(3)+b(3)*P(1)/P(2)+c(3)*P(2)/P(3) \\ &=1.1851+(0.0633*0.234063)+-0.4177*0.547227 \\ &=1.1851+0.0148161+-0.2285767 \\ &=1.1999161+-0.2285767 \\ &=0.9713394 \end{aligned}$$

$$\begin{aligned} K(7) &= a(7)+b(7)*P(1)/P(2)+c(7)*P(2)/P(3) \\ &=1.1639+(0.3190*0.234063)+-0.4435*0.547227 \\ &=1.1639+0.074666+-0.2426951 \\ &=1.238566+-0.2426951 \\ &=0.9958709 \end{aligned}$$

Step 4:

Calculation of the probability of dying at age x, q(x).

The formula used is:

$$q(x) = K(i) \times D(i).$$

The value of x is not generally equal to that of i, because x is related to the average age of the children of women in age group (i).

For x = 1, 2, 3, 5, 10, 15 and 20.

i = 1, 2, 3, 4, 5, 6 and 7.

i,1 corresponds to age group 15-19,

i,2 corresponds to age group 20-24,

· " " " " ·
· " " " " ·

.	''	''	''	''	.
.	''	''	''	''	.
.	''	''	''	''	.
i,7	''	''	''	''	45-49.

The q_x values for the data in table 2.0. are computed as shown below.

$$\begin{aligned}
 q(1) &= K(1)*D(1) \\
 &= 0.927231*0.118373 \\
 &= 0.1097591
 \end{aligned}$$

$$\begin{aligned}
 q(2) &= K(2)*D(2) \\
 &= 0.986046*0.119602 \\
 &= 0.117933
 \end{aligned}$$

$$\begin{aligned}
 q(3) &= K(3)*D(3) \\
 &= 0.971339*0.130753 \\
 &= 0.1270054
 \end{aligned}$$

$$\begin{aligned}
 q(7) &= K(7)*D(7) \\
 &= 0.995870*0.203911 \\
 &= 0.2030688
 \end{aligned}$$

Table 3.2. below shows the worked out values for $P(i), D(i), K(i)$ and $q(x)$ using data from table 3.0. It is a summary of the computational procedure demonstrated above from steps one to four.

Table 3.2. $P(i), D(i), K(i)$ and $q_{(x)}$ values for Mombasa 1979

$P(i)$	$D(i)$	$K(i)$	$q_{(x)}$
0.373049	0.118373	0.927231	0.109759
1.593798	0.119602	0.986046	0.117933
2.912495	0.130753	0.971339	0.127005
3.998500	0.151281	0.993018	0.150224
4.510150	0.166420	1.014965	0.168910
4.568832	0.187685	1.003891	0.188415
4.608941	0.203911	0.995870	0.203069

Source: Computed by author from the 1979 population census.

Once the $q_{(x)}$ value is estimated then it's compliment $P_{(x)}$ can be readily derived thus:- $P_{(x)} = 1.0 - q_{(x)}$.

3.1.7 ASSUMPTIONS (LIMITATIONS) OF BRASS-MORTALITY ESTIMATION METHOD

- i) On applying the method, it is assumed that the age specific fertility schedule has been approximately constant in the recent past and the approximate form of the schedule is known. This assumption is made in the conversion of proportions of children dead among women in the reproductive age groups, to probabilities of dying. Such knowledge of the pattern of fertility prevailing in the study population is uncommon especially in the less developed

countries.

- ii) It is also assumed that Infant and child mortality rates have been approximately constant in the recent years. Data on the age pattern of deaths in the less developed countries is often defective and incomplete. This leads to a pattern which may not always reflect the real situation.
- iii) The constancy implied in assumptions one and two above, may also not be practical in many countries. For instance fertility in Kenya has been declining quite rapidly. Mortality too has been declining quite fast in some parts of the country such as central province. This is evident from the Kenya Demographic and Health Survey, 1989.
- iv) Maternal age, order of birth, and birth spacing affect child survival. This technique overlooks these factors implying that there is no strong association between maternal mortality risks and child survival. This is a notable weakness in the technique.
- v) The method also assumes that the omission rates of the children dead and or surviving children are about the same in the reported numbers ever born. These rates may not be uniform always since the causes of the omissions vary from place to place and over time.
- iv) The method also assumes that the age pattern of mortality among infants and children conforms approximately to the model lifetables.

3.2 Construction of a life table

The figures already worked showing the probability of death can be used to construct a life table. The values of $q(2)$, $q(3)$ and $q(5)$ are used.

Procedure:

Step 1:

Computation of $P(x)$.

The values of $P(x)$ for $x=2,3$, and 5 are calculated with the help of the formula $P(x) = 1.0 - q(x)$.

Where the $q(x)$ values are obtained from the table of Mombasa district, we have the following table.

Table 3.3. $q(x)$ values for Mombasa District.

x	$q(x)$	$P(x)$
2	0.117933	0.882066
3	0.127006	0.872993
5	0.150224	0.849775

Source: Computed by author from Kenya's 1979 population census.

Step 2:

Lower and upper level $P(x)$ values

These are read from Coale and Demeny tables of the West Model of both sexes combined with a sex ratio of 1.05. Table 3.4 shows these values corresponding to the Mombasa District data.

Table 3.4. Lower and Upper P(x) values, Mombasa District.

x	P(x)	Lower P(x)	Upper P(x)
2	0.882066	0.890280	0.905843
3	0.872993	0.881570	0.898622
5	0.849775	0.852051	0.871450

Source: Computed by author from Kenya's 1979 population census.

Step 3:

Calculating the implied level (IL).

This is obtained by applying the interpolation formula below:

$$IL = \text{Lower Level} + \frac{\text{Actual P}(x) - \text{Lower P}(x)}{\text{Upper P}(x) - \text{Lower P}(x)}$$

The implied level values for Mombasa district are given in table 3.5. below.

Table 3.5. Implied level values

x	Lower Level	Upper Level	Lower P(x)	Upper P(x)	I.L
2	16	17	0.89028	0.90584	15.47211
3	16	17	0.88157	0.89862	15.49698
5	15	16	0.85205	0.87145	14.88273

Source: Computed by author from Kenya's 1979 population census.

The three I.L values for x=2, x=3 and x=5 are then used in calculating the average mortality level. This is done by computing the simple average of the three.

Average mortality level of Mombasa district therefore is:

$$\frac{15.47211 + 15.49698 + 14.88273}{3}$$

3

$$= 15.28394.$$

Step 4:

Computation of the interpolated P(x).

The interpolated P(x) values can be found by first, obtaining P(x) values corresponding to the calculated lower and upper mortality levels from Coale and Demeny tables, West Model for 5-year survivorship probabilities for both sexes combined. Secondly these values are subjected to the formula below.

Interpolated P(x) :

$$= \text{Lower P(x)} + \frac{[\text{Average Mortality} - \text{Lower level}] [\text{Upper P(x)} - \text{Lower P(x)}]}{\text{Upper level} - \text{Lower level}}$$

Upper level - Lower level

For Mombasa district therefore when x=5, P(x) =

$$0.85205 + \frac{[15.28394 - 15] [0.87145 - 0.85205]}{16 - 15}$$

16 - 15

$$= 0.85205 + \frac{(0.28394)(0.0194)}{1} = 0.85205 + 0.0055084$$

$$= 0.857558.$$

Table 3.6 below shows the lower level P(x), the upper level P(x) and the interpolated P(x) values using the entire district data.

Table 3.6. Interpolated P(x) values, Mombasa District.

Age Group	P(x) Lower (Level 15)	P(x) Upper (Level 16)	Interpolated P(x)
0	1	1	1
	0.8974	0.90962	0.90087
1	0.85205	0.87146	0.85756
5	0.83858	0.85966	0.84457
10	0.82857	0.85085	0.83490
15	0.81406	0.83785	0.82081
20	0.79462	0.82036	0.80193
25	0.77353	0.80135	0.78143
30	0.75015	0.78016	0.75867
35	0.72365	0.75582	0.73278
40	0.69277	0.72693	0.70247
45	0.65598	0.69164	0.66611
50	0.60873	0.64551	0.61917
55	0.54922	0.58622	0.55973
60	0.47149	0.50769	0.48177
65	0.37662	0.40987	0.38606
70	0.26645	0.29400	0.27427
75+			

Source: Computed by author from Kenya's 1979 population census.

3.2.1 The Life Table; Description and calculation

The values of P(x) obtained above can now be used to calculate other functions of the life table, namely, $l(x)$, ${}_n d_x$, ${}_n L_x$, T(x) and e(x).

(a) L(x): This is the number of survivors at exact age (x) and is obtained by the formula:

$$l(x) = L(0) \times P(x)$$

Where:

L(0) = The radix

Assuming $l(0)$ to be 100,000, $l(1) = l(0) \times P(1)$.

For the Mombasa district data then,

$$l(1) = 0.885702 \times 100,000$$

$$= 88570$$

(b) ${}_n d_x$: This is the number of deaths in between ages x and $x+n$. It is obtained by the formula:

$${}_n d_x = l(x) - l(x+n).$$

For Mombasa district then,

$${}_1 d_0 = 100,000 - 88570$$

$$= 11430$$

(c) ${}_n L_x$: This is the person years lived between exact ages x and $x+n$. It is computed differently according to the corresponding age group - as shown below:

i. For age group 0-1, ${}_1 L_0 = 0.5 \times [l(0) + l(1)]$

ii. For age group 1-4 up to 74.9, it is

$${}_5 L_x = 2.5 \times [l(x) + l(x+n)]$$

iii. For age group 75+ it is

$$L_{75+} = L_{(75)} \log_{10} l(75)$$

For Mombasa district therefore:

$${}_1 L_0 = 0.5 (100,000 + 88570) = 0.5 \times 188570$$

$$= 94285$$

and

$${}_5 L_{10} = 2.5 (84456.84 + 83489.61)$$

$$= 419866.13.$$

(d) $T(x)$: This refers to the person year's lived after exact age x . This is found by adding all the person years lived below

the age group.

For Mombasa, the $T(70)$ value would be:

$$= 121727.1 + 165083.3$$

$$= 286810.4.$$

(e) $e(x)$: This is the life expectancy at age x and is derived thus:

$$e(x) = T(x)/l(x).$$

For Mombasa district, life expectancy at:

i) Birth [$e(0)$] is = $5062904/100000$

$$= 50.62904 \text{ years}$$

$$\approx 50.6.$$

ii) At age 5 [$e(5)$] = $4630785/83325.39$

$$= 55.57472 \text{ years}$$

$$\approx 55.6.$$

3.2.2 Computation of the Time Reference Period [$t(x)$]

$T(x)$ is an estimate of the number of years before the survey data or census data to which the child mortality estimates, $q(x)$, obtained refer. This is based on the assumption that the mortality change is smooth. The value of $t(x)$ is estimated by means of an equation whose coefficients were estimated from simulated cases by using linear regression (see table 3.7).

Table 3.7: Coefficients of West Model For Computing t(x) Values

Age Group	Index (i)	Age x	a(i)	b(i)	c(i)
15-19	1	1	1.0970	5.5628	-1.9956
20-24	2	2	1.3062	5.5677	0.2962
25-29	3	3	1.5305	2.5528	4.8962
30-34	4	5	1.9991	-2.4261	10.4282
35-39	5	10	2.7632	-8.4065	16.1787
40-44	6	15	4.3468	-13.2436	20.1990
45-49	7	20	7.5242	-14.2013	20.0162

Source: UN Manual X: Indirect Techniques for Demographic Estimation P. 78.

Step 1: Derivation of the t(x) value

The equation used in the estimation of $t(x) = a(i) + b(i) [P(1)/P(2)] + c(i) [P(2)/p(3)]$.

For Mombasa district $x=2$

$$t(x) = 1.3062 + 5.5677 \times 0.234063 + 0.2962 \times 0.547227$$

$$= 2.771481.$$

The value of 2.771481 is then converted into years and months. This shows that it is 2 years and (0.771481×12) months before the census. This translates to 2 years and 9.257772 months before August 1979 (the census year). The $q(x)$ values therefore refer to the period November, 1976.

Step 2: Computation of q(x)s to which the Period Computed refer

At this stage, we obtain an interpolated mortality level for each of the $q(x)$ s computed earlier in the construction of the life table. Table 3.8 shows the values for the whole of Mombasa district.

Table 3.8 Interpolated mortality levels, Mombasa District.

i	q(x)	P(x)	Lower Level	Upper Level	Mortality Level	Interpolated Level
1	0.10976	0.89024	0.89740	0.90962	15	14.41412
2	0.11793	0.88207	0.89028	0.90584	16	15.47211
3	0.12701	0.87299	0.88157	0.89862	16	15.49698
4	0.15022	0.84978	0.85205	0.87145	15	14.88273
5	0.16891	0.83109	0.83858	0.85966	15	14.64464
6	0.18842	0.81158	0.80540	0.82857	14	14.26691
7	0.20307	0.79693	0.81406	0.83785	15	14.27995

Source: computed by author from Kenya's 1979 population census.

Once the interpolated mortality levels (shown in the last column of Table 3.8) are derived the next step is to derive $q(x)$ values by interpolation for each of the interpolated mortality levels. The table below shows the interpolated $q(x)$ values for interpolated mortality level 15.47211

Table 3.9. Interpolated $q(x)$ values for interpolated mortality level 15.47211

x	l(x) for level 15	l(x) for level 14	Actual l(x)	q(x)
1	0.89740	0.88476	0.89073	0.10927
2	0.87421	0.85753	0.86541	0.13460
3	0.86388	0.84547	0.85416	0.14584
5	0.85205	0.83174	0.84133	0.15867
10	0.83858	0.81658	0.82697	0.17303
15	0.82857	0.80540	0.81634	0.18366
20	0.81406	0.78938	0.80103	0.19897

Source: Computed by author from Kenya's 1979 population census

The interpolated $q(x)$ values for a given mortality level have a corresponding period in time to which they refer. For instance, the interpolated $q(x)$ values for mortality level 15.47211 above refer to the period 1976.959 or November 1976. The table below shows the interpolated $q(x)$ for Mombasa district and the periods to which they refer in years.

Table 3.10: Time trends for Mombasa District

Period	$q(1)$	$q(2)$	$q(3)$	$q(5)$	$q(10)$	$q(15)$	$q(20)$
1978.424	0.123377	0.153326	0.166587	0.181694	0.197908	0.209838	0.226637
1976.959	0.109272	0.134595	0.145838	0.158671	0.173033	0.183661	0.198968
1974.923	0.108958	0.134180	0.145380	0.158166	0.172486	0.183084	0.183540
1972.593	0.104012	0.127653	0.138176	0.150219	0.163878	0.174018	0.188697
1970.082	0.107091	0.131717	0.142662	0.155167	0.169234	0.179663	0.194710
1967.443	0.125436	0.156072	0.169637	0.185692	0.201574	0.213693	0.230690
1964.577	0.125241	0.155812	0.169348	0.184770	0.201226	0.213328	0.230306

Source: Computed by author from Kenya's 1979 population census

The interpolated $q(x)$ values with the corresponding reference periods are useful in establishing mortality trends. Each $q(x)$ value is plotted against its corresponding reference period and a trend line can then be drawn. Figures 2.0 up to 2.4 below are illustrations of the mortality pattern in the district and as per each division based on $q(2)$, $q(3)$ and $q(5)$ values. A brief explanation of the pattern and an account of the trends is given below.

3.3 Mortality trends in Mombasa District (1963-1979)

3.3.1 Introduction

The trends are a graphic representation of the mortality situation over time. They show the cumulative effect of the various mortality risk factors on child survival at different periods.

3.3.2 The trends

Figure 3.0 shows the $q(2)$, $q(3)$ and $q(5)$ mortality trends for Mombasa district. All the three values show a trend with a fairly similar level of mortality (common direction) over the period under investigation. They all maintained a steady level of between 0.19 ($q(5)$) for the highest and 0.16 ($q(2)$) for the lowest, while $q(3)$ maintained a level of about 0.17. This steady phase was from July 1964 to May 1967. There was a sharp decline from 1967 down to January 1970. From 1970 to July 1972 there was a continuous decline though very gradual. This is contrasted with the period July 1972 to November 1974 which had a gradual rise. These trends tended towards stabilization between November 1974 and November 1976. As in the pre-1967 period this phase saw the $q(5)$ maintain a steady 0.16 value and $q(3)$, a 0.15 while the $q(2)$ maintained a 0.13 value. From November 1976 to 1979, there was a steep rise in all the $q(x)$ values for all the three sets.

Figure 3.1 shows the mortality trends for Kisauni division. Like the district trends, the $q(x)$ values for all

the three sets ($q(2)$, $q(3)$ and $q(5)$) have a common orientation over the entire period. They all rose to a peak in July 1967. During this period, the $q(2)$ value stood at 0.16 and the $q(3)$ at 0.19 while the $q(5)$ value was at 0.20. There was a steady decline of all the $q(x)$ values from July 1967 to February 1978 at which period the $q(2)$ value dropped to 0.11, the $q(3)$ value to 0.12 and the $q(5)$ value to 0.13.

Figure 3.2 shows the mortality trends for Likoni division. The trend lines show a steady rise for all the $q(x)$ values in the pre-1966 period reaching a peak in November 1966. At this peak, the $q(2)$ value stood at 0.18 and the $q(3)$ at 0.19 while the $q(5)$ value was at 0.21. From 1966, there was a sharp decline down to June 1969 when the $q(2)$ value reached 0.13 and the $q(3)$ value reached 0.14 while the $q(5)$ value was 0.16. From June 1969, the decline was gradual down to January 1972 when the $q(2)$ value was 0.13, the $q(3)$ value was 0.14 and the $q(5)$ value was 0.15. From 1972, there was a steep drop down to July 1976 when the $q(2)$ value was 0.09, the $q(3)$ value was 0.10 and the $q(5)$ value 0.11. From July 1976 onwards till 1979, there was another steep rise with the $q(2)$ value in February 1978 reaching 0.12 and the $q(3)$ 0.13 while the $q(5)$ was 0.14.

Figure 3.3 shows the mortality trends for Island division. This division had the most fluctuating trends between January 1965 and August 1978. In January 1965, the $q(2)$ value was 0.11, it rose to a peak 0.12 in January 1968

before it sharply dropped to 0.10 in September 1970. It further declined though gradually to 0.09 in March 1973 before it rose again to 0.10 in June 1975. This index dropped to 0.09 in May 1977 but rose again to 0.11 in August 1978. Both $q(3)$ and $q(5)$ values maintained a similar fluctuating pattern though with values above the $q(2)$ values throughout that period. The $q(3)$ values were above the $q(2)$ values from January 1965 to August 1978 with an average $q(x)$ difference of about 0.010. The $q(5)$ trend line too, maintained a similar average figure, as the difference from the $q(3)$ trend line.

Figure 3.4 shows the mortality trends for Changamwe division. Although the trend lines show marked fluctuations over time, all the three sets of the $q(x)$ values show a good general decline from 1963 up to 1979. In October 1963, $q(2)$ was 0.15 and $q(3)$ was 0.16 while $q(5)$ was 0.17. The $q(2)$ value rose to 0.16 in September 1966 while the $q(3)$ dropped slightly to 0.15 but $q(5)$ rose to 0.19 in the same period. All the three $q(x)$ sets dropped sharply to 0.11 for $q(2)$, 0.12 for $q(3)$ and 0.13 for $q(5)$ in September 1969. There was then a slight rise to 0.12 for $q(2)$ and 0.13 for $q(3)$ and 0.14 for $q(5)$ in April 1975. This was followed by a gradual decline down to June 1977 when $q(2)$ reached 0.11, $q(3)$, 0.12 and $q(5)$, 0.13. From June 1977 towards 1979 all the three sets of $q(x)$ values stabilized at 0.11 for $q(2)$, 0.12 for $q(3)$ and 0.13 for $q(5)$.

In summary, although there are numerous fluctuations in the trends of the respective divisions, all of them exhibit a similar pattern. Mortality was highest in the district between 1964 and 1969. There was a steady decline down to 1977. From 1977, however, the tendency has been for mortality to rise.

Fig.3.0: MORTALITY TRENDS FOR MOMBASA DISTRICT

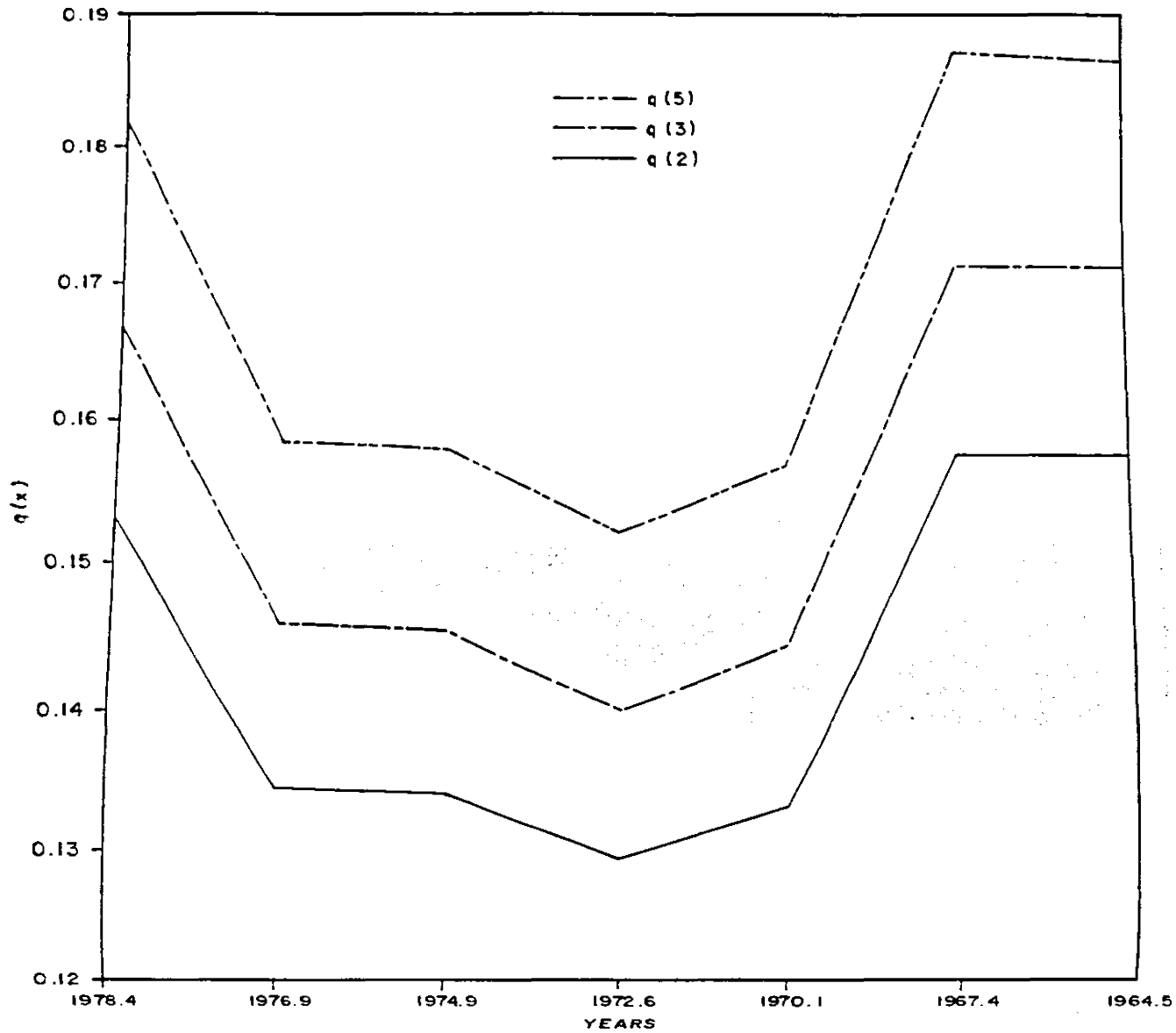


Fig.3.1: MORTALITY TRENDS FOR KISAUNI DIVISION

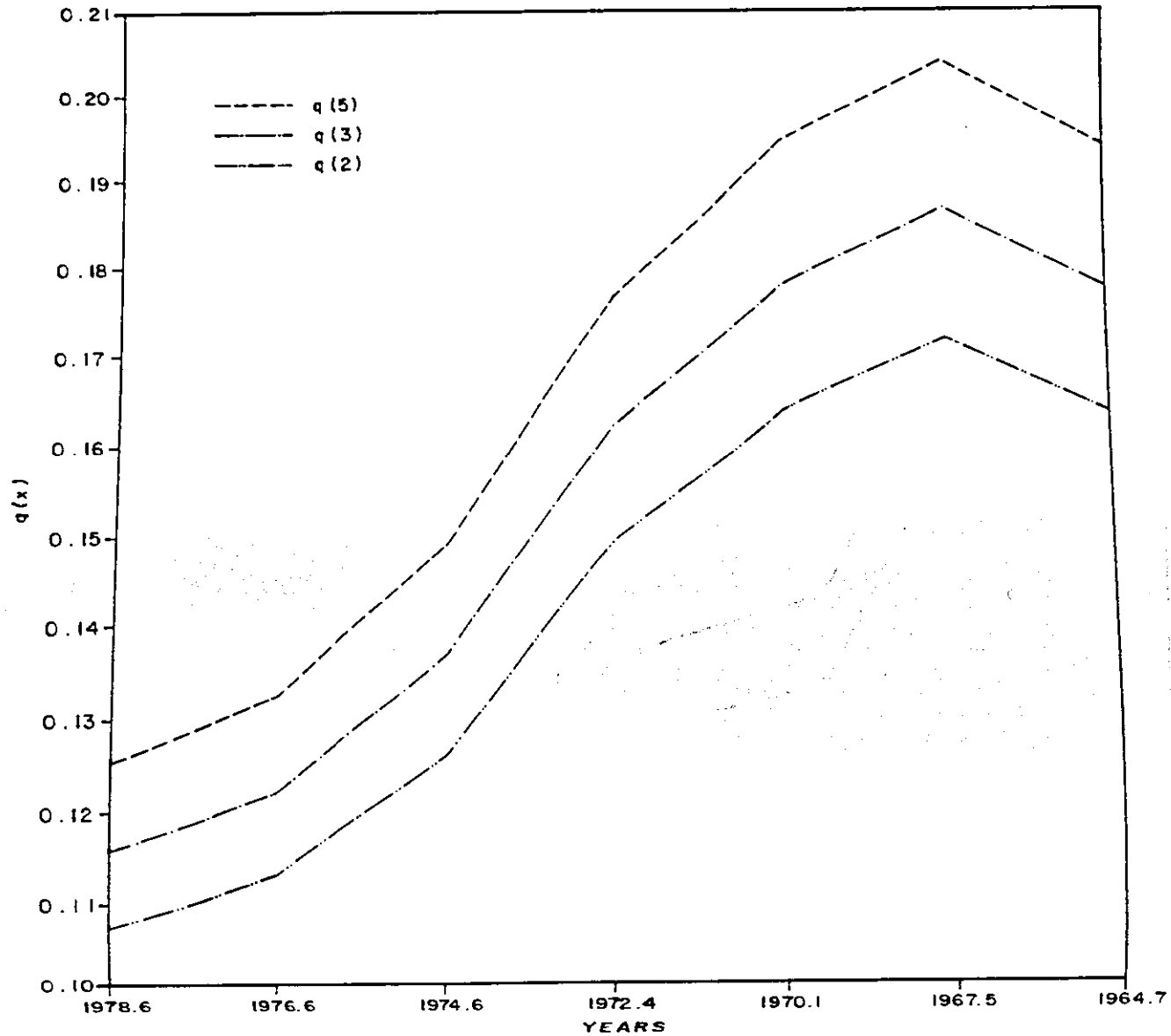


Fig.3.2: MORTALITY TRENDS FOR LIKONI DIVISION

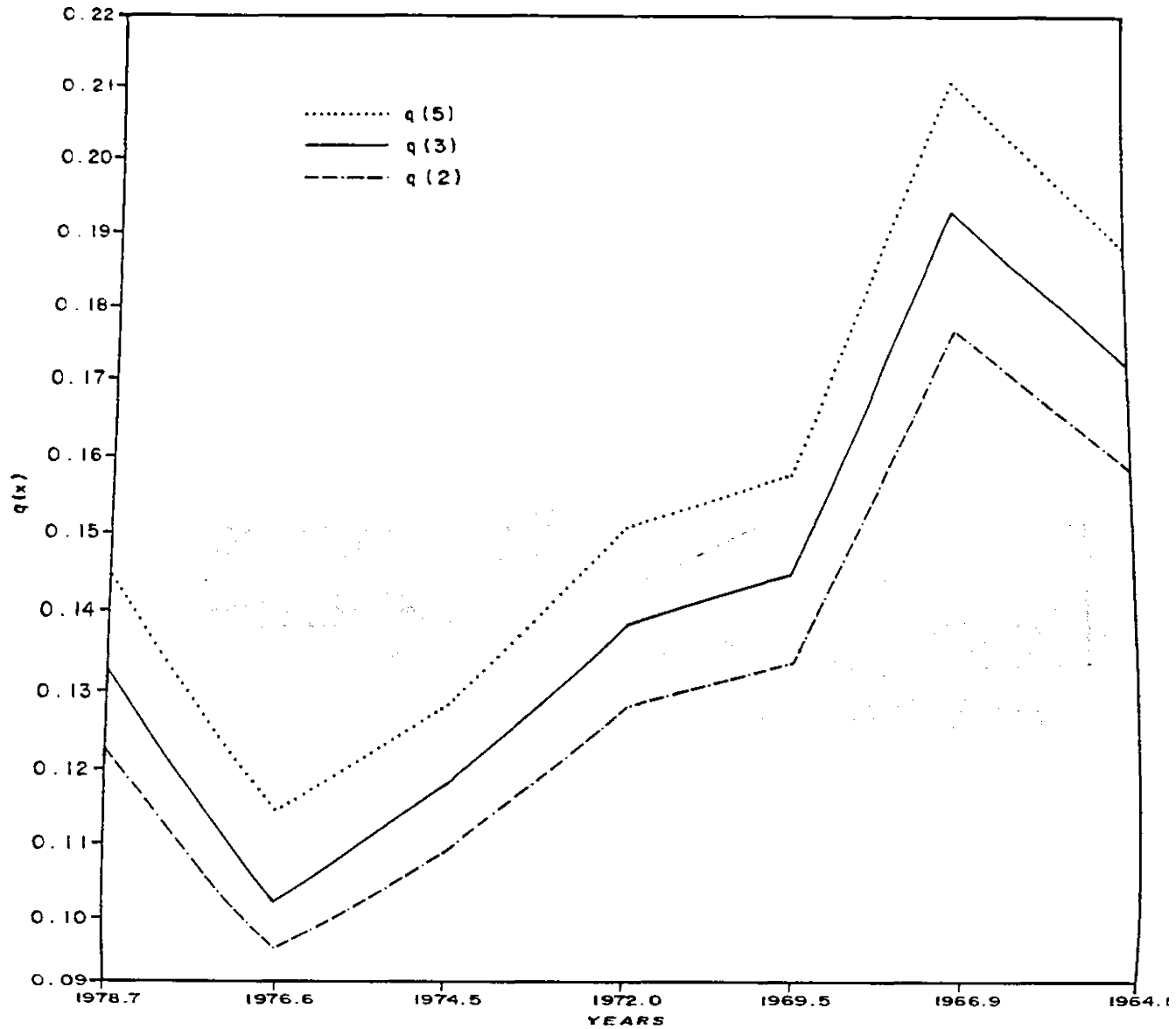
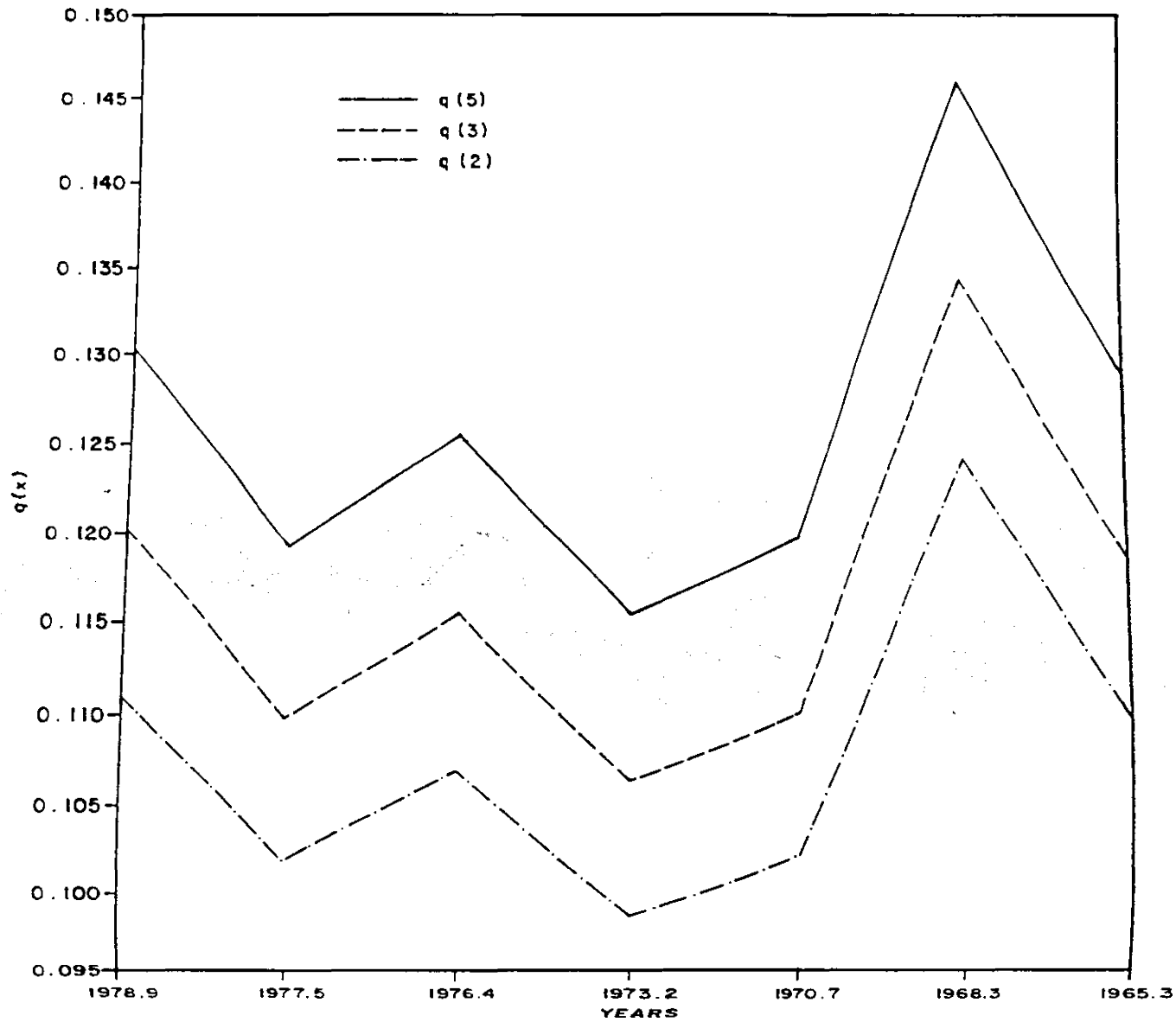
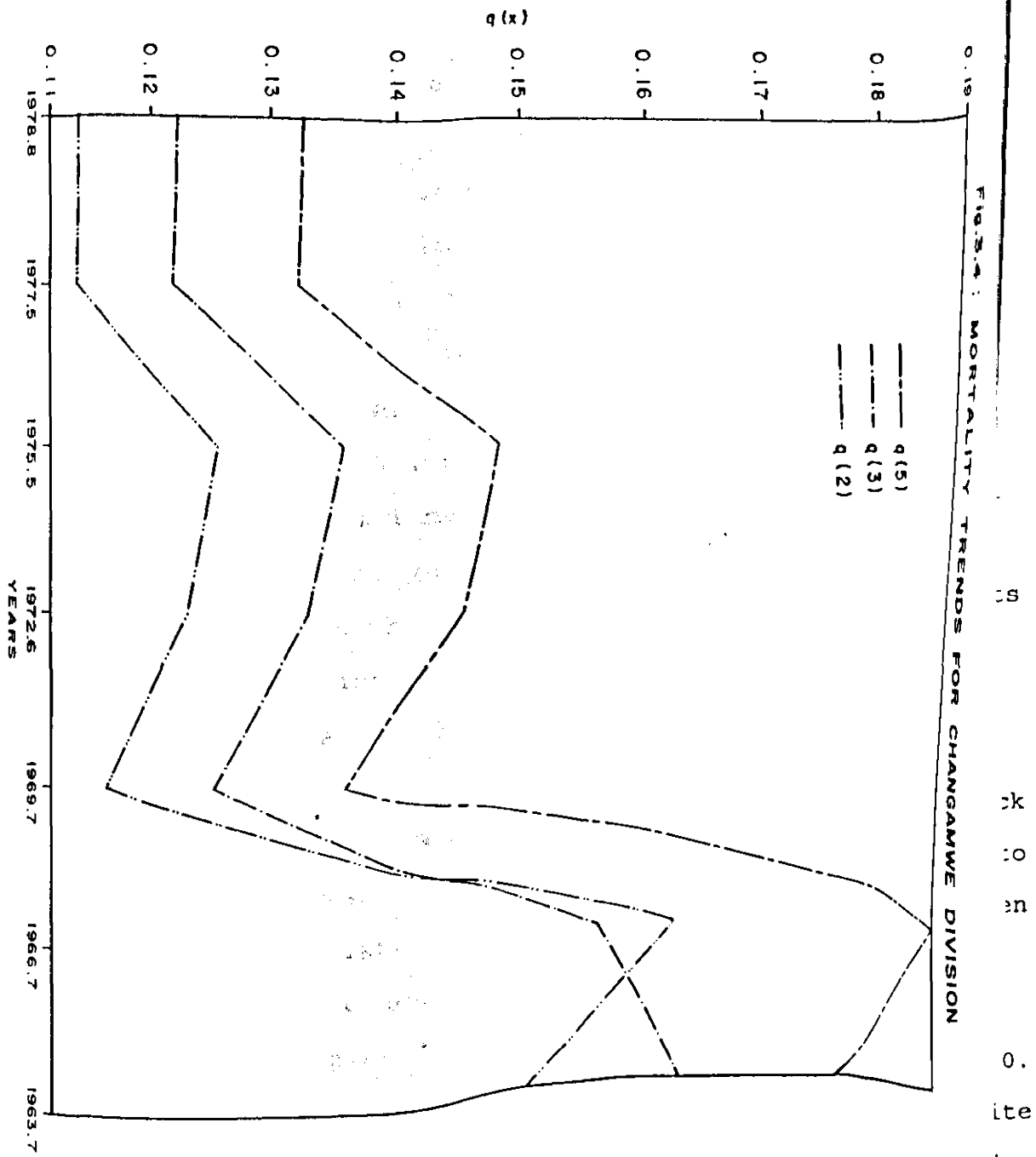


Fig.3.3: MORTALITY TRENDS FOR ISLAND DIVISION





3.3.3 An account of the trends.

The general Infant and childhood mortality patterns for all the divisions are closely related. The divisional deviations from the entire district scenario (fig.3.0.) are minimal. It is evident that before 1967 mortality was quite high. This may be attributed to inadequate and poorly stocked health units. This scenario was typical of the rest of the country in the early years of independence. Deaths which would have been avoided through medication were still unavoidable to those who didn't have easy access to medical centres. In addition, major killers then, such as measles, tetanus and others had not been brought under full control relative to subsequent years.

Improvements in the numbers of health units, equipments and personnel and increasing control of hitherto fatal diseases may have significantly contributed to the decline evidenced between 1967 and 1972.

Mombasa district has for a long time suffered from lack of adequate clean water. Usually this translates easily into poor sanitation, related diarrhoeal diseases and quite often deaths. This may also account for the high mortality levels especially in the pre- 1970's. This situation was particularly bad for deaths by age five as seen in fig. 3.0. because this is the age when environmental factors are quite instrumental in childhood mortality and clean safe water is a key factor in the whole process. Gradually in the 1970's

and 1980's however, more waterworks have been undertaken in the district and this may be positively related to the decline in mortality in this period.

From 1972 to 1977, the mortality the mortality decline was quite minimal. This may be attributed to deteriorating patient-facility ratios due to the increase in population. The upswings and surges in the mortality curves characteristic of Island division (Which is the 'Central Business District') attests to this ratio problem. It takes a short time for additional facilities to be strained and the associated mortality rise may not drop again until more facilities are available, among other factors.

From 1977 onwards mortality increased in all the divisions except Kisauni division. This increase may be attributed to the increased cost of living (Medication, Education, Sanitation etc.) This means fewer people can afford this services both for their children and themselves and are therefore more vulnerable to diseases and subsequent deaths. Productivity especially in the agricultural sector for the divisions which are predominantly agricultural like Kisauni, has been declining too as people move to Island division in preference for commerce. This has led to food becoming scarce and therefore expensive. This food inadequacy leaves the young susceptible to malnutrition and related ailments often leading to deaths. All this are compounded by the high inflation rate which has been typical

of this period.

Recent demographic surveys, however, (K.D.H.S.1993) indicate a mortality decline in the district which has been attributed to increased literacy rates (more people attaining higher levels of education), availability of more health facilities and general improvements in infrastructure.

CHAPTER FOUR

CHILD MORTALITY DIFFERENTIALS IN MOMBASA DISTRICT.

4.1. Introduction

In this study, three mortality differentials are considered, namely, education, marital status and place of residence.

The indicators often used for infant and child mortality differentials include:- $q(1)$, $q(2)$, $q(3)$, $q(5)$, ${}_1q_0$ and ${}_4q_1$.

4.2. The mortality indices.

1. $q(1)$: The probability of dying before age 1.
 2. $q(2)$: The probability of dying before age 2.
 3. $q(3)$: The probability of dying before age 3.
 4. $q(5)$: The probability of dying before age 5.
- and
5. ${}_1q_0$: The probability of dying between age 0 and 1.
 6. ${}_4q_1$: The probability of dying between age 1 and 5.

$q(2)$, $q(3)$ and $q(5)$ are considered more reliable than $q(1)$ or any other. In this study, ${}_1q_0$, $q(2)$, ${}_4q_1$ and $q(5)$ values are used to compare and explain mortality differentials in Mombasa district.

${}_1q_0$ is used to compare and explain infant mortality rates as this refers to the probability of dying within infancy. ${}_4q_1$ is used to compare and explain childhood mortality rates. $q(2)$ and $q(5)$ are used to compare and explain mortality at

age two and five respectively.

4.3. The ${}_1q_0$, $q(2)$, ${}_4q_1$ and $q(5)$ preference.

The above indices are used in preference to the others because of various reasons:

${}_1q_0$ is used as an index for infant mortality because it indicates the probability of dying within infancy. Many infants die early in the year and therefore ${}_1q_0$ would be a better index since it covers the entire period. ${}_4q_1$ is also used on the same strength. However, $q(2)$ is used because this is the period when supplementary foods get more prominence and breastfeeding declines. Many children are weaned off in year two. The supplements introduced then are likely to affect the child's health and if low quality and inadequate supplements are offered to the child, malnutrition and related ailments are likely to weaken the child and be a major predisposing factor in high mortality. If the supplements are also given in unhygienic conditions then chances of diarrhoeal complications arising from contaminated food and water set in. This is likely to contribute to increased mortality. $q(2)$ therefore is a good reflector of the sanitary state. $q(5)$ is a culmination of inadequate childhood feeding and mainly environmental factors. The child is fairly independent from the mother and is therefore more exposed to contaminated food, and accidents. The completely weaned child also lacks the

immunity hitherto provided by the mothers milk and is therefore vulnerable to disease attacks and can easily die. At age five, the child needs enough food for growth, development as well as energy. If malnutrition is allowed to set in at this stage through poor diet and inadequate feeding, the chances of death are increased.

In summary, while ${}_1q_0$ may indicate more biological factors influencing mortality, $q(2)$ and $q(5)$ reflect more of the environmental conditions of the study areas. It is therefore essential to emphasise the use of these indices so as to understand better the main predisposing agents to child mortality in the study area.

4.4. Results

The data for the entire district shows that life expectancy at birth stood at 53.4 years whereas the infant mortality rate was 99 per 1000 live births and q_2 was estimated at 118 per 1000 livebirths (see table 4.1).

Table 4.1.: IMR, e_0 , and $q(2)$ values Mombasa District.

REGION	IMR/1000	e_0	$q(2)$
Island Division	70	59.2	102
Kisauni Division	93	54.6	113
Changamwe Division	82	56.6	113
Likoni Division	87	55.7	95
Mombasa District	99	53.4	118

Source: Computed by author from Kenya's 1979 population census.

4.4.1. Mortality rates by education level

Table 4.2. shows mortality rates by the level of education of the mother in Mombasa district.

Table 4.2.: Estimates of $q(2)$ values by Education level of the mother.

Educational Level	Island	Kisauni	Changamwe	Likoni	Mombasa District
No Education	124	126	150	115	132
Primary Education	110	116	129	110	118
Sec.+	67	77	94	88	79

Source: Computed by author from Kenya's 1979 population census.

Table 4.3. shows infant mortality rates (IMR) and life expectancy at birth by education in the divisions of Mombasa district.

Table 4.3. IMR and e_0 values by education.

REGION	NO EDUCATION		PRIMARY EDUCATION		SECONDARY+	
	IMR	e_0	IMR	e_0	IMR	e_0
Island	85	56.1	69	59.4	41	65.4
Kisauni	103	52.6	81	56.9	48	63.9
Changamwe	121	49.5	92	54.8	59	61.4
Likoni	94	54.3	87	55.7	68	59.6
Mombasa	114	50.6	90	55.0	47	64.0

Source: Computed by author from Kenya's 1979 population census.

The results in table 4.2. for $q(2)$ by education level strongly confirm the widely held view that education is negatively related to mortality. This is both at the divisional as well as the district level.

Changamwe division has the highest $q(2)$ values in all the categories. Kisauni division has the next highest values though it has a lower $q(2)$ value than that of Likoni for secondary plus category. Island division has the lowest $q(2)$ value for the secondary plus category.

IMR and e_0 values shown in Table 4.3. reinforce even further the negative relationship between education and mortality. The table also confirms for all the divisions as well as the district level that life expectancy at birth (e_0) is highest for the secondary and above category and lowest for the no education category, with the primary category falling in between the two.

Once again, Changamwe division has the highest IMR values for all the categories and also records the lowest e_0 in all the categories, except for a dismally better performance above Likoni for the secondary and above category.

Island division has the lowest IMR for the secondary plus category corroborating well with the highest e_0 value for the same category. This compares well with Likoni division which has the highest IMR within that category with the lowest e_0 in the same category. Generally for all the

categories, Island division performs better than the rest both with regard to IMR as well as e_0 .

4.4.2. Mortality differentials by marital status

Table 4.4 shows $q(2)$ values for the various marital status categories in Mombasa district as well as divisions.

Table 4.5 provides estimates of IMR and e_0 for the same levels.

Table 4.4. $q(2)$ Values by Marital Status

REGION	SINGLE	MARRIED	WIDOWED	DIVORCED/ SEPARATED
Island	94	80	136	112
Kisauni	91	101	0	102
Changamwe	75	101	*	*
Likoni	58	88	*	73
Mombasa	90	103	170	106

Source: Computed by author from Kenya's 1979 population census.

* (No frequencies available from census data)

Table 4.5. provides IMR and e_0 values by marital status in Mombasa district by divisions.

Table 4.5. IMR and e_0 Values by Marital Status

REGION	SINGLE		MARRIED		WIDOWED		DIVORCED/ SEPARATED	
	IMR	e_0	IMR	e_0	IMR	e_0	IMR	e_0
Island	71	58.9	62	60.7	85	56.2	81	56.9
Kisauni	85	56.1	101	53.2	65	60.1	77	57.6
Changamwe	93	54.6	89	55.3				
Likoni	72	58.6	86	55.9			71	58.9
Mombasa	69	59.4	82	56.8	109	51.6	109	52.1

Source: Computed by author from Kenya's 1979 population census.

In the 1979 census data there were no frequencies for Likoni, widowed in age group 15-19 as well as Changamwe; widowed as well as divorced/separated in the same age group. This made it impossible to calculate $q(2)$ and other subsequent values for the divisions. This has therefore greatly hampered a complete comparative analysis of all the divisions within the affected categories. However, the entire district data show that the $q(2)$ value is lowest among the single, followed by the married, then the divorced/separated and highest among the widowed. Island division has its lowest $q(2)$ value among the married and it is also the lowest in that category compared to the other divisions as well as the district's average. Within the single category, Changamwe division has the lowest $q(2)$ value.

Table 4.5. shows that for the entire district, IMR is

lowest among the single, followed by the married and highest among the widowed and divorced with an identical value. The single category has the highest e_0 . The category with the second highest value is the married. This is followed by the divorced/separated category and leaving the widowed with the lowest.

Among the divisions, Changamwe division has the highest IMR among the single mothers category a situation which contrasts with that of Island division. In the same category, Island division has the highest e_0 , with Likoni division having the second highest, followed by Kisauni division and Changamwe having the lowest.

Among the married, Kisauni division has the highest IMR while Island division has the lowest. This translates well to the e_0 values where again Island division has the highest value while Kisauni division has the lowest value.

Data per division indicates roughly similar pattern to that of the district with IMR being highest among the widowed and divorced/separated and the lowest being among the single or married categories. The e_0 values, however, do not seem to follow a definite pattern. The separate divisions and their variations will be discussed later in this chapter. In general, however, the relationship between marital status on the one hand and $q(2)$ plus IMR and e_0 on the other hand is not as consistent as for the education variable.

4.4.3. Mortality differential by place of residence

The entire Mombasa district is categorised as urban. The values for the respective divisional totals therefore will be analysed with respect to variations between divisions. A summary of these values $q(2)$, IMR and e_0 are given in table 4.1.

Kisauni and Changamwe divisions have the highest $q(2)$ values (i.e 113 for both). These are followed by Island division with 102 and Likoni division has the lowest $q(2)$ value of 95. Kisauni division has the highest IMR of 93 per 1000 live births. Likoni division is second with 87 and Changamwe division third with 82. Island division has the lowest i.e. 70 per 1000 live births.

The e_0 values translate perfectly into the view that low values have corresponding high e_0 values. Island division has the highest e_0 value while Kisauni division has the lowest.

4.5. Discussion of the results

The results generally show that Mombasa district is a high infant and child mortality area as portrayed by the estimates of IMR (99), and $q(2)$ of (118). The e_0 of 53 years is also quite low compared to other districts in Kenya save for those in Nyanza and Western provinces.

This sorry state is most likely due to the climate of the region and the district's resource base. Mombasa is

generally hot throughout the year with temperatures rising to as high as 34.2 degrees Centigrade in the December/January period. Temperatures rarely go below 26 degrees centigrade . The relative mean annual humidity at 15.00 hours is 67 percent. These conditions are very favourable to disease- causing organisms. This environment is, for instance, conducive to mosquitoes hence the malaria menace.

General agricultural productivity in the district is also quite low. The bulk of its area is under township (204 sq km. out of 275 sq km; of which 65 sq km is under water). This has greatly reduced the ability of the district to be self-sufficient in terms of food supplies. This translates into under-nourishment, in many places, and subsequently degenerates the body, lowering immunity hence making it prone to diseases.

Despite this generally accepted state of high mortality, there are diverse differences among the divisions. Changamwe and Island divisions , for instance, differ markedly from each other. Island division has the lowest IMR and the highest e_0 . This is most probably because the division has most of the health facilities in the district. These include the Coast General Hospital, three private hospitals, fourteen private clinics and a higher number of the health centres than any of the other divisions. Most schools and health care facilities are also

found in the division. The division is also the center of commerce and salaried employment. This also adds to the advantage the division has over others in that the higher income levels lead to greater access to health and education facilities as well as higher nutritional standards.

Conversely, Kisauni and Changamwe divisions have few and poor health and educational facilities. This situation is aggravated by the relatively poor state of infrastructure. According to the 1984/88 District Development Plan, in some parts of the two divisions, a patient may travel 8-19 kms before getting to the nearest health facility. Agricultural productivity is also low especially for Changamwe division which is largely a severely dissected and eroded belt of Jurassic Shale and residual sand. Although Kisauni division has 58 percent of the district's agricultural land, the land is not notably different from that of Changamwe division. In addition, most of its agricultural produce is "exported" to the other divisions, especially the Island. It is therefore not surprising that it has an IMR of as high as 93 per 1000 and an e_0 of only 54 years.

Likoni division has also a very high IMR of 87 per 1000, second only to Kisauni and again an e_0 of 55 years which is only higher than that of Kisauni division. The division is also poorly endowed with health and educational

points. According to the 1984/88 Development Plan, it had only one private clinic.

In summary, Mombasa district is a high mortality area as revealed by the high IMR and $q(2)$ values contrasting with the low e_0 values. This is at divisional as well as the entire district level. Among the most probable reasons to explain this state are the levels of health facilities, education and water provision. All the water consumed in the district comes from out of the district. The district suffers from frequent water shortage which greatly lowers sanitation and hence health standards culminating into disease prevalence. Some essential public facilities are also scarce. For example, there is only one fish market at the old port. The market does not have the basic storage facilities and hence not fully utilised. This has led to mushrooming of open air fish markets with no regard to hygiene conditions translating into many health problems.

Also, the district's intense heat and high relative humidity, given its proximity to the sea level, reduces the people's ability to work for many hours. This hampers productivity especially agricultural and therefore less food is available. These ecological conditions also reduce the degree of agricultural diversification. This is essential for either providing a variety of supplementary foods needed by the body for strength and prevention of diseases or producing for the market and therefore additional income.

4.6 Childhood mortality and the respective differentials

4.6.1 Introduction

In this section, estimates of ${}_4q_1$ and q_5 are used to analyse the child mortality situation in Mombasa. The results of the analysis in this section are compared to the results of the ${}_1q_0$ and $q(2)$ analysis appearing in section 3.4 above. An attempt is finally made to explain mortality variations in the results of the above two sets of indices.

4.6.2 Results

Table 4.6 below shows the childhood mortality rates as well as the mortality rates at age five per 1000 live birth. Life expectancy, in years, is also indicated both at births as well as at age five for comparison purposes.

Table 4.6: Mortality at age five, $q(5)$, Childhood Mortality ${}_4q_1$, and the Life expectancy both at birth (e_0) and age five (e_5): All Cases Combined

REGION	$q(5)$	${}_4q_1$	e_5	e_0
Island Division	115	28	62.6	59.2
Kisauni Division	176	44	59.1	54.6
Changamwe Division	144	37	60.7	56.6
Likoni Division	150	40	60.0	55.7
Mombasa District	150	48	58.3	53.4

Source: computed by author from the 1979 census data.

As shown in table 4.6 above, the mortality rate at age five in Island Division is 115 deaths per 1000. While the childhood mortality rate between age one and four is 28 deaths per 1000. This pattern of higher $q(5)$ values than ${}_4q_1$

is maintained in all divisions including all cases combined for the district. At the district level, 150 deaths per 1000 occur before age five, while 48 deaths occur per 1000 between age one and four.

Kisauni division records the highest mortality at age five with 176/1000. Likoni division is the second highest with 150/1000 and Changamwe division the third highest with 144/1000. Island division has the lowest $q(5)$ and ${}_4q_1$ values of 115/1000 and 28/1000 respectively. The other divisions have ${}_4q_1$ values which follow the $q(5)$ pattern with Kisauni division having the highest value of 44/1000. Life expectancy both at birth (e_0) and at age five (e_5) also follow a similar pattern. Kisauni division has the lowest while Island division has the highest life expectancy at both ages.

4.6.3 Mortality level by education differential

Table 4.7 shows the childhood mortality rates, mortality at age five and life expectancy at age five by the education level of the mother.

Table 4.7: Mortality at age Five, $q(5)$, Childhood Mortality, ${}_4q_1$ and Life Expectancy, e_5 , at age Five for the Education level of the mother.

REGION	NO EDUCATION			PRIMARY EDUC.			SEC. PLUS		
	$q(5)$	${}_4q_1$	e_5	$q(5)$	${}_4q_1$	e_5	$q(5)$	${}_4q_1$	e_5
Island	139	38	60.3	106	28	62.8	56	11	67.2
Kisauni	195	51	57.0	127	36	60.9	56	14	66.1
Changamwe	217	64	55.3	151	43	59.3	89	22	64.3
Likoni	179	45	58.9	133	40	60.0	123	27	62.9
Mmbasa	179	59	56.1	158	42	59.5	62	14	66.2

Source: Computed by author from the 1979 census data

Island division has the lowest $q(5)$ values for all the three education categories. Changamwe division has the highest in the No education and the Primary Education Categories. Likoni Division has the highest in the secondary and above category. Mortality between ages one and four for all the divisions also follow a similar pattern with Island Division having the lowest. Changamwe Division has the highest ${}_4q_1$ values in both the No education and primary education categories. Likoni division has the highest ${}_4q_1$ value in the secondary and above category. The life expectancy at age five also follows a similar pattern with Island Division having the highest number of years while Changamwe division has the lowest number of years for all the education categories.

4.6.4 Mortality level by marital status

Table 4.8 shows the childhood mortality rates, mortality at age five and the life expectancy at age five by Marital Status differential.

Table 4.8: Mortality at age Five, $q(5)$, Childhood Mortality, ${}_4q_1$ and Life Expectancy, e_5 , at age Five for the Marital Status Differential

REGION	SINGLE			MARRIED			WIDOWED			DIVOR/SEPAR.		
	$q(5)$	${}_4q_1$	e_5	$q(5)$	${}_4q_1$	e_5	$q(5)$	${}_4q_1$	e_5	$q(5)$	${}_4q_1$	e_5
Island	125	29	62.4	113	24	63.8	138	38	60.4	131	36	60.9
Kisauni	144	38	60.3	172	49	58.1	194	25	63.3	226	33	61.4
Changamwe	281	44	59.2	138	41	59.7						
Likoni	161	30	62.2	147	39	60.1				172	29	62.4
Mombasa	163	28	62.8	147	36	60.8	188	55	56.9	194	56	57.4

SOURCE. Computed by author from the 1979 census.

Just as with the education differential, Island Division has the lowest $q(5)$ values in all the categories of the marital status differential among all the divisions. The division also has the lowest ${}_4q_1$ values except for the widowed category where Kisauni division has the lowest. Incidentally, Kisauni division has the highest $q(5)$ values in both the married and widowed categories. Lack of frequencies for Changamwe division in the widowed and divorced/separated categories made it difficult to compute the $q(5)$ and ${}_4q_1$ values in those categories. The same explains the lack of values for Likoni division, widowed

category. The general pattern, however, leaves Island division with the lowest mortality and the highest life expectancy at age five in all categories. Kisauni and Changamwe divisions not only experience relatively higher mortality but also experience the lowest expectation of life at age five in all the categories of the marital status differential.

4.6.5 A discussion of the childhood mortality results

The $q(5)$ index of as high as 176/1000 in Kisauni division and 150/1000 for the entire district, all cases combined, indicates that childhood mortality is fairly high in Mombasa. The ${}_4q_1$ index of 48/1000 for the district is also still fairly high. The estimates of ${}_4q_1$ and $q(5)$, as compared to ${}_1q_0$ however, indicate that most deaths occur in infancy. Table 4.6 indicates that 68 percent of the mortality before age 5 in the district is accounted for by infants. The figure is as high as 76 percent in Island division, 75 percent in Kisauni division, 74 percent in Changamwe division and 73 percent in Likoni division.

For survivors at age five, life expectancy increases in all the divisions. The entire district data indicates an increase of about five years from the life expectancy at birth (e_0). Island, Kisauni, Changamwe and Likoni divisions have increments of 3.4, 4.5, 4.1 and 4.3 years respectively. This confirms the fact that early childhood is the highest

mortality risk phase. Survival through the period improves survival into late adulthood. The children who survive through this phase become more prepared physiologically to counter general body weakening malaise and can therefore resist mortality risk factors more effectively.

Estimates of childhood mortality by education level, using both $q(5)$ and ${}_4q_1$ indices confirm the fact that mortality is higher the lower the education level. This is true for all the divisions as well as the district totals. This underscores the importance of education in equipping the mothers with the requisite knowledge to protect their children against mortality risk factors. Using the $q(5)$ index, mothers with secondary and above level of education in Island division save 83/1000 children who would otherwise have been lost were they to have no education. Similarly, mothers with secondary and above education in Kisauni division save 181/1000 live births. Mothers in Changamwe and Likoni divisions with secondary and above education level save 191/1000 and 152/1000 respectively compared to the corresponding mothers in the same divisions but with no education.

Intra-divisional variations indicate that Island division has the lowest mortality levels for all the education categories. This is true despite the fact that it is the most densely populated division in the entire district as can be seen from table 1.1.3. Availability and

use of health, education and general infrastructural facilities account more for the low mortality in the division compared to the other three divisions. The division has most of the education facilities in the district. It is also the hub of most of the elite who understand the value of education. Most of the health facilities are also found on the Island and that explains why the division has the lowest mortality among the No education category. There are also more employment opportunities available in the division and commercial activities are also better established. These ensure higher income for the residents and hence their higher ability to finance education and be able to pay for medical facilities and services. Given that children depend less on mothers milk and more on other foods, a division with higher income is better placed to provide enough and high quality food. The death toll from malnutrition and other deficiency ailments is therefore much less.

Conversely Kisauni and Changamwe divisions have high childhood mortality rates because they are relatively less developed in terms of the communication network, health and education facilities and in addition the commercial sector is not as developed as in Island division. The higher agricultural productivity of Kisauni division over Changamwe division explains in part why generally the former has less childhood mortality than the latter. Agricultural products

do not only provide certain basic foodstuffs but the surplus is also sold for income which can be used to finance medication and education.

Life expectancy improves with higher levels of education in all the divisions. This is basically because mothers with higher education are better protectors of their children from diseases by both curative and preventive measures. They have the know-how and, often the ability to provide the right amounts of high quality food to the children. Well fed children are more able to resist disease attacks which weaken and expose them to mortality. Educated mothers also understand the value of clean environments. Environmental factors are crucial in child survival and this explains in part why there is both high mortality and low expectation of life from mothers with no education.

Childhood mortality by marital status among the divisions still display a pattern where the Island division has the lowest rates in all the marital statuses.

Although the pattern is not as clear as the one portrayed by education level, the rates for both the widowed and divorced/separated are higher than those of the married and the single. This is probably because the widowed and divorced/separated are single parents. Their ability to provide for their young ones is lowered than their counterparts in the married category who combine resources with their husbands. Life expectancy at age five varies

considerably both among the divisions and various socio-economic and demographic groups.

4.6.6. Summary

The results of the $q(5)$ and $q(2)$ analysis both indicate a very strong relationship between education and mortality. Both indices clearly indicate that higher levels of education are instrumental in reducing child mortality. This was also found to be true when using the infant mortality index (${}_1q_0$). Island division has the lowest infant and child mortality and the highest life expectancy. This underscores the significance of health facilities, educational facilities, high income and generally good physical infrastructure in lowering mortality. For all the differentials and in all the divisions the expectation of life increases at age five compared to the expectation at infancy. The success of the physiological adaptations to the harsh environment at infancy ensures better chances of survival to late adulthood.

Education and availability of services and facilities are stronger factors in influencing a reduction in infant and child mortality than marital status.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS.

5.1 General Introduction

This study had one main objective. This was to estimate and describe infant and child mortality levels, trends and differentials in Mombasa district. For the purpose of clarity, three specific objectives were derived from the above broad objective. These were:

1. To estimate levels of infant and child mortality at the district and the divisional level.
2. To ascertain the effect of mother's educational level on infant and child mortality.
3. To investigate the effect of mother's marital status on infant and child mortality.

The data base for this study was the 1979 National Population Census. The technique adopted for the estimation of the infant and child mortality in the district as well as the divisions was the Coale and Trussell indirect technique of estimating mortality. Trussell's west model coefficients were used. The results for application of this technique are reported in chapter four.

5.2 The main findings of the study

Chapter four consists of the results of the analysis done in chapter two. The results indicate that there is a fairly strong relationship between the respondents level of

education, marital status and maternal place of residence on one hand, and infant and child mortality on the other. The main findings of this study are outlined below in accordance with the specific objectives.

The first specific objective was to estimate levels of infant and child mortality at the district and divisional levels. The q_0 , $q(2)$, and $q(5)$ indices all indicate Mombasa district as a high infant and child mortality area. The infant mortality was estimated to be 102 per 1000 live-births while mortality by age five was estimated to be 150 per 1000 live-births.

The mother's division of residence was also seen to affect the levels of mortality as well as life expectancy. Divisions better endowed with infrastructure such as the Island division had the lowest infant mortality rates and highest life expectancy values. Those with few medical facilities and generally poor infrastructure like Kisauni division had the highest infant mortality rates and the lowest life expectancy.

With regard to the specific objective number two, namely to ascertain the effect of mothers educational level on infant and child mortality, the following relationship was established. Using $q(2)$ and $q(5)$ indices, it is evident that the level of education is negatively related to the level of mortality. Live births born to mothers of secondary and above level of education had higher chances of survival than

those born to mothers of primary and below level of education. The pattern of life expectancy was also similar. Infant mortality rates were also found to be inversely related to the level of education.

The third objective was to establish the effect of mothers marital status on infant and child mortality. Using both estimates of $q(2)$ and the infant mortality rates by marital status, mortality was found to be highest among the widowed category and the life expectancy in the same category was the lowest. The results indicate that live births born to single mothers had the lowest mortality and highest life expectancy. The proportion of the single women enumerated in the census is usually small compared to the proportion married. The single mothers therefore constitute cases that are too few to yield results with the true comparative picture of the mortality situation. Given the large proportion of those enumerated within the married category against their respective $q(2)$ and infant mortality rates, it is most probable that births within this category have lower mortality rates and higher life expectancy values.

The level of infant and child mortality in Mombasa was still found to be generally high. Generally the deaths during infancy were more than the deaths occurring between age one and five. This was portrayed in all the divisions and by various socio-economic and demographic categories. Life

expectancy at age five was seen to improve by an average of three years from that at birth. This was also similar in all the divisions.

5.3.0 Recommendations for policy planning

5.3.1 Introduction

The basic concern of humanity is the increment of life expectancy. Efforts towards the fulfilment of this aim include betterment of life through the provision of more and improved socio-economic facilities and services. The early years of life (below age five) are the most critical in the realization of this objective. A child who survives to age five and above has even better chances of surviving to late adulthood. Key strategies in the struggle to prolong life should therefore be concentrated in this phase. The following recommendations are made with the prime purpose of assisting in the reduction of mortality in this phase.

5.3.2 The recommendations

1. This study has established a strong inverse relationship between maternal education level, and infant and child mortality. It is therefore recommended that there should be more effort in the provision of education facilities to all people, particularly women. The government should invest more in educational infrastructure so that there are more schools for the many school age going children. This expansion

should be on a scale to adequately cater for not only the natural increase but also for immigration that is typical of our urban centres. Parents should be advised strongly, possibly through the provincial administration to ensure that all their children especially the daughters acquire formal education. Today's children are the parents of tomorrow and if ill-equipped with child-care knowledge, they contribute to increased infant and child mortality. The aim should not just be basic education but emphasis should be on secondary and above levels of education. At these levels mothers are not only equipped with the relevant knowledge to handle the young ones but also have higher chances of securing salaried employment. The income from earning mothers supplement the father's in providing for the children more and better quality food, clothing, clean water and sanitation. All these reduce the incidence of malnutrition as well as respiratory and diarrhoeal diseases which are major killers in the early years of life.

2. Informal education should also be stepped up through programmes such as mobile film and slide shows and relevant Television programmes. Emphasis should be on the benefits of good pre-natal and ante-natal care, especially in places poorly endowed with health services and facilities for formal education. The ministries of Health, Education, Culture and Social Services should establish departments which should co-ordinate and oversee the efficiency of such

programmes.

3. In view of the ever-increasing cost of formal education, among other aspects of life, the government should consider apportioning an even larger share of the national budget towards the financing of education. This would lessen the burden currently pushed over to parents and in turn more would afford to educate their children to higher levels.

4. Child survival is of equal importance to both parents. The curriculum planners in the Ministry of Education should develop a curriculum to be incorporated in the biological sciences specifically based on pre-natal and ante-natal care. This should be taught both at primary and secondary levels to both sexes. This would hopefully reduce infant and child mortality even among drop-out parents as they would have been taught, at least, the basic information required to successfully rear their young ones through these delicate years.

5. The National Council for Population and Development should step up its campaign for small family units. Couples should be advised to keep to a maximum of three children irrespective of sex. The council should recruit more field staff to augment the information system which today is heavily dependent on the radio. The field staff should work in conjunction with the provincial administration down to the village level.

6. Parents should play a leading role in guiding their

children morally. This should be able to guard the youth against early pregnancy before they are ready for it physically, mentally and economically.

7. The government in collaboration with the churches should strengthen Sunday Schools. The government through the provincial administration should ensure that all youths attend Sunday School. The government should also assist in providing physical infrastructure where it is lacking. As much as possible, facilities used for the usual school activities should be used. The church should provide the teaching personnel who besides teaching religious studies knowledge should also organise courses on how to be prepared for responsible and successful parenthood.

8. The practice of marrying of young girls is prevalent at the Coast. Efforts should be made to discourage this practice. The provincial administration, the church, formal school and the public media system should collaborate in this endeavour.

9. This study has documented that the married women experience relatively lower levels of infant and child mortality. Youths contemplating marriages should be advised by elders and through educational programmes both in schools as well as the church (especially the Islamic church) on the value of stable marital unions. Children in stable marital unions are well catered for both psychologically and material-wise than their counterparts from single, widowed or

divorced/separated parents. The former are therefore better cushioned against mortality risk factors.

10. This study has noted a strong positive relationship between endowment of educational, health, water and other general infrastructural facilities and mortality. These facilities should be expanded and improved. Emphasis should be on special pre-natal and ante-natal facilities and services in a bid to reduce the infant mortality rate which is quite high. More schools should be built, more affordable medical points should be opened and better roads be constructed to improve accessibility of patients to medical points in all areas. Kisauni division with very few of these facilities was found to have high infant and child mortality compared to Island division which is the best served of all the four divisions in Mombasa district. A combined effort of both government and local communities can be instrumental in improving the infrastructural network and hence lower mortality. The Ministry of Water Development should increase the number of clean water points in the entire district. The Taita-Taveta catchment zone should be a useful additional source of water for not only the residents of Mombasa town but also those of the neighbouring North and South coasts.

11. Like most tropical coastal regions, malaria is still a major threat to child survival in Mombasa. The ministries of Health and Education should intensify their anti-malarial campaign. Both curative and preventive measures should be

broadened and intensified in all the four divisions. Emphasis, however, should be on preventive measures such as availability of cheap netting facilities, clean environments through drainage of stagnant waters above the continental shelf and installing devices to attract, trap and kill mosquitoes in many areas.

5.4 Recommendations for further research

5.4.1 Introduction

This study cannot claim to have been an exhaustive analysis of the infant and child mortality situation in Mombasa district. The study was based on a few socio-economic, environmental and demographic factors. There is therefore need for future research to explore more factors and hence the following recommendations.

5.4.2 The recommendations

1. Research needs to be carried out to establish the effect of biological factors such as genetical diseases, post-partum ammenorrhoea and birth interval on infant and child mortality.
2. The role played by other environmental factors such as availability and use of toilet and housing facilities on infant and child mortality should be studied in detail.
3. There is need to investigate further the influence of socio-cultural aspects such as religion and traditional beliefs on infant and child mortality, especially their

effect on age at marriage, types of marital unions and child rearing practices such as breastfeeding duration.

4. Compared to other districts in the country, Mombasa district is fairly well served with health facilities but the mortality level is still comparatively high. There is need for future research to incorporate the question of usability of the available health resources and the contribution of such use to the mortality pattern of the district. The use of preventive services as immunization, malaria prophylaxis and general antenatal care needs to be analysed so as to explain their role in infant and child mortality.

5. The location of Mombasa exposes it to both immigrants as well as inmigrants. Future research should explore the influence of these two on the levels and trends of infant and child mortality over time.

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