ENVIRONMENTAL RISK AND SOCIO-ECONOMIC FACTORS INFLUENCING INFANT AND CHILD MORTALITY IN SIAYA DISTRICT: A CASE STUDY OF JERA SUB-LOCATION

BY

OUMA, FRANCIS ODUOR

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D E C L A R A T I O N

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

Signature: ....
FRANCIS ODUOR OUMA

This Thesis has been submitted for examination with our approval as University Supervisors.

Signature: 24/6/92
PROF. J.A.M. OTTIENO

Signature: ....
MR. B.O. KOYUGI

Population Studies and Research Institute, University of Nairobi,
P.O. BOX 30197,
NAIROBI.

D E D I C A T I O N

Dedicated to

My Father, Ouma Amuga,

my Mother, Alice Akinyi,

my Brothers (Onyango and Odhiambo) and Sisters (Atieno, Awuor, Awino, Apondi and Adhiambo).

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ABSTRACT

The study of infant and child mortality is important in that, its level can be used as a measure of social and economic development of an area. The infant/child mortality rate in Kenya has declined since independence, to less than 70 per 1000 live births. This country's rate aggregate masks wide variations across districts and among the divisions within a district. Such regional variations in infant and child mortality rates have been shown to be related to a number of social, economic, cultural and environmental characteristics of a given area. To specify such linkage we move in this study, from the district level analysis to the divisional and individual level in Siaya district, which is one of the three districts with the highest infant and child mortality in Kenya. The divisional data is derived from the 1979 census data and the individual data from a survey conducted in Jera Sub-location of Ukwala Division by interviewing 415 women aged between 15 and 49 and have given birth.

The objective of this study is to determine the socioeconomic and environmental risk factors among others which are associated with infant and child mortality at the divisional and individual level in Siaya District. The socioeconomic factors at the divisional level are maternal education, place of residence and marital status. At the individual level, the socioeconomic factors measured were maternal and paternal education; maternal labour

participation; religion; marital status; and the number of domestic animals. The environmental risk factors investigated are housing conditions; availability and use of a toilet; water source; cooking and lighting energy; and the concentration in the home. Apart from these two main factors, maternal and infant/child care from the time of conception to the early childhood such as quality of family nutrition; antenatal, natal and postnatal care; and immunization of children were investigated.

The measures used to estimate infant and child mortality at the divisional level are infant mortality rate, $_1q_0$; child mortality rate, $_1q_1$; probability of dying at age x, q(x); and the life expectancy at birth, e_0 . Trussell's technique for estimating child mortality was used to calculate q(x) and the other estimates were obtained from a life table which was constructed by the use of q(x) and the Coale-Demeny life tables. At the individual level the Preston and Trussell's (1982) technique of estimating infant and child mortality index was used to determine the mortality index of an individual woman.

The findings at the district is as expected, that is infant and child mortality rates are very high ($_1q_0$ = 173/1000 and q(2) = 208.8/1000) resulting in a life expectancy at birth of only 41.2 years. At the divisional level, infant and child mortality are still high although there are variations with Bondo Division having the lowest and Ukwala Division the highest while Yala Division had an advantage of Boro Division. An interesting finding at this level is observed in the time trends which shows a drastic decline in infant/child mortality between 1963 and 1967. After 1967, the mortality increased with no sign of decline although the increase was steady after 1975. The socioeconomic differentials revealed that infant and child mortality is inversely proportional to the level of mother's education. Urban residents had a lower infant and child mortality rates than the rural except in Bondo Divion while marital status showed that the single women have a low infant and child mortality rates followed by married, divorced/separated and finally the widowed. At the individual level, all the hypothesized relationships were confirmed. The stepwise regression analysis reveals that place of cooking, father's occupation and maternal education have a significant effect on infant and child mortality at a level of 0.05. At 0.1 level of significance, place of cooking; father's occupation; maternal education; source of cooking energy; age at which supplementary food is introduced and visits to antenatal care significant effect on infant and child mortality.

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CHAPTER 1

GENERAL INTRODUCTION

1.1 STATEMENT OF THE PROBLEM

The level of infant and child mortality which is a sensitive index, not only of the health services of a country or an area but also of the social and economic development have shown a considerable decline at the national level. According to the previous studies, infant mortality declined from over 160 per 1000 live births for period preceding 1958, to about 110 for the period 1958 - 1967 to 94 for the 1968 - 1976 to 87 in 1979 at the national level (Mott, 1979). The level was approximated to be 72 per 1000 live births in 1988 (UN World Population Chart, 1988) and 60 per 1000 live births (Kenya Demographic and Health Survey,KDHS 1989). Although a marked decline has been observed at the national level, this relatively low country-level rate conceals very large variations among the 42 districts of Kenya as shown by Kibet (1982) and Kichamu (1986). They found that the probability of dying at age 2 varies from a low value of 49 per 1000 live births in Nyeri to a very high value of 216 per 1000 live births in South Nyanza. Siaya District is also classified as having very high infant and child mortality. According to the studies on infant and child mortality using the 1979 census data, the probability of dying at age 2, q(2), in Siaya District was 195 per 1000 live births and a life expectancy at birth of 40.24 years in 1979 (Kichamu, 1986). Only two districts, namely Kilifi and South Nyanza with q(2) values of 196 and 202 deaths per 1000 live births respectively outranked Siaya District. Such a heavy loss of human life in the first year and early childhood of life and the associated enormous human suffering, bring out the urgency of improving our understanding of the determinants of infant and child mortality and identifying the factors associated with infant and child mortality.

The purpose of this study is, therefore, to determine the factors that influence infant and child mortality at the divisional and micro-level (individual level) so that effective strategies for improving the health and survival of the child can be identified and appropriate policy measures taken.

The study concentrates on the socioeconomic and environmental determinants that affect the mortality at the divisional and individual level. The high levels of infant and child mortality in Siaya District and Western Kenya as a whole have been attributed to environmental factors. The available evidence indicates that most of the determinants of infant and child deaths in the region are preventable. The implication of this is that, improvement on water and sanitation; and other related environmental conditions can play a significant role in mortality decline. It has been asserted that the prevalence of malaria in this region contribute largely to infant and child mortality (Kibet, 1981; Koyugi, 1982).

1.2 BACKGROUND OF THE STUDY AREA.

Siaya District which is the third largest district in Nyanza Province after South Nyanza and Kisumu covers an area of 3,528 sq. km out of which about 1,005 sq. km. are under water in the lakes Kanyaboli and Victoria and extends from latitude 0^0 13' south to 0^0 18' north and longitude 33^0 58' east to 34^0 33' east. It is bordered by Busia District to the north, Kakamega District to the north-east, Kisumu to the south-east and South Nyanza across the Winam Gulf to the south. To the west lies Lake Victoria.(Fig. 1).

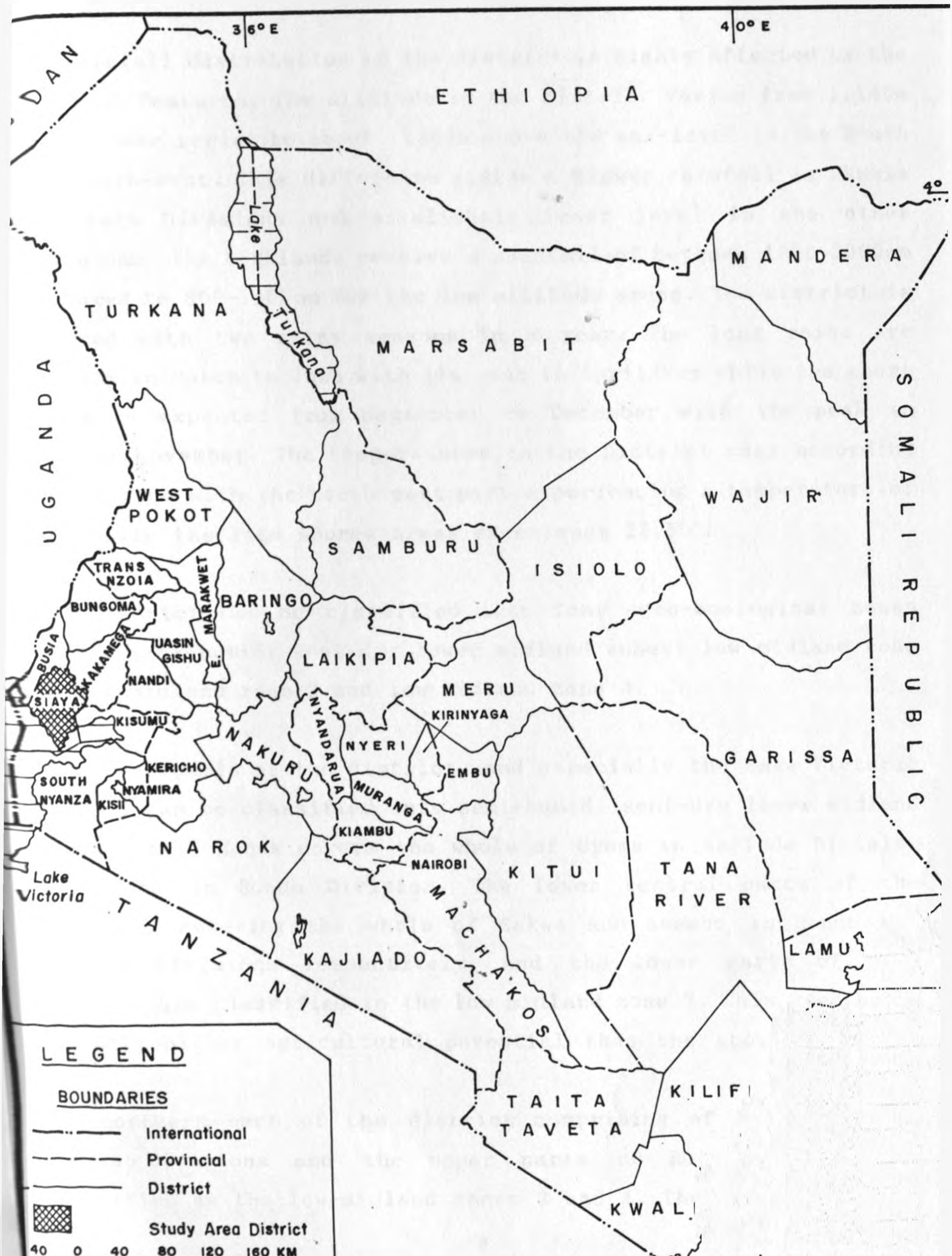

Fig. 1 : LOCATION OF STUDY AREA IN KENYA

The rainfall distribution in the district is highly affected by the physical features. The altitude in the district varies from 1,140m in the lake region to about 1,300m above the sea-level in the South and South-west. This difference yields a higher rainfall in Ukwala and Yala Divisions and a slightly lower level in the other divisions. The highlands receive a rainfall of between 1800-2000mm compared to 800-1600mm for the low altitude areas. The district is blessed with two rainy seasons in a year. The long rains are usually in March to June with its peak in April/May while the short rains is expected from September to December with its peak in October/November. The temperatures in the District vary according to altitude with the North-east part experiencing a temperature of 21^0C while the lake shores areas experience 22.5^0C.

The District can be classified into four agro-ecological zones namely semi-humid, semi-dry lower midland zones; low midland zone 1; low midland zone 2 and low midland zone 3.

The lower parts of the district, and especially the Lake Victoria shores, can be classified into semi-humid, semi-dry lower midland zones. These zones covers the whole of Uyoma in Rarieda Division and Yimbo in Bondo Division. The lower central parts of the district, covering the whole of Sakwa and Asembo in Bondo and Rarieda Divisions respectively, and the lower parts of Boro Division are classified in the low midland zone 3. This area has a slightly higher agricultural potential than the above mentioned area.
The northern part of the district comprising of both Yala and Ukwala Divisions and the upper parts of Boro Division are classified as the low-midland zones 2 and 1. These are sub-humid

and humid zones and the moisture availability is high and crops like sugar-cane, coffee and maize tend to do well in these zones (Fig 2).

Administratively, as in 1979, the district comprised of four divisions, namely Bondo, Yala, Boro, and Ukwala. Presently it is divided into 6 Divisions namely Bondo, Rarieda, Yala, Boro, Ukwala and Ugunja. Rarienda and Ugunja have been carved from Bondo and Ukwala respectively in the recent past.(Fig. 3).

Demographically, the district has reported a medium population growth of between 3.1% and 3.3%. In 1969 the district had a population of 382,710 persons and in 1979 the population increased to 474,516 persons. According to the projection the current population is estimated to be 783,553. The district had a population density of 188 persons per sq. km in 1979. Ukwala Division had the highest population density with a figure ranging between 202 to 277 persons per sq. km. followed by Yala, then Boro and finally Bondo Division having the lowest with only 143 persons per sq. km. (Table 1.1).

TABLE 1.1:

Population Distribution by Division, 1969- 1979.('000)

Division	1969	1979	% increase	Area(sq.km)*	pop. density 1979(persons/sq.km)
Total	382.8	474.5	24.0	2521	188
Bondo	114.4	140.3	22.6	957	143
Boro	91.9	117.8	28.2	613	192
Ukwala	99.8	122.4	22.6	526	232
Yala	76.7	94.0	22.6	407	231

* Area used here is the total area less that under water, i.e. area of inhabitable land only.

Source: Siaya District Development Plan 1984/1988 pg 8.

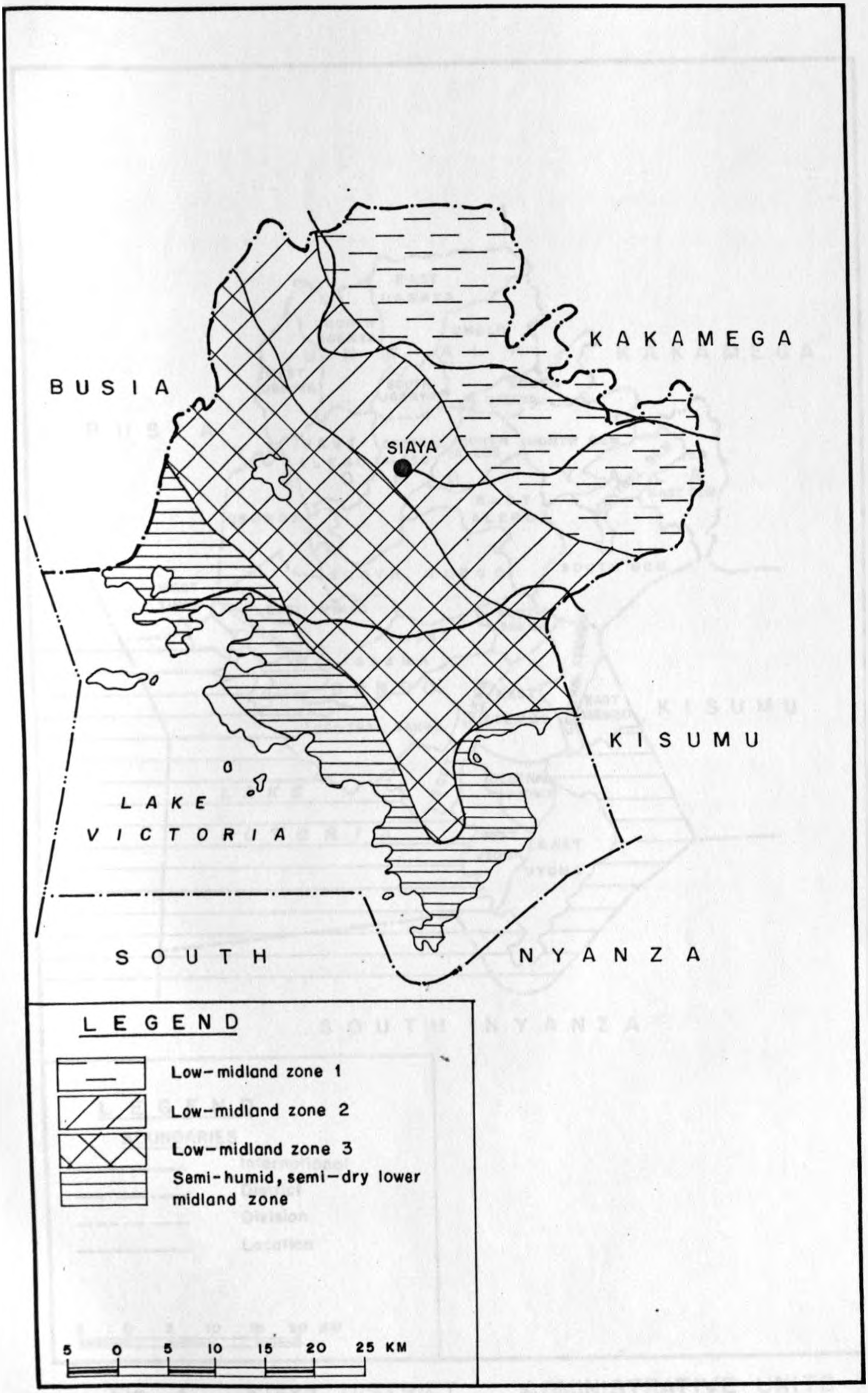

Fig. 2 : SIAYA DISTRICT : SIMPLIFIED AGRO-ECOLOGICAL ZONES

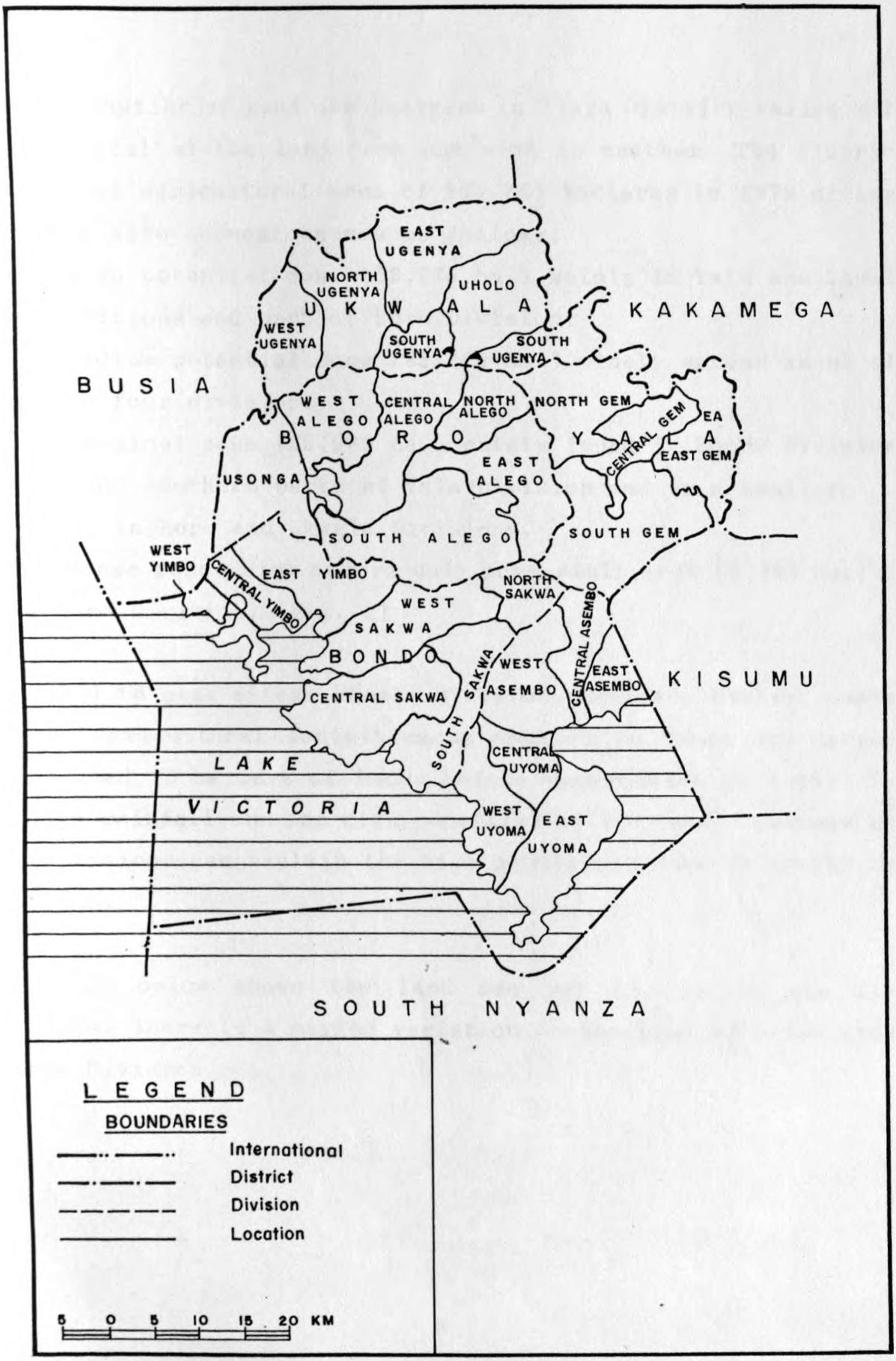

Fig. 3 : SIAYA DISTRICT : ADMINISTRATIVE UNITS

The distribution of land use patterns in Siaya District varies with the potential of the land from one area to another. The District had a total agricultural area of 164,263 hectares in 1979 divided into four agro-economic zones as follows:

(a) High potential zone (52,275 ha.) mainly in Yala and Ukwala Divisions and part of Boro Division.

(b) Medium potential zone (82,220 ha.) widely spread among all the four divisions

(c) Marginal zone (25,980 ha.) mainly found in Bondo Division and the southern parts of Yala Division and to a smaller extent in Boro and Ukwala Divisions.

(d) Range zone which covers only some small area (5,788 ha.) in Boro Division. (Fig. 2)

Yala and to some extent Ukwala Division, depict a higher use of land on agricultural activities as opposed to Bondo and Rarieda (which used to be part of Bondo before demarcation in 1988). The adequate rainfall and the high potential of the land in Ukwala and Yala Divisions can explain the high population density in the two Divisions.

Table 1.2 below shows the land use per sq. km in the five Divisions. There is a marked variation on the type of crops grown in each Division.

TABLE 1.2

Land Use Patterns By Division in Siaya (Hectares)

Division	Agric area (sq.km)	maize	sugar	grazing	fallow	bush	cassava
Ukwala	525	6040	1270	20310	8180	1940	4880
Boro	612	8500	0	20790	6690	4180	4350
Yala	406	6650	1030	18950	5100	1660	1480
Rarieda	398	5620	0	13050	10850	2350	750
Bondo	574	3930	0	12290	18290	12020	380
Total	2515	30740	2300	85390	49110	22150	11840

Source: Siaya District Development Plan 1989/1993 pg 8.

TABLE 1.2 cont.

Division	woodlot	cotton	sorghum	bareground	swamp	hedge
Ukwala	200	0	0	1180	250	3550
Boro	390	430	270	1810	7330	3490
Yala	190	590	170	500	0	1950
Rarieda	0	2,170	1070	970	0	1460
Bondo	90	670	1580	1360	5340	1240
Total	870	3,860	3,090	5,640	12,920	11,690

Source: Siaya District Development Plan 1989/1993 pg 9.

Ukwala and Yala Divisions have a substantial area of their land covered with sugarcane plantation while other Divisions had zero hectares under this cash crop. Cotton is another cash crop that is unevenly distributed among the Divisions in the District. Rarieda (which was part of Bondo Division in 1979) have the largest area under cotton followed by Bondo, Yala, Boro respectively while Ukwala Division had none. Cassava which is very resistant to ecological changes covers a substantial area in Ukwala and Boro Divisions. Ukwala has the highest area with 4,880 hectares while Bondo had only 1,130 hectares. Maize also covers a substantial area in the District with each Division having over 6,000 hectares.

A large area of Bondo Division is still covered by bush. This has the implication that there is still enough land and crop rotation can be carried out to ensure high productivity unlike other

Divisions.

Siaya District exhibits unbalanced physical and social infrastructural facilities such as roads, electricity, water, postal office and telephone services, schools, health institutions and social halls. These facilities have been found to be inversely related to infant and child mortality.

Most of the roads in the district are in poor condition especially during the rainy seasons. Table 1.3 shows the road distribution in the district in 1983.

TABLE 1.3

Road Distribution in the Divisions of Siaya District in 1983.

Division	Classified Bitumen Roads (km)	Classified Gravel/Earth Roads (km)	Unclassified R.A.R Roads (km)	Unclassified School Access Roads (km)
Bondo	48.8	399.2	69.3	172.2
Boro	21.0	235.4	59.0	77.8
Yala	51.4	167.3	37.2	57.4
Ukwala	20.6	233.7	56.0	65.7
Total	141.8	1035.6	221.5	373.1

Source: Siaya District Development Plan 1984/1988

From Table 1.3, we can see that Yala and Bondo Divisions had more than double the length of all weather roads (bitumen roads) compared to that of Boro and Ukwala Divisions. However, Bondo Division had the longest classified gravel/earth roads which can also be used to a certain extent during the rainy seasons. On the contrary, Yala Division which has the longest classified bitumen roads, lags behind in all the other types of roads. If we consider the total length of road then Bondo is better off than the other Divisions. Yala Division have the shortest length with Boro having a slight advantage over Ukwala (Fig 4).

Fig. 4 : SIAYA DISTRICT : COMMUNICATION NETWORK

Considering the health facilities in the district, we find that there is only a total of 41 health institutions serving a population of 713,312 persons as of 1988. This gives a ratio of 17,398 persons per health institution showing a very heavy dependence in a district where both mortality and morbidity is high.

According to the present District Health Profile, the district is covered by 8 doctors, paramedical staff of various cadres working within one hospital. In addition the district has 13 health centres, 27 dispensaries, several private clinics and a few NGOs operated clinics. It should further be noted that the above facilities are poorly staffed, equipped and most of them are over-utilized.

Few of these rural facilities are service delivery points, while outreach services from these health centres are irregular and serves less than 1/4 of the targeted population (i.e. the population under 5 years). This partly contributes to the high infant and child mortality rate.

TABLE 1.4

Distribution of Health Facilities in the District: 1984-1988

Division	1984			1988		
	Hosp.	dispensary	health centre	Hosp.	dispensary	h/centre
Boro	1	7	0	1	8	1
Ukwala	0	7	2	0	6	3
Bondo	0	4	1	0	6	2
Rarieda	0	4	1	0	4	1
Yala	0	4	3	0	3	6
Total	1	26	7	1	27	13

Source: Siaya District Development Plan 1989/1993

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Total	1	26	7	1	27	13

Source: Siaya District Development Plan 1989/1993

Looking at the above distribution of the health facilities in 1984 we can conclude that there is an even distribution of health facilities in the district (Table 1.4). Boro Division had one hospital (District Hospital) and 7 dispensaries. Bondo Division (Bondo and Rarieda combined) had 8 dispensaries and 2 health centres, Yala had 4 dispensaries and 3 health centres while Ukwala had 7 dispensaries and 2 health centres (Fig.5). There was an increase in the number of dispensaries and health centres in the District.

Although there is an even distribution of health facilities (structures), the availability of staff and medicine in this area are expected to vary with the distance between each health facility and the district hospital from which the drugs are supplied. The distance between a health facility and a supplying point is further aggravated by poor conditions of roads and lack of adequate funds allocated for fuel and maintenance of the existing vehicles. Most of the medical staff are stationed at the district hospital and the other health facilities are in most cases headed by only a clinical officer assisted by one or two nurses.

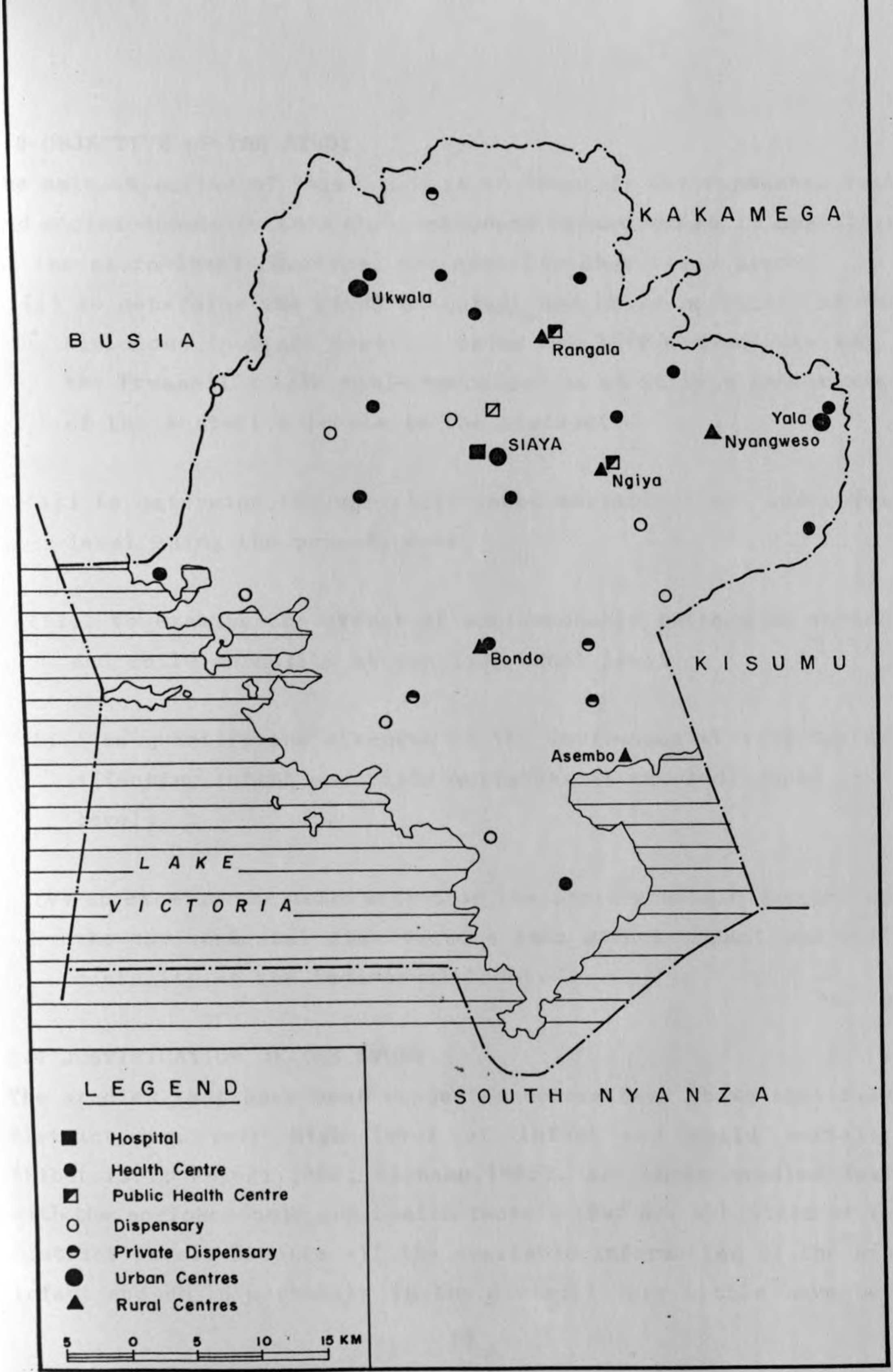

Fig. 5 : SIAYA DISTRICT : HEALTH FACILITIES

.3 OBJECTIVE OF THE STUDY

he main objective of this study is to identify environmental risk nd socioeconomic factors that influence infant and child mortality t the micro-level. However, the specific objectives are:-

(i) to determine the level of infant and child mortality of the Divisions in Siaya District using the 1979 census data and the Trussell's life table technique so as to have an overview of the mortality levels in the District.

(ii) to determine the mortality index mortality at individual level using the primary data.

(iii) to examine the effect of socioeconomic factors on infant and child mortality at the individual level.

(iv) to quantify the strength of the environmental risk factors affecting infant and child mortality at the individual level.

(v) to examine the interaction of the socio-economic factors and the environmental risk factors that affect infant and child mortality at the individual level.

1.4 JUSTIFICATION OF THE STUDY

The studies that have been conducted before have shown that Siaya District has very high level of infant and child mortality (Kibet,1981; Koyugi,1982; Kichamu,1986). All these studies dealt with the socioeconomic and health factors that are exhibited at the District level. Despite all the available information of the high infant and child mortality in the district very little have been done at micro level to determine the impact of socioeconomic development on the health care and environmental risk factors; taking into consideration that a high proportion of the district's population is under age 5, a group which is more sensitive to the environmental hazards than adults.

This high infant and child mortality at the district level provides a natural laboratory for investigating the correlates of infant and child mortality at the lower administrative levels such as at the Divisions and finally at the individual level, since an individual determines the overall infant and child mortality level. The micro-level study area (Jera Sub-location) was chosen from Ukwala Division which as shown in chapter II had the highest infant and child mortality among all the divisions in the district.

Apart from the above, studies of mortality differentials are useful in at least three ways, namely:-

(i) they provide information for assessing inequalities among people with respect to longevity and health;

(ii) data on mortality differentials help to identify those underprivileged segments of the population hence appropriate policies and programmes for improving health conditions and survival can be introduced in those areas; and

(iii) Studies of mortality differentials would improve our understanding of the determinants of mortality and their inter-relationships, on basis of which proper policy measures for reducing mortality can be developed, selected and improved.

1.5 LIMITATION AND SCOPE

There are several limitations that have hindered the easy collection and accurate analysis of the field data. The 1979 census data which is one of our data source reported massive underreporting in Nyanza Province. This coupled with misreporting of age, children ever born and children dead due to memory lapse and cultural beliefs affect the accuracy of the results obtained. The tabulations that were available for this census lack some of the important variables such as availability of clean drinking water; toilet facilities and type of housing, that can be used to explain the mortality differentials obtained in the district.

Lack of adequate time and money allocated for fieldwork only enabled us to collect a small sample from only one division in Siaya District. Jera Sub-location for which a sample of 415 women were taken lies in Ukwala Division which showed a high infant and child mortality among the divisions in the district.

Another limitation is that, some of the household variables such as number of cows owned by one or type of housing in which one lives may be recent phenomena and might not bear any relation with infant and child mortality history. This means that some of the household characteristics that are indicated now might not have been there at the time the woman experienced a child death. Since mortality is a lifetime measure, we can expect some errors in trying to explain the mortality conditions of the past with the present household variables. For this reason analyses has been carried out for the lifetime and the recent (last five years) mortality experience.

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1.6 LITERATURE REVIEW

Since the second World War, most of the developing countries have been experiencing dramatic decrease in mortality levels. The general consensus of opinion is that this decrease has been mainly due to macro factors, such as improved medical technology, disease control, and increased availability of medical facilities.

Stolnitz (1974) estimated that disease control programs alone may reduce mortality to a level sufficient to raise the expectation of life at birth to about 50-55 years. He based this assessment on a review of the experience of countries for which reasonable complete vital registration data were available.

With respect to Latin America, Arriaga in 1970 expressed similar views. Thus in his study of the mortality trends between 1930 and 1960 he concluded that, "public health programmes are no longer dependent on a country's economy but rather, to a large degree on technology and concern of the most advanced countries in the world". -

Preston (1976) while studying causes of death concludes that factors other than social and economic development - notably health measures could be credited with about one-half of the 18-year increase in developing world life expectancy between 1935-40 and 1965-70.

The level of maternal education has been found to be a very important socio-economic determinant of infant and child mortality (Caldwell,1979; Preston,1978; Kitagawa and Hauser,1973).
Caldwell,1979, established a strong correlation between the levels

of women education and survivorship of their children in Yoruba, Nigeria. He presented an argument to show why female education in Nigeria might have an impact on infant and child mortality. It was suggested that schooling was more important than the content of schooling in that both the recipient and others saw the mother as changed - that is she is free from the constraints of traditional culture. A young mother with education is allowed to seize a greater share of personal initiative in treating sick children by non-traditional methods, and in controlling the family's drinking water and toilet arrangements. Perhaps, more importantly she can move to reallocate relative care given to each member of the family and the family's internal distribution of food both by volume and type. She can also manipulate the modern world better by ensuring that her children have access to health services, and insisting that medical personnel should take action without undue delay. Caldwell went further and calculated life expectancies at different levels of education, he found that life expectancy at birth are 49 years for families of mother's with no schooling, 57 for those with only primary schooling and 65 for those with some secondary education.(Caldwell,1978:Table 3).

Palloni (1981), undertaking an analysis of infant and child mortality differentials among Latin American countries, noted the strong influence of the level of literacy and eating high-protein foods - such as chicken and eggs - which in India. Kerala state had the lowest infant mortality rate than any other state, although it ranks only 7th in per capita product (out of 15 states) and last in per capita calorie consumption. Its mortality advantage is maintained in both rural and urban areas but is exceptionally large in rural areas. The experience in Kerala is reviewed by the United Nation (1975, chapter x), which concludes that "the most important single factor to which the better levels of health in Kerala could be attributed might well be the spread and accessibility of medical care in the state" (p133). In a similar study it was found that in Indonesia the infant mortality rate varied from a high value of 160 per 1000 live births for urban women with no schooling to a low value of 47 per 1000 for urban women with upper secondary education.

Gwatkin (1980) using regression analysis of education and mortality data, estimates that a rise in adult literacy from 50% to 90% would be expected to be accompanied by a fall in infant mortality rate of 15% greater over the next 20 years than if no literacy improvements were seen.

Diaz - Briquents (1978), accounting for mortality situation in Cuba concluded that between 1958 and 1973, a modest expansion in hospital beds per capita of 13% was achieved but more important was a deconcentration such that the percentage of beds in the Province of Havana declined from 63% to 44% of the total. Rural facilities were distinctly upgraded, particularly through an expansion of clinics. The water supply system was tremendously improved and illiteracy has been virtually eliminated. Educational campaigns have been widely utilized in support of vaccination efforts and personal hygiene improvements. Between 1953 and 1970, life expectancy at birth rose from 58.8 to 70.2 years.

Thomas W. Merrick (1970), studying the effect of piped water on early childhood mortality in urban Brazil found a strong correlation between poor nutrition and environmental factors and concluded that children who were undernourished after birth were also more susceptible to infections associated with unsafe water, poor sanitation and inadequate housing.

Isenman (1978) found that the widespread decrease of mortality in Sri Lanka was due to the wide population coverage achieved through primary health care facilities staffed by paramedics and with increased number of clinics and hospitals. The eradication of malaria and the improvement in the provision of safe drinking water and sewerage services which mainly benefited those living in towns, the estates and the prosperous classes in rural areas had a major impact on mortality. He has also cited an extensive food rationing system which varied between two to four pounds per week per capita as a major contributor to the low mortality.

Katende (1983) in her study of the housing conditions on mortality in Bushenyi District in Uganda found that the poorer the housing condition the higher the mortality. The children born in the temporary houses had higher mortality than those in a semi-permanent and permanent houses. The temporary class is mainly dominated by the uneducated who are usually very careless about such details like drinking clean water, washing hands before eating etc and the supply of good toilet facilities was again found to be most defective among the temporary class dwellers.

In most developing countries, environmental factors like; housing, sanitation, weather; and scarcity of medical care, have been mentioned to be highly responsible for prevalence of diseases.

Gwendoline (1965) while stressing the importance of public health, attributed the high mortality levels amongst infants in Africa to poor environmental status. She suggested the campaign against diseases through the availability of piped water system and environmental sanitation such as wastage and sewerage disposal.

Diarrhoea and vomiting are the commonest diseases of children in developing countries particularly in highly overcrowded areas and those places with poor sanitation accompanied by an increase of bottle-feeding in dirty containers. In most of the rural areas these diseases are due to malnutrition which means that children have low resistance to infection(ibid 1982).

Bourgeois-Pichat (1952) highlighted the differences in the relative importance of "endogenous" and "exogenous" causes of infant mortality in different countries. Exogenous causes of infant mortality relate mainly to the environment and include deaths due to infectious, parasitic or respiratory diseases. Endogenous causes, on the other hand, form a "hard core" and include deaths due to congenital malformations, circumstances of prenatal life and the birth process. Exogenous causes predominate in the post-neonatal phase, whereas most deaths in the early neonatal period are mainly the result of endogenous causes.

Meegama (1980) while studying the socioeconomic determinants of infant and child mortality in Sri Lanka found that high post-neonatal and child mortality were due to respiratory diseases and from the diarrhoea-malnutrition syndrome. He also found that the death rates during the entire period of childhood are very high in households which have no toilet facilities. The death rate was even high in households with the cesspit type of latrine.

Malnutrition and infectious diseases were found to be the major causes of death in the 1-4 age group in Ghana. Omran (1970, p47) observed, among other things, that "... when children are weaned the available diet becomes inadequate without the mother's milk " and that " ...this is also aggravated by occurrence of weaning diarrhoea which is a malnutrition diarrhoea that is responsible for high fatality in the second year of life".
The incidence of malnutrition is highest between ages 2-5 when there is close birth interval and very little food to supplement after weaning.

Kielmann and McCord (1977) stated that when infant mortality rate is high, say above 120, neonatal tetanus, malaria, diarrhoea, and childhood infections account for a majority of deaths. Simple and effective public health measures such as vaccination and vector control oral rehydration offer direct means to reduce these causes of death. Further reduction in infant mortality rate, say from 120 to 70, seem to require improved prenatal and postnatal care, access to safe water, simple curative intervention such as early treatment for pneumonia.

Beyond these basic primary health services, it appears that changes of a more general societal kind such as improved education, employment, housing and particular measures to insure good prenatal and infant nutrition are required to reduce infant mortality rate towards 40.

Wyon and Gordon (1971) while studying Khanna population problems in rural Punjab found that the risk of infection was directly proportional to family size in Punjabi population due to the sharing of small quantities of available food for the family

The risk of infection was observed more in families that favour children of one sex over the other. In these families differential care leading to differential male-female mortality rates is common. In this study it was found that the female death rate was 74 per 1000 per year and that for males was 50 in the first five years of life since males received more food and medical care than females.

Stan D'Souza and Lincoln Chen (1980) in a study in Bangladesh found that male mortality exceeds female only at the neonatal period, thereafter female mortality exceeds male mortality by increasing amounts upto 3 years when female death rates are 46 to 53% higher than corresponding male rates. The ratio declines in fourth year of life.

Malaria has been found to be a major cause of death in the third world countries. Giglioli (1978) considers that the eradication of malaria reduced neonatal mortality (by improving the mother's health) and mortality from anaemia in women in Guyana. During the first period (1937-46), reported deaths caused by malaria represented 12% of all deaths; the crude death rate (CDR) was about 17.4 per 1000 live births and the malaria death rate about 2.0 per 1000 live births. Malaria deaths decreased rapidly during the period of DDT application (1947-50). From the first (1937-46) to the third (1951-58) period, the CDR decreased by about 8.8 per 1000 live births.

Mata (1978a,1982) found that improvement of nutritional status contributed to a decline in diarrhoeal disease in Costa Rica. Diarrhoea is associated with nutrient wastage and stunting. Furthermore, diarrhoea may be accompanied by dehydration and these, with or without underlying chronic malnutrition, may result in death if not treated. The strong correlation between diarrhoeal disease deaths and infant mortality in Costa Rica suggests that it was a strong cause of death in that age group. If the environment is unsanitary and personal hygiene is poor, and if this is compounded by minor seasonal fluctuations as in the tropics, then dissemination of diarrhoea agents and opportunities for their acquisition by infants and small children are optimized.

John (1973) found that causes of death varied, depending on the state of the standard of living, the environment, public health measures and the demographic structure of the country under study. He found that in developing countries, due to poor environmental conditions and few health personnel, the major causes of death were infective and parasitic diseases followed by perinatal and respiratory diseases.

Preston (1980) estimated the effect of the elimination of a given cause or group of causes on longevity. At the level of mortality corresponding to female life expectancy at birth of 45 years, elimination of maternal mortality would raise life expectancy by 0.5 years; and elimination of the infectious and parasitic diseases would add about 6 years to the average life expectancy. Averting diarrheal diseases and respiratory diseases(influenza, pneumonia, bronchitis) would add 2.8 and 4.8 years respectively. If all the above five groups of diseases which causes death were eliminated, interaction effects would raise the combined gain in life expectancy at birth by 16.5 years. He also suggested that household living standards have played and will continue to play an important role in mortality level. The control of morbidity and mortality from a broad array of causes will depend on environmental sanitation (water supply and sewerage in particular).

ayne (1976) and Fontaine (1978) in their study of the impact of malaria on mortality found that with spraying, infant mortality reduced from 157 per 1000 to 93 per 1000 (40.8%) in Kisumu in 1973/74 and 1974/75 and CDR reduced from 23.9 to 12.3 per 1000 (48.5%).

Pull and Grab (1974) also found that infant mortality was greatly reduced by specific protection against malaria in places like Kisumu (Kenya) and Garki (Nigeria).

Anker and Knowles (1977) and Kibet (1981) correlated infant and child mortality with urban population, female literacy, malaria cases, kilometres of roads, population density and number of beds per 1000 population using 1969 census and 1979 census respectively. Anker and Knowles measured the infant and child mortality by considering the life expectancy at birth e_0 while Kibet used the probability of dying at age 2, q(2). Both of them used Brass estimation technique to obtain their levels. Using multiple regression, Kibet found that malaria and mother's education were the two major factors affecting child mortality.

Kichamu (1986), while studying the mortality differentials in Kenya using the Trussell's technique found that infant and child mortality levels are lowest in the highlands and highest in the Lake basin and coastal strip which are malaria-infested areas.

Mott (1982), using Kenya Fertility Survey data found that infant mortality in Kenya varied by their parity and could be reduced by a decline in fertility. Infant mortality was found to be high for the first birth and higher parities. The decline in fertility would allow women to start childbearing at late ages and stop much earlier with enough birth spacing.

Bunyasi (1984), while studying the seasonality and patterns of causes of death in Kenya found that the three leading groups of diseases which cause death are :-infective and parasitic diseases, diseases of respiratory system and circulatory diseases. He further found that (using multiply regression analysis) environmental factors (rainfall; relative humidity; temperature; and morbidity) influenced mortality to a certain extent. The three causes were responsible for 55% of the total deaths.

Ndede (1988), while studying infant and child mortality differentials among the divisions in South Nyanza found that the divisions that border Lake Victoria (Macalder and Ndhiwa) had a higher infant and child mortality than those far away from the lake shore (Kehancha and Kendu). He attributed the high infant and child mortality in the district to the environmental factors such as prevalence of malaria, bilharzia, sleeping sickness and measles.

Munala (1988) did a similar study in Kakamega District and found that Mumias Division had the highest infant and child mortality in the district. He suggested that the high infant and child mortality in Mumias Division could be as a result of malnutrition brought about by abandoning the food crops in favour of sugarcane.

Omurundo (1989) while studying fertility and infant/child mortality in Western Province found that Hakati Division that borders Lake Victoria experienced the highest infant and child mortality in the district.

Nyokangi (1984) found that the elimination of infective and parasitic diseases that are related to unhygienic environment would increase the life expectancy at birth more than the elimination of other diseases. The elimination of these diseases could add 7.88 years for males and 9.48 years for females while elimination of respiratory diseases would increase the life expectancy by 4.56 for males and 6.92 for females.

1.7 THEORETICAL FRAMEWORK

The present study borrows ideas from the literature cited above and develops a theoretical model which gives socio-economic and environmental interpretation to infant and child mortality by examining the process in the context of the changes that have occurred and continue to occur at both micro and macro level.

One such model that combines both socio-economic and environmental risk factors among other variables in explaining infant and child death is the Mosley and Chen model. By neglecting to look at specific environmental risk variables which cause death, the mechanisms by which the socio-economic variables operate to produce observed levels of mortality are unknown and mortality is still largely unexplained.

The proximate determinants framework defines a set of intermediate (biological) variables through which all social and economic determinants operate to influence infant and child health and survival.

Mosley and Chen have given five such variables as:-

(i) Maternal factors (e.g. pattern of family formation, birth orders, maternal age and the birth spacing),

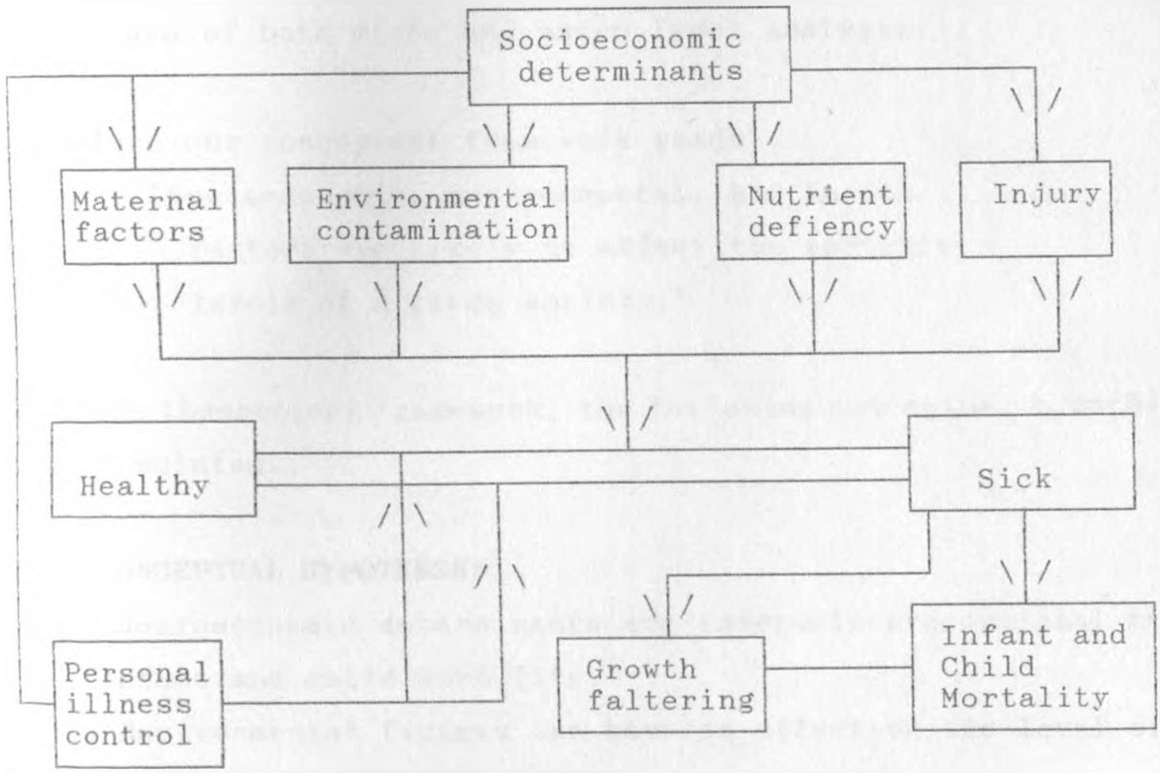
(ii) Environmental Contamination (exposure to diseases),

(iii) Personal illness control (this may operate to diminish morbidity through behaviours that limit exposure and susceptibility or to diminish case fatality through curative measures),

(iv) Nutritional inputs,

(v) Accidental injury.

Broadly all socio-economic and environmental determinants can be shown to operate through one or more intermediate variables resulting in morbidity, which may be transitory or which results in a permanent residual effect which is cumulative along survivors and/or which ultimately can lead to death.



Source: Mosely and Chen 1984.

The main short-coming of Mosley and Chen model is that it does not indicate the level (macro or micro) in which it is to be applied, i.e. whether it applies to both infant/child mortality at individual (micro) or at community (macro) level.

Since infant and child mortality levels depend on the socio-economic development of an individual, it is important to determine its influence at this level. The general argument in this study is that the macro level infant and child mortality rates that are observed at the Divisions, District, Province and National level are as a result of the influence of socio-economic factors at the individual level.

In using the Mosley and Chen model in this study we assume that it takes care of both micro and macro level analysis.

Therefore our conceptual framework reads:

> "Socioeconomic, environmental, and health factors are likely to affect the mortality levels of a given society."

From the theoretical framework, the following conceptual hypotheses are formulated.

1.8 CONCEPTUAL HYPOTHESES

(i) Socioeconomic determinants are inversely proportional to infant and child mortality;

(ii) Environmental factors can have an effect on the level of infant and child mortality;

(iii) Health factors are likely to affect infant and child mortality.

1.9 DEFINITION OF CONCEPTS

The definition of these concepts only apply to this study. They can be defined in a much wider scope depending on the data available.

1.9.1 Determinants of mortality- A determinant of mortality can be defined as a variable that would change a population's mortality level if its own value were altered.

1.9.2 Socioeconomic determinants

These include maternal and paternal education and their occupations, mariatl status, religion, ownership of transistor radio and ownership of domestic animals.

1.9.3 Health determinants

These include visits to antenatal clinic, place of delivery, immunization, duration of breast-feeding, age at which supplementary food are introduced, type of treatment accorded to the sick infant/child.

1.9.4 Environmental determinants

These include housing conditions, sanitation, water source & treatment, number of houses in the compound, source of lighting & cooking energy, place of cooking,and place where animals are kept.

1.9.5 Infant mortality

Deaths of children aged between 0-1 year.

1.9.6 Child mortality

In this study, child mortality refers to deaths of children aged between 1 and 5 years.

.10 OPERATIONAL HYPOTHESES

The following operational hypotheses can be formulated from the onceptual hypotheses;

(i) The level of mother's education is negatively related to infant and child death,

(ii) The level of father's education is negatively related to infant and child death,

(iii) The mother's work status can have an influence on infant and child death,

(iv) The father's work status is negatively related to infant and child death,

(v) Marital status of the mother can have an influence on infant and child death,

(vi) The religious affiliation have an effect on infant and child death,

(vii) Ownership of a transistor radio have an effect on infant and child death

(viii) Ownership of domestic animals is negatively related to infant and child death.

(ix) Visits to antenatal clinic have a negative influence on infant and child death.

(x) Place of delivery have a negative influence on infant and child death.

(xi) Immunization is negatively related to infant and child death.

(xii) Duration of breast-feeding is negatively related to infant and child death.

(xiii) Age at which supplementary food are introduced can have an influence on infant and child death.

(xiv) Type of treatment accorded to the sick infant/child can influence infant and child death.

(xv) Number of houses can have an influence on infant and child death.

(xvi) Source of cooking and lighting energy can have an influence on infant and child death.

(xvii) Housing condition is negatively related to infant and child death,

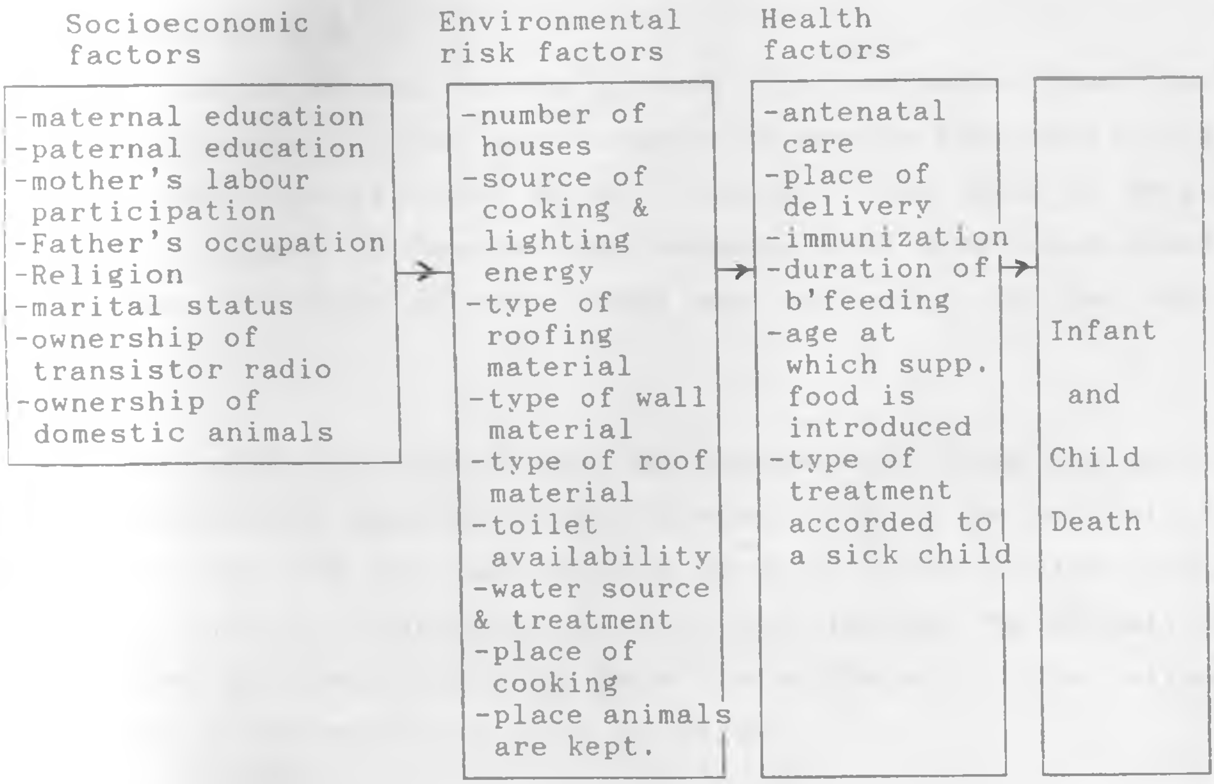
(xviii) Availability of toilets is likely to affect infant and child death,

(xix) The availability of clean drinking water is negatively related to infant and child death,

(xx) Place where domestic animals are kept can have an influence on infant and child death.

(xxi) Place where cooking takes place have an influence on infant and child death.

Operational Model



1.11 VARIABLES

INDEPENDENT VARIABLES	DEPENDENT VARIABLES-
Education; occupation; religious affiliation; marital status; ownership of a transitor radio; number of domestic animals; age at which supplementary food is introduced; visits to antenatal clinic; Duration of breast-feeding; immunization status; place of delivery; treatment accorded to a sick child; housing condition; sanitation; water source and & treatment; number of houses in the compound.	Infant and Child Death

1.12 SOURCE OF DATA

The main source of data is the primary data collected from Jera sub-location using a coded questionnaire. Since the sub-location is large we used the villages as our clusters. From each of these clusters a sample of females aged between 15-49 were interviewed at random. A sample of 415 women was collected in the sub-location.

The second source of data is the 1979 census data. From this data, we used the female population aged between 15-49 in an interval of five, children ever born and children dead to calculate the level of infant and child mortality at Divisional levels. The mortality level found in Ukwala Division, where the sub-location lies, gives a picture of the mortality level in 1979.

CHAPTER 2

MORTALITY DIFFERENTIALS BY DIVISIONS IN SIAYA DISTRICT

2.1 INTRODUCTION

In this chapter, our main focus will be on methodology of analyzing the mortality level in Siaya District using the 1979 census data and Trussell's technique and the mortality differentials in the district. The analysis involves calculating the infant and child mortality levels and the life expectancy at birth for the Divisions in the District. These measures are also calculated for different socioeconomic factors such as education, type of residence and marital status.

The level of Education has been categorized into three groups namely none, primary and secondary plus. Type of residence is categorized into rural and urban while marital status is split into single, married, divorced/separated and widowed.

2.2 METHODOLOGY OF DATA ANALYSIS

Trussell's Technique

In calculating the estimates of infant and child mortality in the District, we used Trussell's technique for estimating child mortality, an extension of Brass child mortality technique. Brass was the first to develop a procedure for converting proportions of children dead and children ever born reported by women in age groups 15-19, 20-24, etc into estimates of the probability of dying before attaining a given exact childhood age. He developed a set of multipliers to convert observed values of the proportion dead among children ever born, D(i), into estimates of q(x). The multipliers are selected according to the value of P(1)/P(2)- a good indicator of fertility conditions at young ages- where P(i) is the average parity or average number of children ever born reported by women in age group i. Trussell improved the Brass technique by introducing a set of multipliers by the same means but using data generated from the model fertility schedules developed by Coale and Trussell.

This technique requires children ever born (CEB) and children dead (CD) classified by the age of mother. We also require the female population(FPOP) classified by the five year age-groups. The probability of dying at age x is given by the formula

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

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

while

i = 1,2,3,4,5,6,and 7 representing the age groups 15-19, 20-24,........,45-49.

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

where a(i), b(i) and c(i) are Trussell's coefficients for estimating child mortality.

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

and

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

for age group i.

An important assumption made in the development of this method is that the risk of dying of a child is a function only of the age of the child and not of other factors, such as mother's age or the child's birth order.

2.3. CALCULATION OF q(x) VALUE.

The probability of dying at age x, q(x), which is a measure of infant and child mortality developed by Brass and improved by Trussell requires the following data:-

(i) the number of children ever born, classified by five year age groups.

(ii) the number of children surviving (or the number dead) classified by five year age group of mother.

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

<u>Computational Procedure</u>

We first calculate the average parity per woman P(i) where i = 1,2,3,...,7 and P(1) is the parity for women aged 15-19 and P(2) for women aged 20-24 etc.

In general

$$P(i) = CEB(i)/FPOP(i) \quad .... (2.1)$$

where CEB(i) is the number of children ever born in age group i and FPOP(i) is the number of women in the ith age group irrespective of their marital status.

The second step is to calculate the proportion of children dead for each age group of mother. The proportion of children dead, D(i), is defined as the ratio of reported dead to reported children ever born, that is

$$D(i) = CD(i)/CEB(i) .... (2.2)$$

where CD(i) is the reported number of children dead in the ith age group and CEB(i) is the number of children ever born in the ith age group.

The third step is to calculate the multipliers. The values used to calculate the multipliers are shown below.

TABLE 2.1

COEFFICIENTS FOR ESTIMATION OF CHILD MORTALITY MULTIPLIERS WHEN DATA IS CLASSIFIED BY AGE OF MOTHER, WEST MODEL.

Age group	i	a(i)	b(i)	c(i)
15-19	1	1.1415	-2.707	0.7663
20-24	2	1.2563	-0.5381	-0.2637
25-29	3	1.1851	0.0633	-0.4177
30-34	4	1.1720	0.2341	-0.4272
35-39	5	1.1865	0.3080	-0.4452
40-44	6	1.1746	0.3314	-0.4537
45-49	7	1.1639	0.3190	-0.4435

The multipliers denoted by K(i) is obtained by

K(i) = a(i) + b(i)* P(1)/P(2) + c(i)* P(2)/P(3)............(2.3)

where a(i), b(i) and c(i) are constant coefficients in the ith age group and P(1), P(2) and P(3) are average parities for age groups 15-19, 20-24 and 25-29 respectively.

The fourth step is to calculate the probability of dying denoted by q(x). This is obtained by multiplying K(i) by D(i), i.e.

q(x) = K(i)*D(i)...............................(2.4)

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

Applying the above procedure on the 1979 census data for Siaya District, we obtain

TABLE 2.2

FEMALE POPULATION, CHILDREN EVER BORN, CHILDREN DEAD, PROPORTION DEAD, PROBABILITY OF DYING AT AGE x AND THE MULTIPLIERS OF SIAYA DISTRICT.

i	FPOP(i)	CEB(i)	CD(i)	P(i)	D(i)	K(i)	q(x)
1	26802	10607	1824	0.395754	0.171961	1.047394	.180112
2	19244	39935	8270	2.075192	0.207086	1.008413	.208828
3	17004	64055	15228	3.767054	0.237733	0.967069	.229904
4	14468	78802	22109	5.446640	0.280563	0.981308	.275319
5	12536	80055	24760	6.386008	0.309287	0.999986	.309283
6	13209	90180	30649	6.827163	0.339864	0.987866	.335740
7	12675	86447	32868	6.820276	0.380209	0.980420	.372765

P(1)/P(2) = 0.190707 P(2)/P(3) = 0.550879

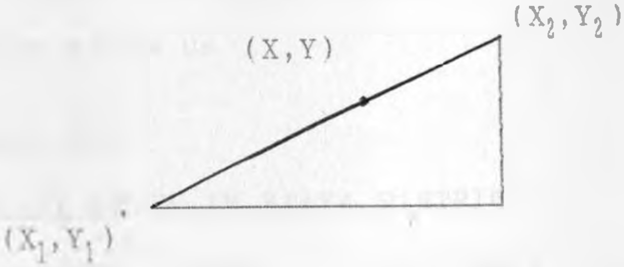
Trussell's method helps us to measure infant and child mortality in terms of q(x). However, other measures such as infant mortality rate, $_1q_0$; child mortality rate, $_4q_1$; and life expectancy at birth, e_0 can also be used. This measures are functions of life tables. To construct a life table, Trussell's, q(x), values will help us to construct the life table.

2.4 CONSTRUCTION OF LIFE TABLE

A life table is a statistical model used to measure mortality (or diminishing rate) of a hypothetical population. It can be used to estimate the infant and child mortality rate and the life expectancy at birth which is used as a measure of the mortality level of a given society. The first step in constructing a life table is to calculate the mortality levels corresponding to the values of q(x) obtained above.

Calculation of mortality levels

The calculation of mortality levels involves the use of linear interpolation. Given two points (X_1, Y_1) and (X_2, Y_2), if a point (X, Y) lies in-between them then,



$$\frac{X_2 - X_1}{X - X_1} = \frac{Y_2 - Y_1}{Y - Y_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.5)$$

this implies that

$$X - X_1 = \frac{(Y - Y_1)*(X_2 - X_1)}{Y_2 - Y_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.5.1)$$

therefore

$$X = X_1 + \frac{(Y - Y_1)*(X_2 - X_1)}{Y_2 - Y_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.5.2)$$

Similarly

$$Y = Y_1 + \frac{(X - X_1)*(Y_2 - Y_1)}{X_2 - X_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.6)$$

If in equation 2.6 $X_2 - X_1 = 1$, then

$$Y = Y_1 + Y_2 * (X - X_1) - Y_1 * (X - X_1) \quad \ldots\ldots\ldots\ldots (2.6.1)$$

$$= (1 - (X - X_1)) * Y_1 + (X - X_1) * Y_2 \quad \ldots\ldots\ldots \quad (2.6.2)$$

In this analysis, $X = P(x)$;

X_1 = lower l(x);

X_2 = upper l(x);

Y = interpolated mortality level;

Y_1 = lower mortality level;

and Y_2 = upper mortality level.

Therefore the above data gives us

TABLE 2.3

CALCULATION OF MORTALITY LEVEL IN SIAYA DISTRICT

x	q(x)	p(x)	lower l(x)	upper l(x)	lower mort. level	interpolated mort.level
1	.180112	.819887	.80708	.82447	9	9.73652
2	.208828	.791171	.77972	.80019	10	10.55940
3	.229904	.770095	.75989	.78220	10	10.45743
5	.275319	.724680	.71176	.73733	9	9.505282
10	.309283	.690716	.68828	.71540	9	9.089853
15	.335740	.664259	.64184	.67119	8	8.763851
20	.372765	.627234	.61811	.64860	8	8.299259

i.e. interpolated mortality level $= 10 + \dfrac{.791191 - .77972}{.80019 - .77972}$

$= 10.55940$

The mean mortality level is given by

$(10.55940 + 10.45743 + 9.505282)/3$

$= 10.17404$

To construct a life table for Siaya District using mortality level 10.17404, we are required to determine l(x) and ${}_nL_x$.

TABLE 2.4

CALCULATION OF THE PROBABILITY OF DYING IN SIAYA DISTRICT

Age x	l(x) level 10	l(x) level 11	actual l(x)
0	1	1	1
1	0.82447	0.84080	0.827312
5	0.73733	0.76173	0.741576
10	0.71540	0.74139	0.719923
15	0.69937	0.72647	0.704086
20	0.67802	0.70642	0.682962
25	0.65032	0.68028	0.655534
30	0.62070	0.65222	0.626185
35	0.58844	0.62154	0.594200
40	0.55346	0.58800	0.559471
45	0.51521	0.55092	0.521424
50	0.47384	0.51015	0.480159
55	0.42442	0.46076	0.430744
60	0.36778	0.40311	0.373928
65	0.29891	0.33196	0.304662
70	0.22337	0.25212	0.228373
75+	0.14479	0.16699	0.148653

After getting the value of l_x, other values of the life table can be obtained as follows:-

${}_nP_x$ = the probability of surviving between age x and x+n

$$= \frac{l_{x+n}}{l_x} \quad \text{...} \quad (2.7)$$

${}_nd_x$ = number of persons who die between age x and x+n

$$= l_x - l_{x+n} \quad \text{...} \quad (2.8)$$

${}_nL_x$ = the number of persons years lived between age x and x+n where

$$ {}_1L_0 = 0.3*l_0 + 0.7*l_1 \quad \text{...........................} \quad (2.9)$$

$$ {}_4L_1 = 1.3*\ l_1 + 2.7*l_4 \quad \text{.........................} \quad (2.9.1)$$

$$ {}_5L_x = 5*(l_x + l_{x+5})/2 \quad \text{for } x= 5,10,15,...,\ 70. \quad \text{.....}(2.9.2)$$

$$ L_{75+} = l_{75+} * \ \log_{10} l_{75+} \quad \text{.....................} \quad (2.9.3)$$

T_x = the total person years lived from age x

$= T_{x+n} + {}_nL_x$ ....(2.10)

${}_nq_x$ = probability of dying between age x and x+n

$= 1 - {}_nP_x$ ....(2.11)

e_x = expectation of life at age x

$= \frac{T_x}{l_x}$ ....(2.12)

Therefore the life table for Siaya District is as follows:-

TABLE 2.5

LIFE TABLE FOR SIAYA DISTRICT.

Age x	${}_nq_x$	${}_nP_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	e_x
0	.172687	.827312	100000	17268.79	87911.84	4121095	41.20
1	.103631	.896368	82731.20	8573.55	307776.2	4033183	48.75
5	.029198	.970801	74157.65	2165.33	365374.9	3725407	50.24
10	.021997	.978002	71992.32	1583.68	356002.4	3360032	46.67
15	.030001	.969998	70408.64	2112.37	346762.3	3004030	42.66
20	.040161	.959838	68296.27	2742.85	334624.2	2657267	38.91
25	.044770	.955229	65553.42	2934.85	320429.9	2322643	35.43
30	.051079	.948920	62618.57	3198.50	305096.6	2002213	31.97
35	.058447	.941552	59420.07	3472.94	288418.0	1697116	28.56
40	.068004	.931995	55947.13	3804.64	270224.0	1408698	25.18
45	.079140	.920859	52142.49	4126.56	250396.0	1138474	21.83
50	.102913	.897086	48015.93	4941.48	227726.0	888078.7	18.50
55	.131901	.868098	43074.46	5681.58	201168.3	660352.7	15.33
60	.185240	.814759	37392.88	6926.68	169647.7	459184.3	12.28
65	.250403	.749596	30466.20	7628.84	133258.9	289536.6	9.50
70	.349076	.650923	22837.36	7972.00	94256.83	156277.7	6.84
75+	1	0	14865.36	14865.36	62020.93	62020.93	4.17

Using the same technique the mortality estimates at the divisional level can be calculated (Appendix 1).

The estimates to be used in analyzing the differentials are ${}_1q_0$ for the infant mortality; ${}_4q_1$ for the child mortality; q(2), q(3) and q(5) are the probability of dying at age 2,3 and 5 respectively and finally e_0 which is life expectancy at birth.

In Table 2.5, ${}_1q_0$ = 0.172687; ${}_4q_1$ = 0.103631 and e_0 =41.2.

2.5 THE MORTALITY ESTIMATES AT DIVISIONAL LEVEL

In this section we are going to look at the differential in infant mortality, $_1q_0$; child mortality, $_4q_1$; and life expectancy at birth, e_0 among the Divisions in Siaya District using the 1979 census data. To obtain these estimates, similar calculations as the one done above was carried out and a summary of the measures is given in Table 2.6. A detailed analysis at the divisional level is provided in the appendix.

TABLE 2.6

IMR, CHILD MORTALITY, PROBABILITY OF DYING AT AGE x, q(x), AND THE LIFE EXPECTANCY AT BIRTH IN DIVISIONS IN SIAYA DISTRICT.

	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Siaya	172.7	103.6	208.8	229.9	275.3	41.21
Bondo	157.7	92.9	192.7	212.9	245.7	43.43
Yala	167.1	100.0	204.4	221.4	266.7	41.96
Boro	179.8	108.7	218.9	234.9	282.4	40.20
Ukwala	190.4	116.2	234.0	251.3	300.2	38.74

The pattern is that, Bondo Division has the lowest infant and chil(mortality followed by Yala while Boro has an advantage over Ukwala The difference in infant mortality rate, $_1q_0$, between Bondo an(Ukwala Division is about 32.7 per 1000 live births which i approximately 20.7% . This difference is large enough and suggest that there is a significant differentials in factors determinin infant mortality in these divisions. A similar pattern is observe for the child mortality, $_4q_1$ although the difference between Bond and Ukwala is lower compared to that of their IMR. The differenc is 23.3 per 1000 live births which represents a percentag difference of 18.0%. Bondo and Yala Divisions also experience a lo infant and child mortality than the district's average value (Fig 6).

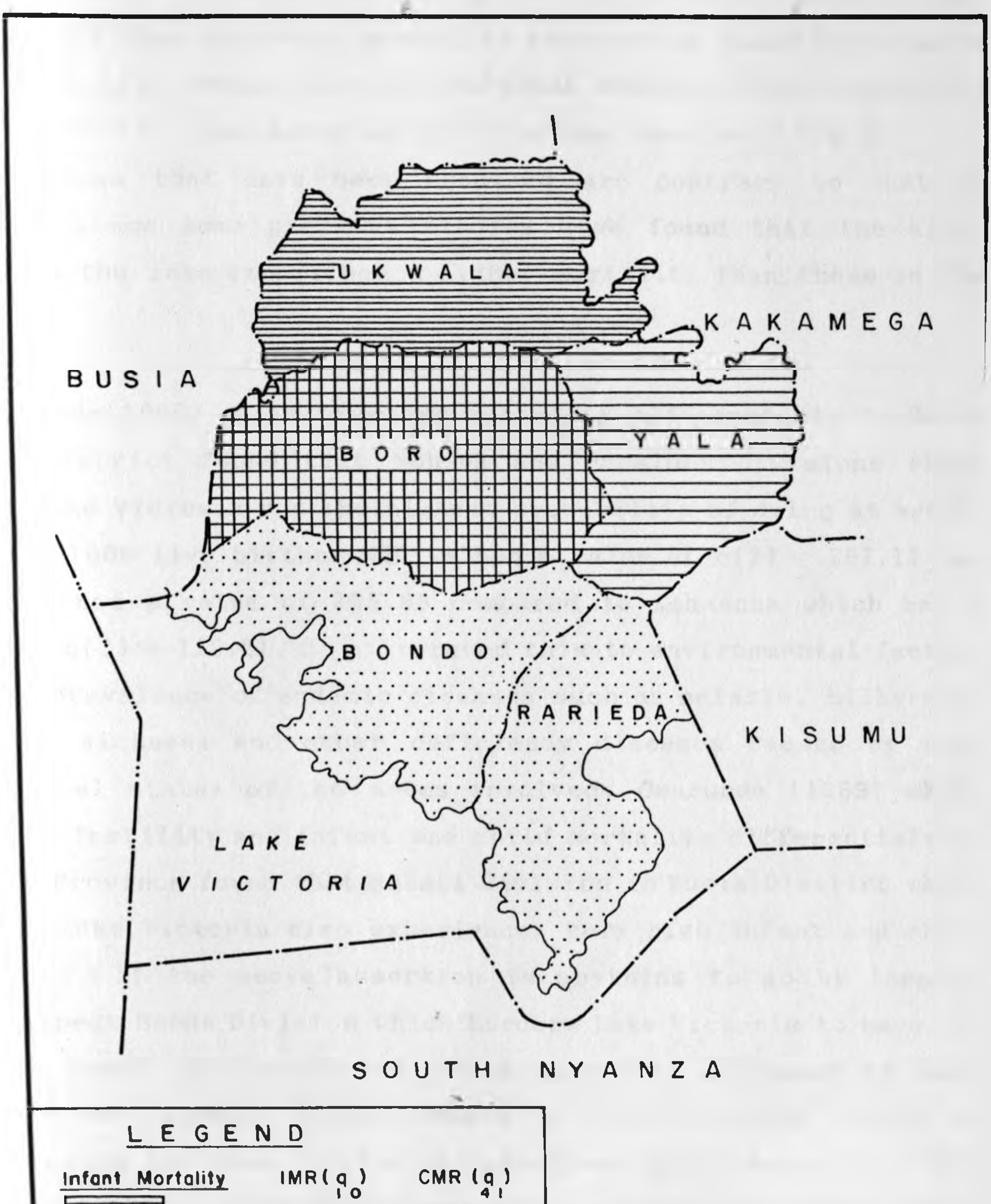


Fig. 6 : INFANT AND CHILD MORTALITY RATES BY DIVISIONS OF SIAYA DISTRICT, 1979

Although there is variations among the divisions in the district, the lowest infant and child mortality observed in Bondo Division is still very high compared to the national average. This results in a very low life expectancy at birth in the district (Fig 6).
The findings that have been obtained are contrary to what is expected since some previous studies have found that the areas nearer to the lake experience a higher mortality than those in the interior.

Owino Ndede(1988) while studying mortality differentials in South Nyanza District found that Ndhiwa and Macalder Divisions which border Lake Victoria had the highest probability of dying at age 2, q(2) per 1000 live births. Ndhiwa had a value of q(2) = 267.11 and Macalder had a value of 265.83 compared to Kehancha which had a value of q(2) = 112.21. He attributed this to environmental factors such as prevalence of endemic diseases such as malaria, bilharzia, sleeping sickness and other deficiency diseases caused by poor nutritional status of the areas involved. Omurundo (1989) while studying fertility and infant and child mortality differentials in Western Province found that Hakati Division in Busia District which borders Lake Victoria also experiences very high infant and child mortality. If the above assertion is anything to go by then we would expect Bondo Division which borders Lake Victoria to have the highest level of infant and child mortality followed by Boro Division and finally either Ukwala or Yala Division should be experiencing the lowest value of infant and child mortality. This shows that there are other factors that influence the levels shown in Table 2.6 which enable Bondo Division to have the lowest mortality.

This unexpected trend may be due to the different socio-economic development that exists in the district. From the introductory part of the study area it was observed that Ukwala Division had the highest population density of 232 persons per sq. km. followed by Yala then Boro and finally Bondo with only 143 persons per sq. km. This high concentration leads to environmental degradation resulting in low output of essential foods that are necessary for both the child and the mother's well-being. Lack of adequate essential food can lead to malnutrition which has diverse effect on infant and child mortality since the body's defence mechanism which protects the infant/child is likely to be weak. Another effect of high concentration is the ease at which communicable diseases such as measles, cholera, meningitis to mention but a few can be spread. Therefore, different population densities in the district could be a contributory factor to the high and low infant and child mortality in Ukwala and Bondo Division respectively.

Land use and agricultural potential in the District can also explain the variations in mortality levels. Ukwala and Yala Divisions fall in the high potential areas and would therefore be expected to have a lower infant and child mortality levels and yet this is not the case. The agricultural potential in these two Divisions can explain the high population density that is observed in this area.

We have also observed that Ukwala and Yala Divisions are the only Divisions with sugarcane plantations in the district. According to the previous studies, the sugar belt areas have shown higher mortality levels than the other regions. Munala (1988) found that Mumias Division which is predominantly covered with sugarcane plantation had the highest infant and child deaths in Kakamega District. Sugarcane plantation offers suitable breeding grounds for mosquitoes which increase the prevalence in malaria. Water borne diseases are also rampant in the sugar belt area since plantations are in most cases bushy and are likely to attract the residents to use them as toilets. The refuse is dumped into the water source during the rainy seasons. This increases the chance of infants and children to suffer from diarrhoea, worms and other water borne diseases. Sugarcane is a perennial cash crop (takes almost 2 years to be ready) and furthermore payment to the farmers takes a long time after delivery to the nearest sugar factory. It should also be noted that since sugarcane is the major cash crop grown in this region, other types of crops such as maize, beans, cassava to mention a few are abandoned by the people. Thus there is more concentration on cash crop other than food crops. Therefore due to the above mentioned fact, children from this area tend to suffer from malnutrition. Another factor which contributes to the high mortality in the sugar belt area is the prevalence of polygamous unions as men tend to use the 'Boom' to marry many wives. Polygamy thus becomes a contributory factor on infant and child mortality because the available resources have to be sub-divided among all these women. These factors attributed to sugarcane plantation can be contributing to the high infant and child mortality observed in Ukwala Division.

Cotton is another cash crop that is unevenly distributed in the district with Bondo Division having the largest area and Ukwala having no area under this cash crop. In Yala and Boro, cotton covers a small area compared to Bondo. This cash crop has no adverse effect on infant and child mortality as sugarcane. Its' advantages on the health contribution through economic well being of the household can help reduce the infant and child mortality in Bondo. Bondo Division has another advantage in that fishing is done in large scale compared to the other Divisions. This improves both the economic and nutrition status of the household which in turn reduces the infant and child mortality in the division.

The high infant and child mortality that is observed in Ukwala Division can also be attributed to the poor road network. Lack of proper communication network hinders accessibility to the scattered and often poorly equipped health facilities. According to Otieno D.S.O. (1989) the road linking Bondo Health Centre and Siaya District hospital cannot be used during rainy seasons hence forcing patients to be taken to Kisumu which is 59 Km. away for treatment. This proves to be very expensive for most people in the rural areas. During the rainy seasons, most roads are not accessible because they are not tarmacked and it is at this time that most of the water borne diseases are prevalent. The inaccessibility of this roads hinders the distribution of drugs to the health centres. Therefore the poor road network observed in Ukwala Division could be a contributory factor to the high infant and child mortality.

There is also a problem of distance between the health centres and the district hospital where the distribution of drugs and other treatment materials are carried out. Apart from Boro which houses the district hospital, Bondo sub-district hospital is nearer to Siaya town than the other Divisional headquarters. Kibet (1982) found that the distance from the hospital is inversely related to the mortality level. From this, Ukwala which is far away from the District Hospital is expected to have high levels of infant and child death taking into account that the drugs to the nearest dispensary or health centre have to be transported from the

District hospital that has very few vehicles which are also not properly maintained.

In conclusion it is interesting to note that Ukwala, Mumias and Hakati Division border each other. Munala (1988) and Omurundo (1989) found that Mumias and Hakati had the highest infant and child mortality in Kakamega and Busia District respectively. In this study Ukwala Division has shown a high infant and child mortality in Siaya District. These findings suggests that there are some factors apart from the socioeconomic development that affect infant and child mortality in these three bordering divisions.

2.6 CALCULATION OF REFERENCE PERIOD IN SIAYA DISTRICT.

Since mortality is not likely to have remained constant in Siaya District until 1979, it is useful to know the reference period, t(x), of each q(x) estimate. The values of the ratios P(1)/P(2) and P(2)/P(3) that are needed to estimate t(x) have already been computed in Table 2.2 above.

When mortality is changing smoothly, the reference period, t(x), is an estimate of the number of years before the survey date to which the child mortality estimates, q(x), obtained in the previous section refers. The value of t(x) is estimated using an equation whose coefficients are shown in Table 2.7 below:

TABLE 2.7

OEFFICIENTS FOR ESTIMATION OF THE REFERENCE PERIOD TO WHICH THE ALUES OF q(x) ESTIMATES FROM THE DATA CLASSIFIED BY AGE REFER.

ge grp.	i	Age x	q(x)	d(i)	e(i)	f(i)
5-19	1	1	q(1)	1.097	5.5628	1.9956
0-24	2	2	q(2)	1.3062	5.5677	0.2962
5-29	3	3	q(3)	1.5305	2.5528	4.8962
0-34	4	5	q(5)	1.9991	-2.4261	10.4282
5-39	5	10	q(10)	2.7632	-8.4065	16.1787
0-44	6	15	q(15)	4.3468	-13.2436	20.1990
5-49	7	20	q(20)	7.5242	-14.2013	20.0162

t(x) = d(i) + e(i)*P(1)/P(2) + f(i)*P(2)/P(3).

Using the coefficients in Table 2.7 we can calculate the reference period for Siaya District as follows.

TABLE 2.8

REFERENCE PERIOD FOR MORTALITY VALUES IN SIAYA DISTRICT

Age grp.	i	Age x	q(x)	Ref. period	Actual period
15-19	1	1	q(1)	1.097	1978.673
20-24	2	2	q(2)	1.3062	1977.200
25-29	3	3	q(3)	1.5305	1975.017
30-34	4	5	q(5)	1.9991	1972.450
35-39	5	10	q(10)	2.7632	1969.659
40-44	6	15	q(15)	4.3468	1966.762
45-49	7	20	q(20)	7.5242	1963.889

After obtaining the actual period we calculate the values of q(x) for all mortality levels obtained in Table 2.7 above. The values of q(x) for different mortality levels are shown in Tables 2.8.1-2.8.7 below.

TABLE 2.8.1

Determining q(x) Values for mortality level 9.736515.

x	l(x) for level 10	l(x) for level 9	actual l(x)	q(x)
1	.82447	.80708	.8198880	.1801120
2	.77972	.75813	.7740314	.2259686
3	.75989	.73645	.7537139	.2462861
5	.73733	.71176	.7305927	.2694073
10	.71540	.68828	.7082543	.2917457
15	.69937	.67119	.6919450	.3080550
20	.67802	.64860	.6702683	.3297317

TABLE 2.8.2

Determining q(x) Values for mortality level 10.55940.

x	l(x) for level 10	l(x) for level 11	actual l(x)	q(x)
1	.82447	.84080	.8336050	.1663950
2	.77972	.80019	.7911709	.2088291
3	.75989	.78220	.7723702	.2276298
5	.73733	.76173	.7509794	.2490206
10	.71540	.74139	.7299388	.2700612
15	.69937	.72647	.7145297	.2854703
20	.67802	.70642	.6939070	.3060930

TABLE 2.8.3

Determining q(x) Values for mortality level 10.45743.

x	l(x) for level 10	l(x) for level 11	actual l(x)	q(x)
1	.82447	.84080	.8319398	.1680602
2	.77972	.80019	.7890836	.2109164
3	.75989	.78220	.7700953	.2299047
5	.73733	.76173	.7484913	.2515087
10	.71540	.74139	.7272886	.2727114
15	.69937	.72647	.7117664	.2882336
20	.67802	.70642	.6910110	.3089890

TABLE 2.8.4

Determining q(x) Values for mortality level 9.505282.

x	l(x) for level 10	l(x) for level 9	actual l(x)	q(x)
1	.82447	.80708	.8158669	.1680602
2	.77972	.75813	.7690390	.2109164
3	.75989	.73645	.7482938	.2299047
5	.73733	.71176	.7246801	.2515087
10	.71540	.68828	.7019832	.2727114
15	.69937	.67119	.6854288	.2882336
20	.67802	.64860	.6634654	.3089890

TABLE 2.8.5

Determining q(x) Values for mortality level 9.089853.

x	l(x) for level 10	l(x) for level 9	actual l(x)	q(x)
1	.82447	.80708	.8086425	.19135745
2	.77972	.75813	.7600699	.2399301
3	.75989	.73645	.7385562	.2614438
5	.73733	.71176	.7140575	.2859425
10	.71540	.68828	.6907168	.3092832
15	.69937	.67119	.6737221	.3262779
20	.67802	.64860	.6512435	.3487565

TABLE 2.8.6

Determining q(x) Values for mortality level 8.763851

x	l(x) for level 9	l(x) for level 8	actual l(x)	q(x)
1	.80708	.78849	.8026900	.1973100
2	.75813	.73530	.7527387	.2472613
3	.73645	.71175	.7306171	.2693829
5	.71176	.68492	.7054218	.2945782
10	.68828	.65994	.6815875	.3184125
15	.67119	.64184	.6642590	.3357410
20	.64860	.61811	.6413888	.3586002

TABLE 2.8.7

Determining q(x) Values for mortality level 7.522536

x	l(x) for level 8	l(x) for level 7	actual l(x)	q(x)
1	.78849	.76856	.7789741	.2210259
2	.73530	.71111	.7237501	.2762499
3	.71175	.68566	.6992930	.3007070
5	.68492	.65669	.6714412	.3285588
10	.65994	.63030	.6457880	.3542120
15	.64184	.61125	.6272344	.3727656
20	.61811	.58646	.6029983	.3970017

TABLE 2.8.8

Time Trends for the probability of dying at age x, q(x)

Reference Period	TIME TRENDS q(1)	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)
1963.889	.180112	.225968	.246286	.269407	.291745	.308055	.329731
1966.762	.166394	.208829	.227629	.24902	.270061	.285470	.306093
1969.659	.168060	.210916	.229904	.251504	.272711	.288233	.308988
1972.450	.184133	.230960	.251706	.275319	.298016	.314571	.336534
1975.017	.191357	.23993	.261443	.285942	.309283	.326277	.348756
1977.20	.197310	.247261	.269382	.294578	.318412	.335740	.358600
1978.673	.221025	.276249	.300707	.328558	.354212	.372765	.397001

Note that the t(x) values imply that the estimates of q(1), q(2), q(3) and q(5) obtained above refer to mortality conditions prevalent approximately one year, two years, four and a half years,...., until 15 years before the census.

These time trends give useful information for the study of child mortality trends over time. The same procedure is used for the Divisions.

Figure 7 shows the graph of the probability of dying at age x, q(x), for x = 2, 3, and 5 against the approximate date of death in the District.

Figures 8, 9, 10 and 11 show the same graph for Bondo, Yala, Boro and Ukwala Division respectively. The graphs showed that there was a significant decline in infant and child mortality in Bondo and Yala Divisions while Ukwala and Boro showed negligible decline between 1963 and 1967. The probable reason for this trend can be explained by the socio-economic and socio-political development that took place in Bondo and Yala immediately after independence. For example, during this period, Bondo Division managed to get a health centre which is currently a sub-district hospital apart from other socio-economic development.

Between 1963 and 1979, the time trends shows that there were three sub-periods of socioeconomic and political changes in the district. Between 1963 and 1967, there was a drastic decline in infant and child mortality in the district and particularly in Bondo and Yala Divisions. Later between 1969 and 1975, infant and child mortality increased steadily. Between 1975 and 1979, the infant and child mortality was still high but more or less steady.

This decline in infant and child mortality was short-lived. Between 1967 and 1972 all the divisions in the district experienced a steady increase in infant and child mortality. In the subsequent years, the mortality somehow standardized, although it was still showing some signs of increase. This can suggest that the factors that contribute to infant and child survival in the district has been worsening or that the growing population have outstripped the improvement in social, economic, health and other contributing factors that affect infant and child mortality. Siaya District as a whole showed a slight decline in infant and child mortality between 1963 and 1967 and thereafter the mortality was on the increase with no sign of decline in the near future.

Figure 12 and 13 shows the probability of dying before age 2 and 5 respectively in the district. The figures show that in both cases Ukwala had the highest values of q(2) and q(5) while Bondo had the lowest except in 1966 when Yala showed the lowest q(2) and q(5) values.

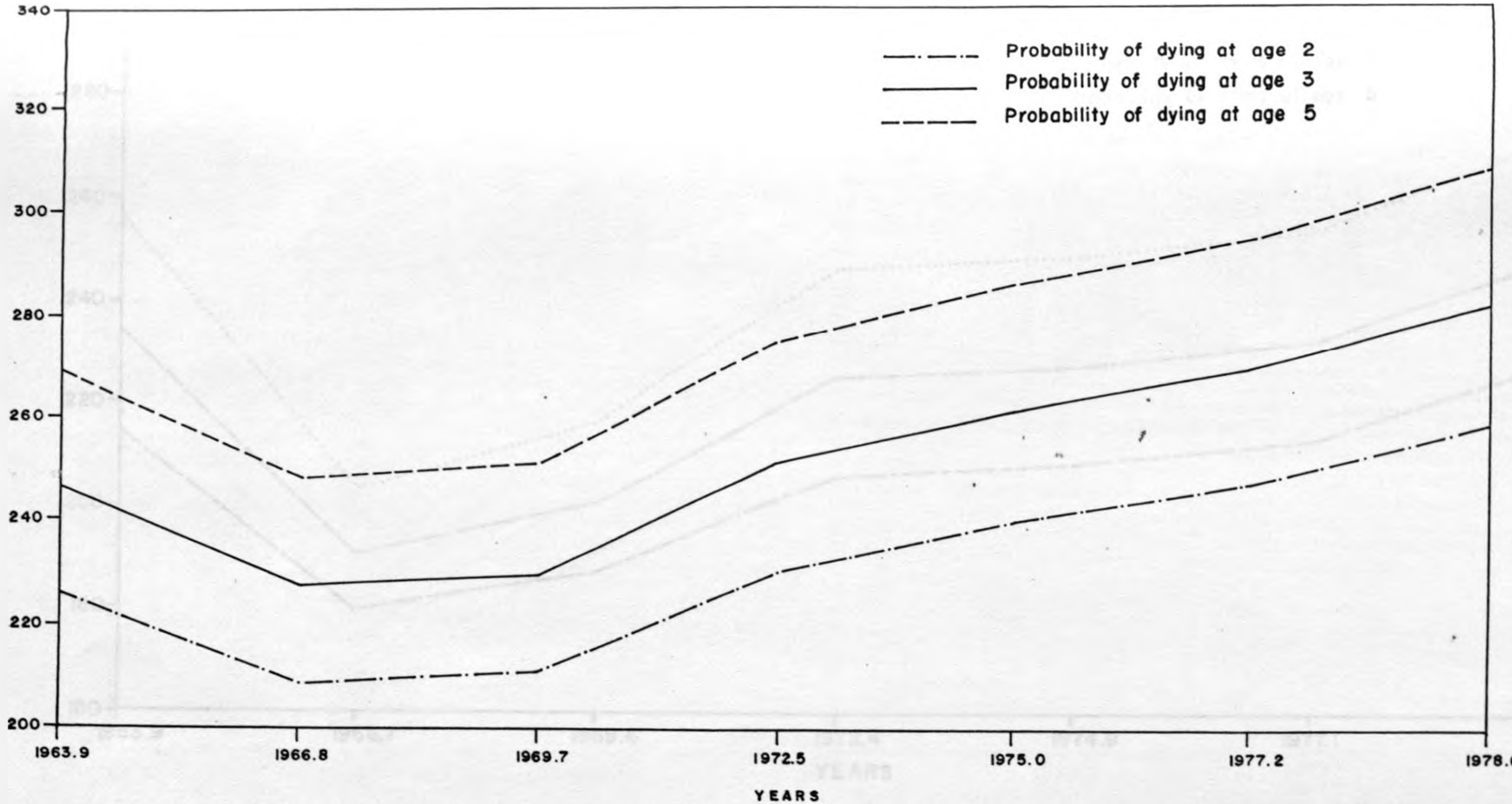


Fig. 7 : PROBABILITY OF DYING AT AGE 2,3,5, q(2), q(3), q(5), VERSUS REFERENCE TIME OF DEATH IN SIAYA DISTRICT

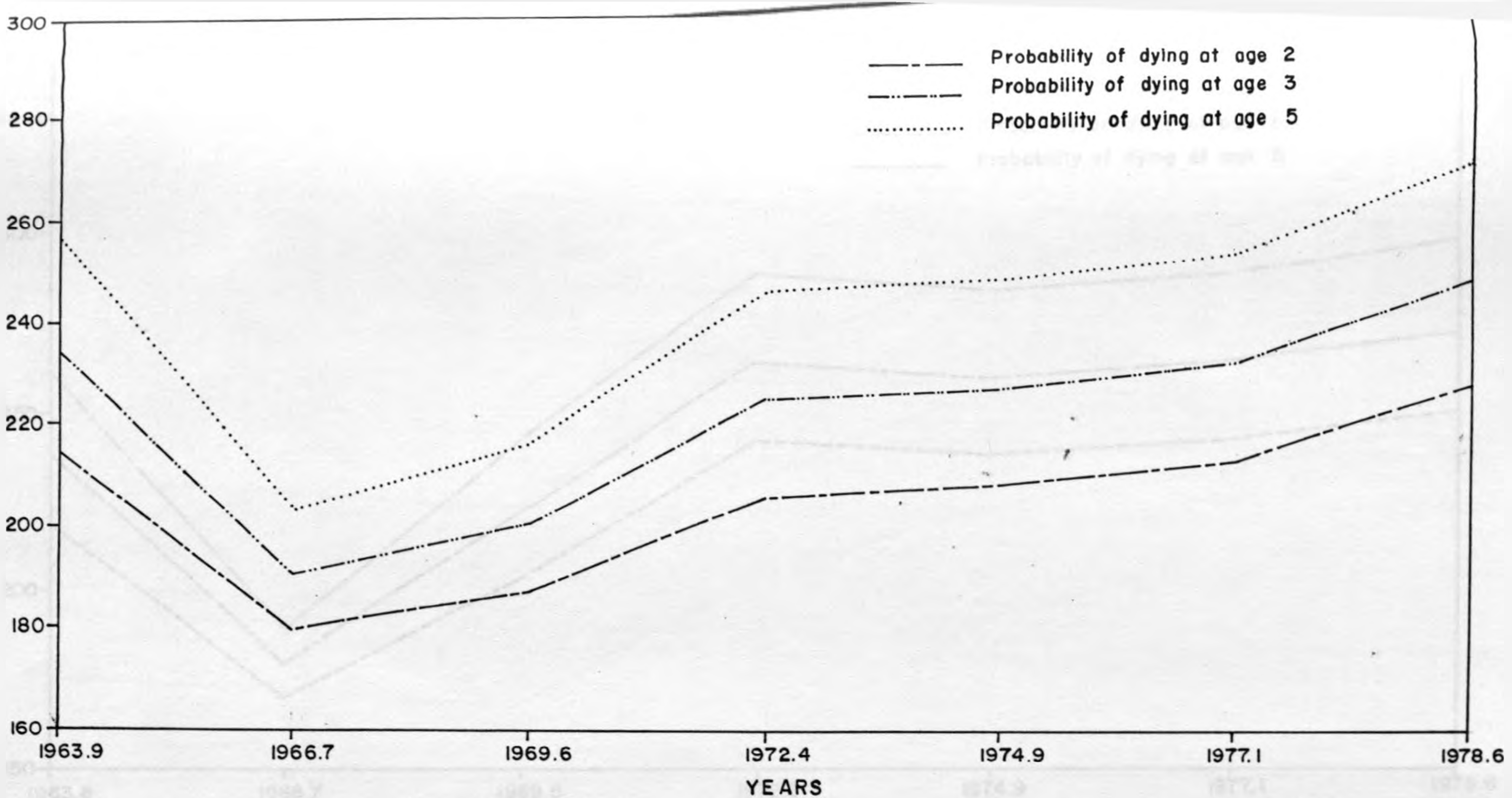


Fig. 8 : PROBABILITY OF DYING AT AGE 2,3,5 q(2), q(3), q(5), VERSUS REFERENCE TIME OF DEATH IN BONDO DIVISION

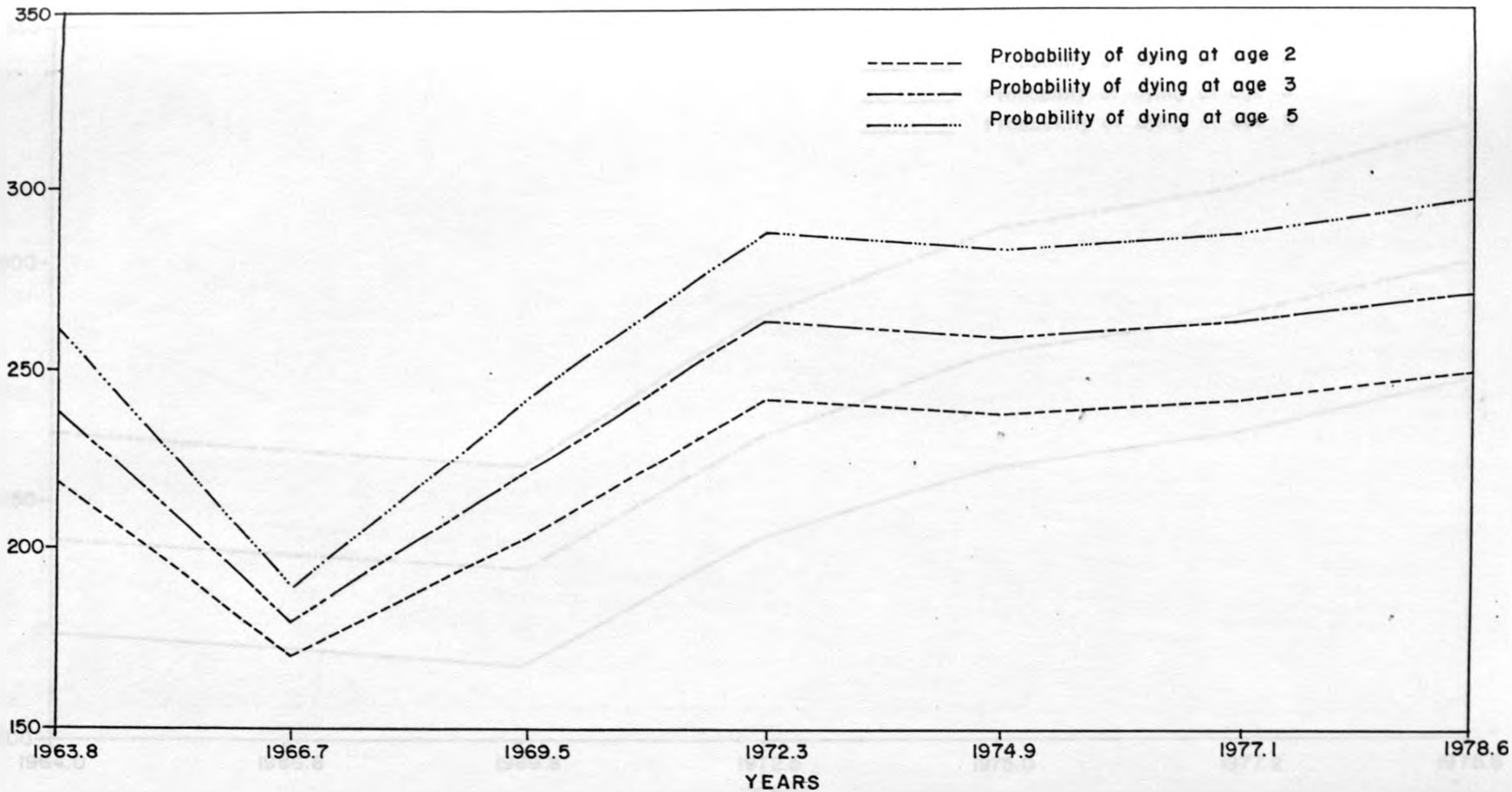


Fig. 9 : PROBABILITY OF DYING AT AGE 2,3,5, q(2), q(3), q(5), VERSUS REFERENCE TIME OF DEATH IN YALA DIVISION

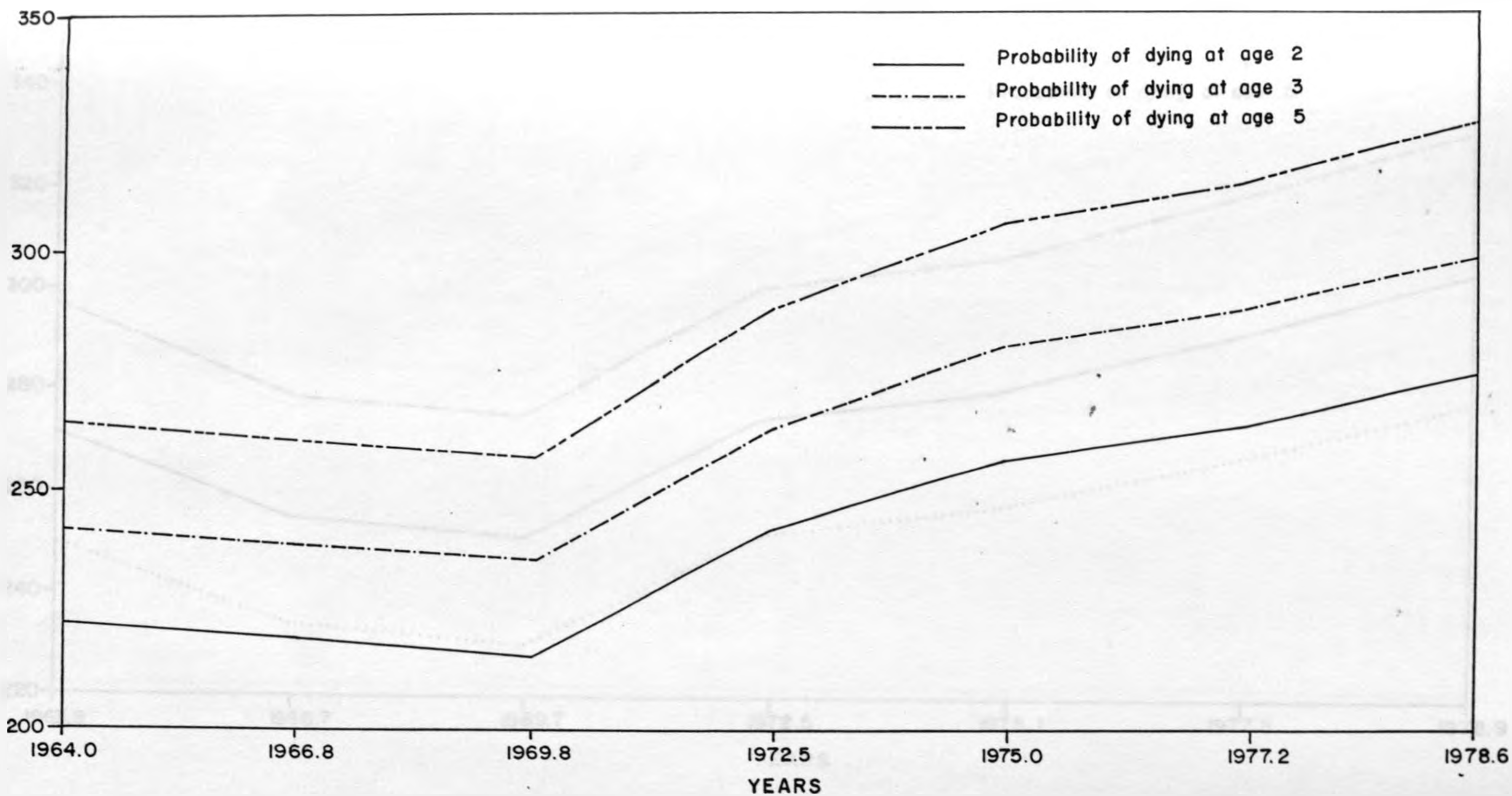


Fig. 10 : PROBABILITY OF DYING AT AGE 2,3,5, q(2), q(3), q(5), VERSUS REFERENCE TIME OF DEATH IN BORO DIVISION

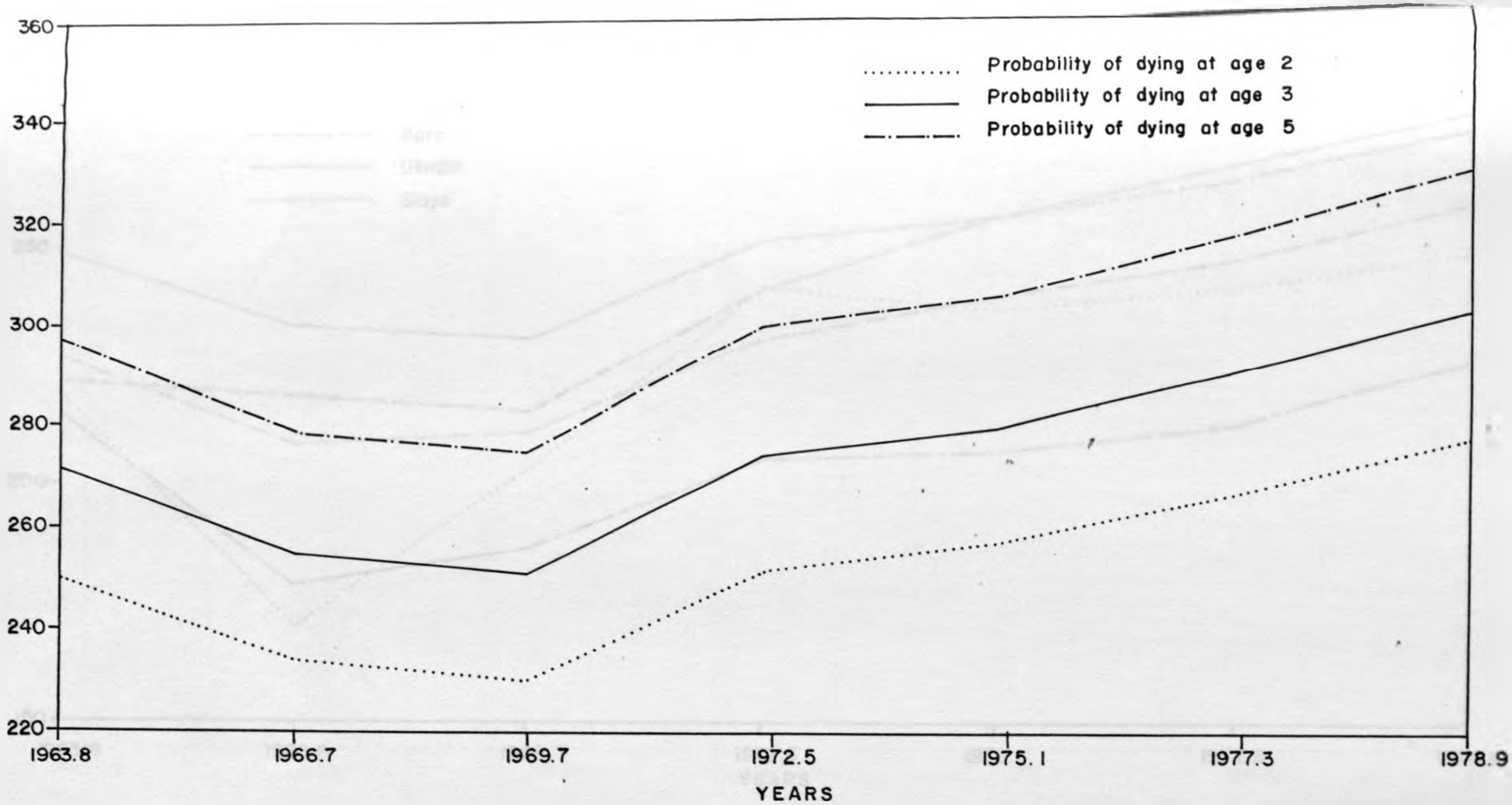


Fig. 11 : PROBABILITY OF DYING AT AGE 2,3,5, q(2),q(3),q(5), VERSUS REFERENCE TIME OF DEATH IN UKWALA DIVISION

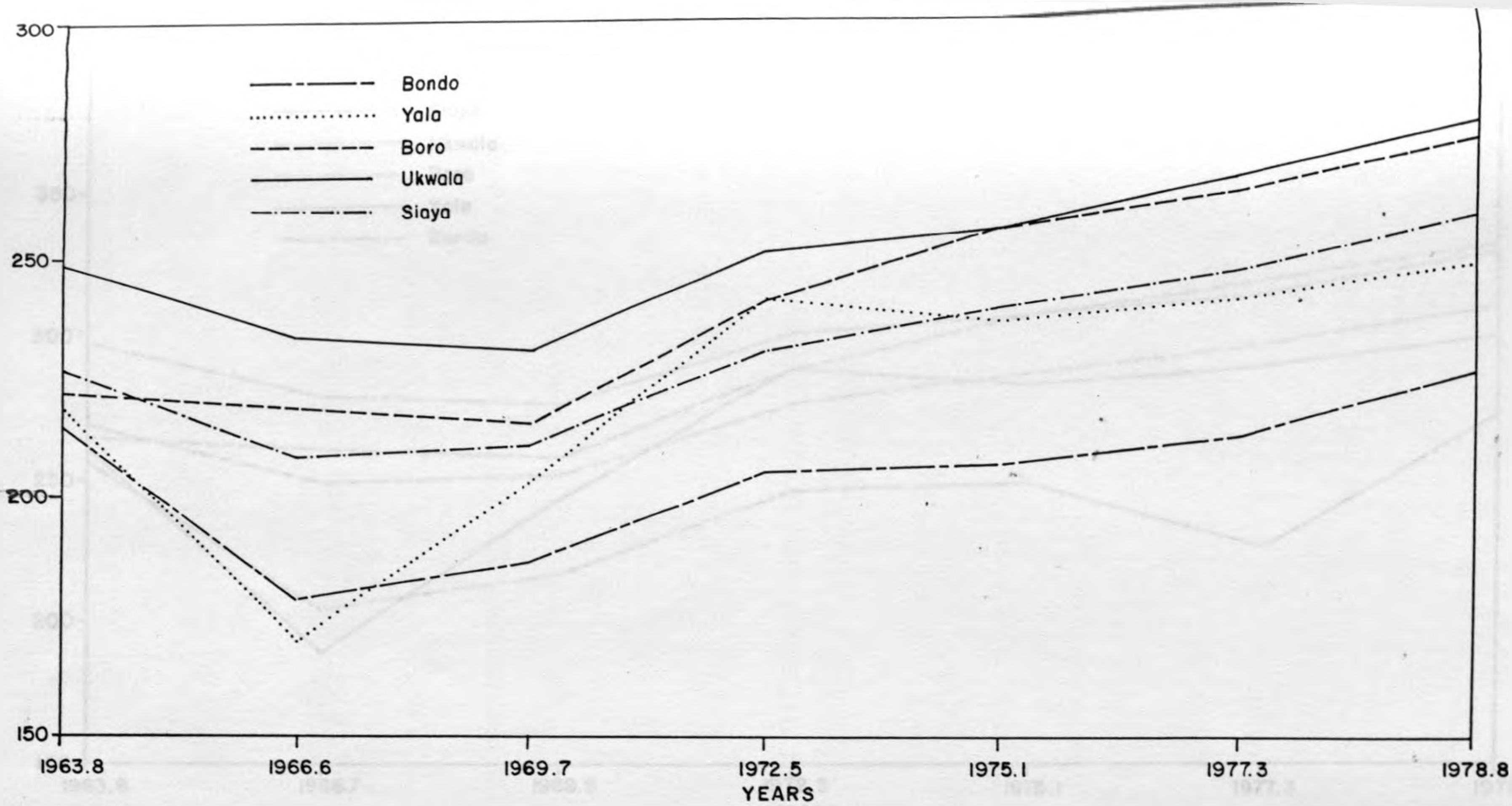


Fig. 12 : PROBABILITY OF DYING AT AGE 2, q(2) VERSUS REFERENCE TIME OF DEATH IN SIAYA DISTRICT

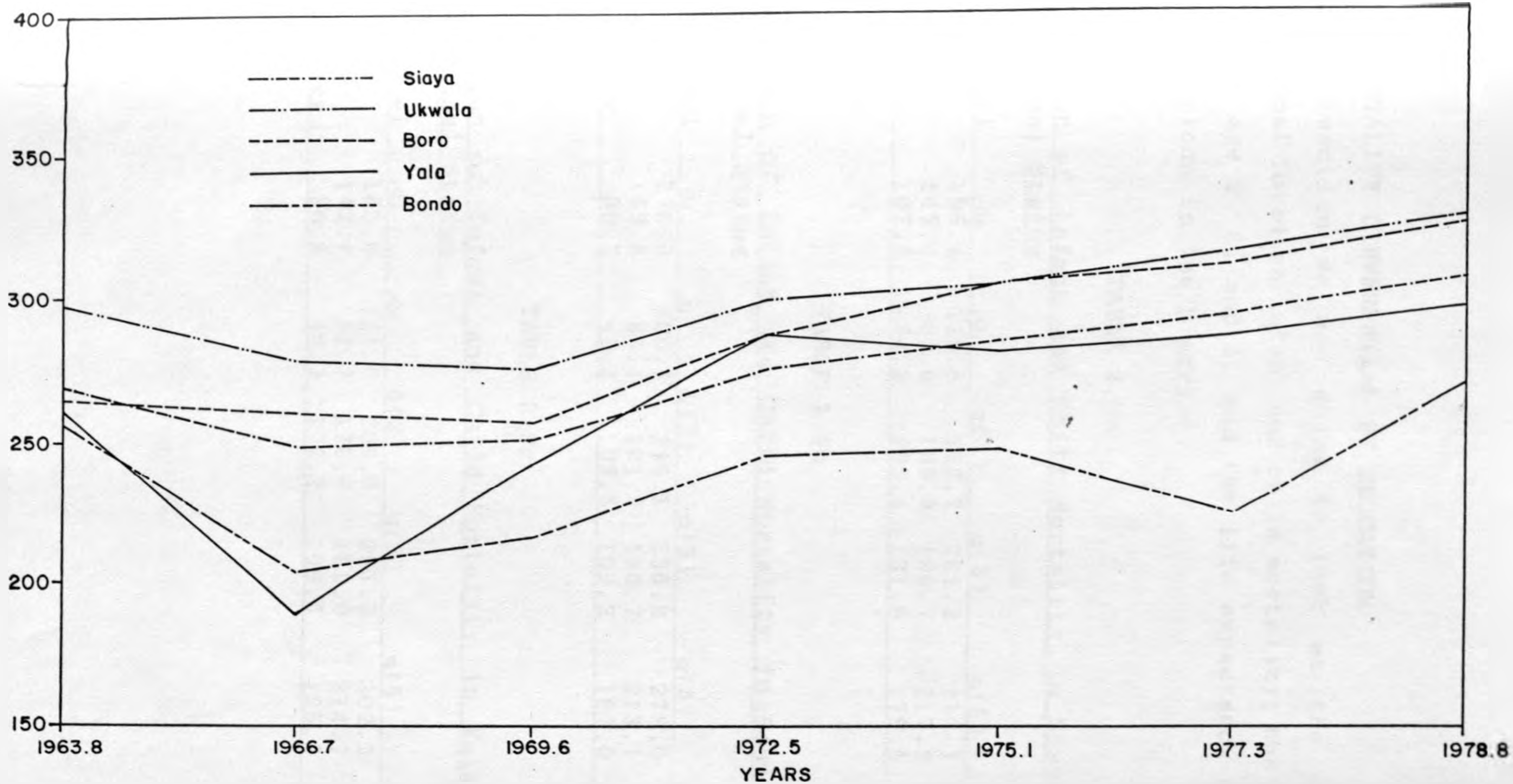


Fig. 13: PROBABILITY OF DYING AT AGE 5, q(5) VERSUS REFERENCE TIME OF DEATH IN SIAYA DISTRICT

7 MORTALITY DIFFERENTIAL BY EDUCATION

n this section we are going to look at the association of educational level on infant and child mortality; the probability of dying at age 2, 3, and 5; and the life expectancy at birth among the Divisions in the District.

TABLE 2.9a

Estimation of Infant and Child Mortality in Siaya District by Educational Status

Edu. Level	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
None	195.4	119.8	232.7	261.2	313.1	38.06
Primary	147.4	85.6	189.0	199.7	217.2	45.03
Secondary	107.5	54.2	125.4	131.6	178.5	51.86

TABLE 2.9b

Estimation of Infant and Child Mortality in Bondo Division by Educational Status

Edu. Level	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
None	175.9	105.9	213.1	235.8	278.0	40.75
Primary	143.8	83.1	181.7	196.7	213.1	45.58
Secondary	89.3	41.3	97.6	109.2	187.0	55.27

TABLE 2.9c

Estimation of Infant and Child Mortality in Yala Division by Educational Status

Edu. Level	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
None	183.8	111.6	205.6	255.0	302.2	39.64
Primary	142.1	81.7	178.9	191.0	214.7	45.87
Secondary	96.6	46.3	102.2	109.5	195.5	53.90

TABLE 2.9d

Estimation of Infant and Child Mortality in Boro Division by Educational Status

Edu. Level	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
None	195.6	120.0	231.3	262.1	314.7	38.04
Primary	148.1	86.1	198.2	198.3	220.9	44.92
Secondary	109.6	55.7	149.2	151.5	197.0	51.49

TABLE 2.9e

Estimation of Infant and Child Mortality in Ukwala Division by Educational Status

Edu. Level	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
None	206.0	127.3	247.0	272.6	329.5	36.70
Primary	158.7	93.7	202.2	216.0	235.4	43.26
Secondary	131.4	73.1	143.5	163.5	198.7	47.67

The estimates in Tables 2.9a-e show that infant and child mortality varies significantly with the level of mother's education. The infant mortality rate, $_1q_0$, is highest for mothers with no schooling in all the divisions. The value of $_1q_0$ for this class of women vary from 175.9 per 1000 live births in Bondo Division to 206.0 per 1000 live births in Ukwala Division. The life expectancy at birth, e_0 , varies from 40.75 for Bondo Division to 36.70 years for Ukwala Division. The level of infant and child mortality declines for mothers with primary education. Bondo Division had a value of 143.8 while Ukwala Division had 158.7 per 1000 live births with Boro and Yala Division having 142.1 and 148.1 per 1000 live births respectively. The life expectancy at birth, e_0, varies from 45.87 for Yala to 43.26 years for Ukwala Division. The infant mortality rate and e_0 values improve further with attainment of Secondary education. The level of infant mortality for the mothers with no education is almost double that of those ith Secondary school education. The difference in the life expectancy at birth ,e_0, between those with Secondary and no education is 14.52 years in Bondo , 14.26 in Yala, 13.45 years in Boro and 10.97 years in Ukwala Division.

The above trend is similar to those that have been obtained at the national and district levels. The difference in the life expectancy between those with no education and those with secondary school education shows that the level of education and particularly secondary school education is a better remedy for reduction of infant and child mortality. The difference in their life expectancy at birth is more than 10 years. The same trend is observed for the child mortality.

Education per se does not contribute to a child death, for instance a child does not die because his/her mother did not attend school but dies because of other proximate determinants such as health care, nutrition, just to mention a few. The mechanism through which education acts has been expressed by many scholars. Ratcliffe (1978) found that in Kerala, at any income level above the very lowest, families with literate housewives were less likely to have calorie deficiencies than those with illiterate ones. The suggestion he offered was that literacy promotes better utilization of limited resources for meeting basic personal needs. Caldwell (1979) also argued that education freed a woman from the traditional culture and she can manipulate the modern world better by ensuring that her children have an access to health facilities as soon as possible. She is also able to feed the child with more nutritious foods which might be considered by the uneducated as a traditional taboo.

It has also been argued that women who are better educated can have longer birth intervals. This argument can only hold if modern contraceptive methods are available since this group of people tend to ignore the traditional method of birth spacing such as prolonged breast-feeding and postpartum abstinence.

2.8 MORTALITY DIFFERENTIAL BY PLACE OF RESIDENCE

In this section we are going to look at the association of place of residence on infant and child mortality; the probability of dying before age 2, 3, and 5; and the life expectancy at birth among the Divisions in the District.

TABLE 2.10a

Estimation of Infant and Child Mortality in Siaya District by Place of Residence

place of res.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Rural	173.11	103.94	209.52	231.09	275.10	41.15
Urban	148.40	86.30	177.85	160.17	251.78	44.87

TABLE 2.10b

Estimation of Infant and Child Mortality in Bondo Division by Place of Residence

place of res.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Rural	157.65	92.92	192.74	213.06	245.20	43.43
Urban	168.68	100.75	179.85	181.37	257.46	41.80

TABLE 2.10c

Estimation of Infant and Child Mortality in Yala Division by Place of Residence

place of res.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Rural	163.74	97.24	189.82	221.66	267.15	42.52
Urban	131.98	73.52	182.66	185.75	167.60	47.58

TABLE 2.10d

Estimation of Infant and Child Mortality in Boro Division by Place of Residence

Place of res.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Rural	190.36	116.24	221.41	238.73	287.04	38.74
Urban	145.70	84.40	175.76	144.85	261.68	45.29

TABLE 2.10e

Estimation of Infant and Child Mortality in Ukwala Division by Place of Residence

Place of res.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Rural	189.76	115.81	232.94	251.32	299.57	38.83
Urban	157.04	92.48	176.49	199.31	279.26	43.53

Table 2.10a-e above show that there is a significant difference in the mortality level between the rural and urban residence. At the district level, the urban residents had a lower infant and child mortality. The level of infant mortality for the urban was 148.40 per 1000 live births while for rural it is 173.11 per 1000 live births. This shows a difference of 16.6%. The difference in life expectancy at birth is about 3.72 years.

A similar trend is also observed in Yala, Boro, and Ukwala Divisions except that the difference is large. In Yala Division the difference in the level of IMR between the rural and urban residence is 31.76 per 1000 live births and about 5.06 years when we consider life expectancy at birth. For Boro and Ukwala Divisions, these values are 44.66 per 1000 live births, 6.55 years and 32.72 per 1000 live births, 4.70 years respectively.

In Bondo Division, the rural residents have a lower infant and child mortality rates than the urban. This is not usually the case since the urban population is expected to be better off socially and economically. Koyugi (1982), argues that the urban population should have a lower mortality rates because of better sanitation and housing, short distance to the health facilities and high income levels existing in the urban area on the average.

Bondo urban centres seems to have a disadvantage in some of these facilities compared to its rural areas. Poor housing and sanitation in an urban area can have a far greater effect on infant and child mortality than the same conditions in the rural area. The deterioration of housing, sanitary and the living conditions can lead to an upsurge and an entrenchment of many communicable diseases as cholera and measles in urban areas.

2.9 MORTALITY DIFFERENTIALS BY MARITAL STATUS.

In this section we are going to look at the association of marital status on infant and child mortality; the probability of dying at age 2, 3, and 5; and the life expectancy at birth among the Divisions in the District.

TABLE 2.11a

Estimation of Infant and Child Mortality in Siaya District by Marital Status

Marital Status.	q_0	q_1	q(2)	q(3)	q(5)	e_0
Single	164.9	98.0	156.0	264.2	269.9	42.35
Married	166.0	98.8	180.3	229.0	281.9	42.19
Widowed	207.5	128.4	290.9	220.5	347.7	36.49
Div. & Sep.	176.0	106.0	196.9	244.0	289.6	40.73

TABLE 2.11b

Estimation of Infant and Child Mortality in Bondo Division by Marital Status

Marital Status.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Single	147.9	86.0	149.6	184.2	257.8	44.95
Married	151.2	88.3	164.9	212.0	260.7	44.43
Widowed	176.4	106.3	248.7	213.2	284.3	40.67
Div. & Sep.	172.0	103.1	223.5	215.5	270.4	41.32

TABLE 2.11c

Estimation of Infant and Child Mortality in Yala Division by Marital Status

Marital Status.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Single	141.9	81.5	131.9	227.9	233.4	45.90
Married	157.6	92.9	165.6	218.0	273.7	43.44
Widowed	224.1	140.3	286.5	286.1	318.4	34.44
Div. & Sep.	158.0	93.2	141.8	247.5	275.5	43.37

TABLE 2.11d

Estimation of Infant and Child Mortality in Boro Division by Marital Status

Marital Status.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Single	165.1	98.2	187.0	210.9	289.8	42.33
Married	173.7	104.3	189.1	236.5	298.2	41.07
Widowed	220.3	137.5	162.1	333.8	443.1	34.91
Div. & Sep.	163.7	97.2	201.7	225.9	272.4	42.52

TABLE 2.11e

Estimation of Infant and Child Mortality in Ukwala Division by Marital Status

Marital status.	$_1q_0$	$_4q_1$	q(2)	q(3)	q(5)	e_0
Single	160.0	94.6	164.1	173.2	265.4	43.08
Married	182.3	110.7	201.8	249.1	308.5	39.80
Widowed	228.7	143.6	310.4	294.5	358.7	33.88
Div. & Sep.	217.3	135.4	197.3	312.2	327.1	35.27

Table 2.11a-e above show that there exists significant

fference in the level of infant and child mortality by marital atus. In the District as a whole, single mothers have a slight vantage over the married ones. The gap between the married and e divorced and separated widens and lastly the widowed are hardly t with almost 25.8% difference in infant and child mortality as mpared to the single. The difference in life expectancy is about .86 years between the single and the widowed.

similar pattern is observed in Bondo, Yala and Ukwala Divisions lthough the difference in infant and child mortality between the ingle and the widowed varies among the divisions. In Bondo ivision the difference in $_1q_0$ was 28.5 per 1000 live births while ala and Ukwala had 82.2 and 68.7 per 1000 live births espectively. The difference between the single and widowed in erms of e_0 were as follows 4.28, 11.46, 9.20 years in Bondo, Yala and Ukwala Division respectively.

The pattern observed in the previous paragraph differs in the case of Boro Division with the divorced and separated having a better chance of infant survival followed by single, married and finally widowed. The same pattern is observed for the child mortality, $_1q_1$, although the probability of survival before age 2, q(2), shows that the widowed are the most advantaged group followed by the single then married and finally the divorced and the separated. This variation could be explained by the level of development in Boro Division. Since this Division houses the District headquarter, effects of urban lifestyle is felt in Boro more than in any part of the District.

Generally, infants born to single mothers have a better chance of survival compared to infants of married women. Widowed women show higher mortality than the divorced and separated. The low fertility for the single mothers reduces the risk for infant and child death because they have not been exposed to longer periods of child bearing unlike the married women.

The widowed women are the worst affected group in the district. This might be due to high dependence they might have had on their husbands in terms of income and other households necessities that can boost the chances of child survival. Newland (1981), postulated that children whose fathers are dead or absent have additional effect against them. Their mothers bear the entire burden of providing child care and acts as the sole provider for family's income. In most cases therefore, female headed households are likely to be susceptible to high mortality rates.

CHAPTER 3

ESCRIPTIVE ANALYSIS OF INFANT AND CHILD MORTALITY AT THE INDIVIDUAL LEVEL

.1 INTRODUCTION

n chapter 2, we found that Ukwala Division had the highest infant and child mortality in Siaya district. Therefore it is of interest in this chapter to go further and find out the effect of socioeconomic and environmental risk factors that contribute to infant and child death at the individual level in one of the sub-locations in this division. We are therefore going to utilize data collected in Jera sub-location to do this in-depth analysis. The analysis in this chapter is descriptive in nature and it gives the proportion of women in each category so as to have a picture of the percent distribution for each category in a given variable.

3.2 SAMPLE DESIGN AND IMPLEMENTATION

Because of time and cost, we fixed in advance a sample of size 450, this implies that 450 questionnaires were prepared. The number of questionnaires distributed to the villages in the sub-location was proportional to the number of eligible women (aged 15-49 years) in each village as shown in Table 3.1. In distributing these questionnaires, we made sure that every home with at least one eligible woman had at least a questionnaire. With the help of the headmen, who are in-charge of the villages; and the assistant chief, the number of households eligible for the interview were listed down. It was noticed that most of the eligible women were out of the sub-location with their husbands.

This design is a multistage sampling where in the first stage we ve 5 villages. In the second stage, we have clustered the useholds by the number of eligible women, that is, one cluster onsists of households with one eligible member, the second cluster onsists of households with 2 eligible members in each household c. In the third stage, all the households with one member are iumerated while at least one member from the households with 2 or ore members are also taken.

TABLE 3.1
HE NUMBER OF ELIGIBLE WOMEN AND THE SAMPLE SIZE TAKEN IN EACH VILLAGE

illage	No. eligible women	Sample Size	No. of households
alak	99	83	75
era	104	87	72
hola	115	98	91
1auna	88	74	70
ela	130	109	99
Total	536	450	407

3.3 METHODOLOGY OF DATA COLLECTION AT MICRO-LEVEL.

3.3.1 Introduction

The individual data was collected by using a coded questionnaire which was prepared in English and each of the research assistants (interviewers) was given a copy translated in Dholuo, since the area is predominantly populated by the Luos. A pretest was conducted in the neighbouring Sub-location (Nyamsenda) a week earlier to detect errors in the questionnaire. Eight interviews were conducted to determine whether the interviewers (and the respondents) could understand and interpret the questions correctly. The response was quite good and therefore there was no adjustment or modifications.

.2.2 Content of the questionnaire

The questionnaire had 8 major sections which are as follows:

section I dealt with respondents background

section II dealt with marriage

section III dealt with reproduction

section IV dealt with birth history

section V dealt with work status of the parents and father's education level

section VI dealt with pregnancies and breast-feeding (births in the last five years)

section VII dealt with weaning and associated illness (births in the last five years) and

section VIII dealt with environmental conditions.

The first section of the individual questionnaire included seven questions designed to collect information on a number of background characteristics of a respondent including maternal age, educational status, whether she had lived in a town or city and the duration of stay, the ownership of a transistor radio.

The maternal education was grouped into five categories according to the level of education, namely none, primary 1-4, primary 5-8, secondary and above secondary. Maternal education is expected to decrease the infant and child mortality, although the question remaining concern the magnitude and nature of its effect in different settings. One aim is to determine the degree at which the maternal education effect works through other socio-economic variables whose values are established later in life. For example much of the importance of the mother's education could result from the ability of a better educated woman to attract a husband who arns more. Maternal education is expected to be the strongest and ost reliable because it is a characteristic, a woman is likely to ave since the beginning of her childbearing. All the other emaining variables are those that prevailed during the survey that ight be different at the time of infant/child death.

The duration of stay in a town or city and ownership of a transistor radio were used to measure whether the respondent has been exposed to some informal education on modern technology and health care of their children.

The second section included six questions designed to collect data on the marital status and religious affiliation of the respondent. The respondent was asked whether she has lived with a man, and if the response is positive, she was further asked to state her current marital status i.e. whether married, widowed, divorced or separated. Those who were married were required to state whether their husbands were living with them and if there is another co-wife(wives). In several studies that have been conducted , single women experience a lower infant and child mortality than any other marital group. Children of the widowed or divorced mothers have been found to experience higher infant and child death since this group is associated with substantial stress, which in turn may affect child health. By depriving a mother of principal means of support for her child rearing activities, widowed or divorced may also have a calamitous effect on her financial situation (Taubman and Rosen, 1980). The other aspect of marriage was whether the respondent was in a monogamous or a polygamous union since polygamy has been associated with increased infant and child death. The respondent was also asked to state the religion she belongs to i.e. catholic, protestant, legio maria, roho and others. The commitment these religious groups was not measured. At a more general level ere has been a good deal of reflection on the relationship tween religion and modernization. Some attitudes and beliefs held certain religious communities may be at odds with modern chnology such as utilization of medical facilities and can also nder individual's well-being.

ction III consisted of five questions on the respondents productive behaviour. Questions in this section required the others to state the number of children ever born, the number iving at home, elsewhere and those who have died each classified ccording to their sex. This was followed by section IV which dealt ith the birth history of the respondent. They were asked to state he names, sex, date of birth of their children starting with the irst up to the last born, whether still alive or dead. The espondents were required to state the age of those who are alive and the age at death for those who have died. These two sections are very important in this study because, the mortality situation of the area depends on the accuracy accorded to these two sections. The accuracy of the dependent variable M_{ij} (mortality index) which is used for the micro-level analysis depends on these two sections. The birth history can also be used to counter check the values given in section III and if there is any doubt, the respondent was probed on the missing birth or death.

Section V which included five questions was designed to collect data on the respondents' work status and the general wealth of the households. The respondents were further asked whether they have ever worked to earn money. Those who responded positively were further asked if it was wage or self employment. In this section those who were married were asked to state whether their husbands tended school and the number of years completed. In several udies, paternal education has not been given ample emphasis cause in many societies the division of labour and predominant x roles discourage men from taking day-to-day child caring. creased education of the father, if it raises the purchasing ower, may improve housing and sanitation facilities and the uality of food and clothing, and enable parents to take better dvantage of health care. The data on the work status of the usband was also obtained and was divided into wage employed, orking in his own farm, working in other people's farm, usinessman and others. Since household income level is very ifficult to get in the rural areas, the traditional wealth (number f domestic animals: cows, goats and sheep) was measured.

In the analysis, it is only the number of cattle (whether improved or local) that was considered since a goat or a sheep is assumed to be cheap and easily affordable.

Section VI dealt with the pregnancies and duration of breast-feeding in the last five years from the time of survey. In this section, eight questions were asked to ascertain the care taken during pregnancy. The questions include the age at first birth and the date of last birth. Respondents were also expected to state the type of food they usually take while pregnant, activities performed during pregnancy, visits to the antenatal clinic, place of delivery, immunization of children and the period taken to breast-feed.

Section VII dealt with weaning and associated illness for the births in the last five years. The mother was asked to state the duration after which she starts giving supplementary food to her

fant/child, the composition of the weaning food, what facilities re used to give such foods, whether the child's health status anged after weaning and if it did, which changes did she observe. e type of disease the child has suffered from in the last one nth and the treatment accorded to the sick child.
e questions in these two sections were designed to measure the reatment or precautions taken during antenatal, natal, prenatal nd early childhood in order to provide information on the health tatus of the mother and the child.

ection VIII dealt with the environmental contamination factors of he household. The characteristics of the dwelling place has been ecognized as an important factor influencing infant and child mortality because of their perceived health effects. In this study the impact of housing conditions on mortality is viewed against the number of houses in the compound, the power source, the type of building materials, availability of toilet, age at which the child starts using the toilet, type of water source, cooking place and the place animals are kept.

The information on these facilities was obtained by asking simple questions about the relevant aspect as regard dwelling units. The building materials included the type of roof, wall and the floors.

The power source was divided into two, namely, energy source used for cooking and lighting.

On the availability of toilet facilities the respondents were only suppose to respond whether there was one or not, because the only type of toilet facility is pit latrine.
The water source was divided into two, namely spring (well) and

rehole. There was an additional question on the treatment of ter in which the respondents were asked whether they boiled the ter before using it. The question on the cooking place was to scertain whether cooking takes place in the kitchen, the living lace (main house) or outside in the open air.
he most important effect of housing condition on health is eflected in its impacts on the incidence of infectious diseases uch as diarrhoeal diseases. Crowding in the dwelling unit or ompound encourages the spread of some of this diseases. Feachem 1981) pointed out that, the reduction of the infectious diseases ould be a major benefit of the programmes launched with aim of mproving dwelling units and other related facilities.

3.3.3 Field Activities.

(i) **Recruitment and Training of Interviewers**

Recruitment and the training of interviewers (Research assistants) was done a week before the survey started. Three research assistants with at least four years of secondary education were recruited. Two of them had an added advantage of being teachers in the area. Their knowledge of the area and the status they held in the community helped to induce more confidence on the respondent and thus helped in reducing cases of non response.

The training of these interviewers took four days after which a pretest on the questionnaire was done in the neighbouring sub-location to determine the reaction of the local community on the questions and also to gauge the interviewers' understanding and interpretation of the questionnaire.

ii) **Fieldwork**

The field-staff which comprised of four interviewers (the three research assistants and I) carried out the survey for 15 days. On average each interviewer completed 8 questionnaires per day. The number was low because, most of the respondents were not easily available in the early and late hours of the day. The interviews were conducted between 11.00 a.m. and 3.00 p.m. to avoid interfering with the respondent's daily routine. Those who could not be available at those hours were interviewed mostly on sunday morning which most of them considered as a rest day.

With the help of the local administration (an assistant chief and headmen) the number of non-response was low since their company helped in injecting some confidence on the respondent.
Although, in general, no major problem was encountered in the field, there were difficulties in collecting information on ages and date of birth of the respondent and that of their children. Those who could not remember their age and had children were treated as non-respondents.

3.3.4 Data processing and analysis

After editing the questionnaire the field data was entered into a computer and analyzed using SPSS package, since the questionnaire was already coded. The processing and analysis took almost a month to be completed.

3.4 GENERAL CHARACTERISTICS OF THE WOMEN INTERVIEWED

This section examines the socio-economic, demographic and environmental risks characteristics of the sample of women interviewed in the survey. Knowledge of these characteristics of the sample would enable the readers to interpret better the detailed findings of the survey.

3.4.1 Age Distribution

The age distribution of the survey respondents is shown in Table 3.2. The mean age of the women interviewed was 29.9 years, with more than half of the respondents being less than 30 years of age. The proportion of women declines with increasing age, and only seven percent of the respondents reported ages between 45-49.

TABLE 3.2

MEAN AGE, PER CENT DISTRIBUTION AND PROPORTION DEAD OF ALL WOMEN AGED BETWEEN 15 AND 49

Age	% dist.	Prop. Dead
15-19	9.4	0.067
20-24	22.4	0.132
25-29	21.2	0.180
30-34	17.8	0.219
35-39	13.5	0.183
40-44	9.2	0.216
45-49	7.0	0.211
Mean age	29.9	

3.4.2 Sex Ratio at Birth

The sex ratio at birth which is calculated by dividing the number of males by the females reported by the mothers is 896/896=1. This shows that the misreporting or under-reporting of births did not vary so much since the sex ratio at birth for the district in 1979 was 0.946 and again the value is near the range of 1.02 and 1.05 which is internationally accepted.

3.4.3 Education Status.

The respondents were asked if they have ever gone to school. Those who responded affirmatively were further asked to state the highest level attained in the country's formal education system. Respondents were grouped into five categories: those who have not attended, those with primary 1-4, primary 5-8, secondary and above secondary. Table 3.3 shows that 34.2 percent of the respondents had no formal education, 19.3 percent had completed 1-4 years of primary education, 38.1 percent had completed 5-8 years of primary education and only 8.6 percent had achieved secondary level and above.

TABLE 3.3

PER CENT DISTRIBUTION AND PROPORTION DEAD OF ALL WOMEN BY EDUCATION STATUS

Education Level	1979 census data Ukwala	1979 census data Siaya	Farmers' grp Ukwala	Field	Prop Dead (CD/CEB
None	59.9	53.6	30.32	34.0	0.201
Prim 1-4 }	34.8	40.5	58.63	19.3	} 0.138
Prim 5-8 }				38.1	
Sec+ (9+)	5.3	5.9	8.95	8.6	0.023

Comparison of the field data with the census data for Ukwala Division reveals that the percentage of women aged 15-19 who have no formal education have reduced tremendously. This is further confirmed by the 1985 first report on the data obtained by the Farmer's Group and Community Support Project which collected information on infant and child mortality in all the Divisions in Siaya District. The data also shows that the percentage of women with primary education has also increased from 34.8% in 1979 to

8.6% in 1985 (according to the farmers' group project) which is in greement with the field data which shows a level of 57.4%.

he married women were also asked to state whether their husbands ad any formal education, thus those responding in affirmative were equired to state the education level attained by their husbands.

TABLE 3.4

PER CENT DISTRIBUTION AND PROPORTION DEAD OF CURRENTLY MARRIED WOMEN 15-49 BY THE EDUCATIONAL LEVEL OF THEIR HUSBANDS

<table>
<tr><th>Education level of husband</th><th>% dist.</th><th>Prop Dead (CD/CEB)</th></tr>
<tr><td>None</td><td>18.1</td><td>0.157</td></tr>
<tr><td>Prim 1-4</td><td>13.1</td><td rowspan="2">0.174</td></tr>
<tr><td>Prim 5-8</td><td>47.2</td></tr>
<tr><td>Sec+</td><td>21.5</td><td>0.110</td></tr>
</table>

Table 3.4 shows that the percentage of paternal education is higher than that of the mother which is a common trend in the developing countries. Only 18.1% of the husbands had no formal education, 13.1% had 1-4 years of primary education, 47.2% had 5-8 years of primary education and 21.5% had secondary and above.

.4.4 Other Characteristics

he other characteristics are summarized in Table 3.5.

TABLE 3.5

PERCENT DISTRIBUTION AND PROPORTION DEAD FOR THE OTHER CHARACTERISTICS

ariable	No.of women	% dist.	Prop Dead (CD/CEB)
MARITAL STATUS			
single	38	9.2	0.039
married	342	82.4	0.165
widowed	32	7.7	} 0.169
divorced	2	0.5	
Not living together	1	0.3	
RELIGION			
catholic	218	52.4	0.153
protestants	134	32.2	0.148
legio maria	11	2.7	} 0.186
roho	50	12.0	
others	2	0.5	
OWNERSHIP OF A TRANSISTOR			
Yes	179	43.1	0.166
No	236	56.9	0.150
MATERNAL LABOUR PARTICIPATION (ever worked)			
yes	60	14.5	0.137
no	355	85.5	0.133
TYPE OF JOB			
wage employed	39	65.0	0.100
self employed	21	35.0	0.275
PLACE OF DELIVERY			
hospital	201	48.4	0.121
home	212	51.1	0.228
others	2	0.5	0.570
VISITS ANTENATAL CLINIC			
Yes	406	97.8	0.118
No	9	2.2	0.360

able 3.5 cont...

MUNIZATION			
yes	364	87.7	0.153
yes but not complete	42	10.1	0.153
no	9	2.2	0.326
URATION OF BREAST-FEEDING			
1-6 months	38	9.2	0.223
6-12 months	92	22.2	0.132
12-18 months	97	23.4	0.193
18-24 months	108	26.0	0.146
24+ months	80	19.3	0.119
AGE AT WHICH SUPPLEMENTARY FOOD IS INTRODUCED			
0-3 months	231	55.7	0.170
4-6 months	132	31.8	0.148
7+ months	52	12.5	0.127
TREATMENT TAKEN			
saw a traditional healer	30	7.2	0.192
dispensary	381	91.8	0.154
withdrew food	1	0.2	} 0.172
didn't care	3	0.7	
NUMBER OF HOUSES			
1-3 houses	66	15.9	0.200
4-6 houses	186	44.8	0.145
7+ houses	183	39.3	0.153
COOKING ENERGY			
paraffin	13	3.1	0.267
firewood	392	94.4	0.158
others	10	2.4	-
LIGHTING ENERGY			
paraffin	409	98.6	0.153
firewood	6	1.4	0.402
ROOFING MATERIALS			
grass thatch	356	85.8	0.161
iron sheet	59	14.2	0.136
WALL MATERIALS			
mud and sticks	370	89.4	0.142
stone and bricks	45	10.6	0.129

ble 3.5 cont...

OOR MATERIALS			
oncrete	44	10.6	0.133
owdung	336	81.0	0.149
ud	35	8.4	0.177
VE A TOILET			
s	355	85.5	0.150
	60	14.5	0.198
E CHILDREN START USING OILET			
-3 years	113	27.2	0.141
-5 years	201	48.4	0.151
6+ years	101	24.3	0.195
ATER SOURCE			
well	231	55.7	0.151
borehole	184	44.3	0.110
OIL WATER			
yes	102	24.6	0.155
no	313	75.4	0.163
PLACE OF COOKING			
separate kitchen	287	69.2	0.134
living house	120	28.9	0.174
outside	8	1.9	0.256
PLACE ANIMALS ARE KEPT			
residential unit	43	14.2	0.190
kitchen	87	28.8	0.169
separate place	106	35.1	0.125
outside (open air)	66	21.9	0.198

CHAPTER 4

UNIVARIATE ANALYSIS OF INFANT AND CHILD MORTALITY AT INDIVIDUAL LEVEL

4.1 INTRODUCTION

In this chapter we are going to look at the univariate analysis of the socioeconomic and environmental risk factors that influence infant and child mortality at the individual level. The analysis involves the use of infant and child mortality index obtained by the use of Trussell and Preston (1982) technique.

4.2 METHODOLOGY OF DATA ANALYSIS

Trussell and Preston(1982)

Trussell and Preston (1982) developed and tested a method for analyzing mortality differentials from child survivorship data. The essential feature is to construct an index of infant and child mortality for women and compare the values of the index among different groups of women.

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

The index of infant/child mortality for a woman of a certain age is constructed as the ratio of the actual proportion of her children who have died to the proportion expected for an "average" woman in opulation of the same age.

For each woman, an index of her children's mortality is created. The index is equal to the number of her dead children divided by the expected number of dead children. The expected deaths is derived by multiplying her number of births by the expected proportion of children dead.
This expected proportion dead in turn is based upon general mortality condition in the population as well as upon the distribution of exposure times of her children to the risk of mortality, as measured by the mother's age.

The index of infant/child mortality for woman i of age group j , M_{ij}, is

$$M_{ij} = \frac{d_i}{N_i * EPD_j} \text{, where}$$

d_i = number of dead infants/children for woman i,

N_i = number of births to woman i,

EPD_j = expected proportion dead for a woman of age group j,

j refers to age groups 15-19, 20-24, 25-29,..., 45-49.

To derive EPD_j the mortality estimation procedure originally developed by Brass in 1968 is used. Brass developed a system of equation, based on simulation, for converting an observed proportion dead among women in category j into a life table measure of mortality. The equations are of the form:

$q(x) = K(j)*D(j)$, where

$q(x)$ = probability that an infant/child will die at age x,

$D(j)$ = proportion dead among children ever born to women in age group j,

$K(j)$ = multiplier suitable for women in age category j.

The (x,j) correspondences when j refers to age group of mother are (1,15-19),(2,20-24),(3,25-29),(5,30-34),(10,35-39),(15,40-44), (20,45-49).

Equations for the multipliers used in this work are those derived by Trussell (United Nations, 1983). To use the above equation, we suppose a "standard" mortality function ,$q_s(x)$, and convert that standard into an expected proportion dead by rewriting the previous equation for q(x) as :

$$EPD_j = q_s(x)/K(j)$$

To obtain the value of $q_s(x)$ we either use "North" or "West" model life table systems of Coale and Demeny are most frequently employed.

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

$$M_{ij} = \frac{d_i}{N_i * q_s(x)/K(j)}$$

The index of mortality, M_{ij}, as any other mortality index is always positive and can be interpreted as follows:-

If

$M_{ij} < 1$ then the number of children dead for woman i in age group j is likely to be lower than expected.

M_{ij} = 1 then the number of children dead for woman i in age group j is likely to be equal than expected.

M_{ij} > 1 then the number of children dead for woman i in age group j is likely to be higher than expected.

n this study the values of $q_s(x)$ and K(j) for different age groups e given in the tables 4.0a and 4.0b respectively.

Table 4.0a

Values of the Standard Mortality function $q_s(x)$

x	1	2	3	5	10	15	20
$q_s(x)$	.199	.234	.251	.300	.330	.360	.398

Table 4.0b

Values of Multiplier suitable for women in category j

j	1	2	3	4	5	6	7
K(j)	1.106	1.025	.971	.981	.998	.985	.978

It is worth noting that the value of M_{ij} depends on the ratio of K(j) to $q_s(x)$ [$K(j)/q_s(x)$] which vary from 2.2 to 5.6 in this study.

For example, if the first woman in age group 20-24 has given birth to 4 children out of which 1 have died then the M_{ij} value of this woman is

$$M_{12} = \frac{1}{4 * 0.234/1.025}$$

$$= 1.1$$

This method gives us each value of M_{ij} for each woman in different age groups. Our tabulations will represent the average value for l the values of M_{ij} which is observed for each variable.

n the following analyses we have used two infant and child ortality indices namely $M_{ij}5$ and $M_{ij}40$. The $M_{ij}5$ represents the ortality index for infant/child who were born in the last five ears (recent mortality experience) and $M_{ij}40$ represents lifetime ortality index.

4.3 THE EFFECT OF SOCIOECONOMIC FACTORS ON INFANT AND CHILD MORTALITY.

In this section we have looked at the effect of maternal and paternal education, religion, marital status, ownership of transistor radio, and the work status of the mother and father on infant and child mortality.

4.3.1 Maternal Education.

Table 4.1, which shows the ratios of observed to the expected deaths by the mother's level of education, indicates that infant/child mortality is inversely related to the educational level.

TABLE 4.1

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MATERNAL EDUCATION

maternal education	$M_{ij}40$	$M_{ij}5$
None	.67	.54
Prim	.55	.48
Sec+	.08	.04

The Table shows that the change from primary to secondary school have a greater effect in the reduction of infant and child mortality than the change from no education to primary education. The lifetime mortality index shows that the move from no education to primary level reduces infant and child by 0.12 (17.9%) while the ove from primary to secondary school level results in 0.47 (85%). The recent mortality index shows the same trend with mothers who attended Primary school education having 0.06 (11%) lower infant and child mortality than those with No level of education. The move from primary to secondary level of education reduces infant and child mortality by 0.44 (91.7%). This shows that an increase in the level of schooling from primary to secondary has a substantial effect on the reduction of infant and child mortality. Deaths in the rural areas are primarily due to water borne diseases, contaminated or lack of food and feces, for which prevention appears to be responsive to improved personal hygiene which can be achieved by increased female education.

4.3.2 Paternal Education

Table 4.2 shows that the ratio of reported to expected dead children with paternal education does not show any pattern. The mortality indices shows that fathers with primary education experience a lower infant and child mortality than those with no education. However, attainment of secondary school education reduces the infant and child mortality to a substantial level although it is not as low as that of the mothers. The deviation in the expected trend may be a reflection of problems in data quality such as inaccurate reporting of the husband's level of education.

TABLE 4.2

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY PATERNAL EDUCATION

Paternal education	$M_{ij}40$	$M_{ij}5$
None	.53	.41
Prim	.61	.55
Sec+	.40	.27

The clearer and more consistent relationship of mother's education o infant and child mortality than that of the father appears to reflect a greater impact of maternal education on child survival. The father's education in itself might not be having any influence unless it improves the standard of living in the household e.g by providing income, improving the dwelling unit and sanitation condition of the household.

The inconsistency of the father's education with infant and child mortality also shows that child caring in this society is solely left for mothers, if the argument that improvement in educational level helps in improving the hygienic and feeding practices of an individual. Most of the husbands of the rural women live in the urban centres and their contribution to child care can only be felt if they improve the economic condition of the household by sending some of the resources back home.

4.3.3 Religion

Table 4.3 shows that mothers who belong to African Independent churches such as Legio Maria/roho/other religious group experience a high infant and child mortality than the catholics and protestants. The lifetime mortality index shows that the protestants and the catholic experience the same infant and child mortality with each having a value of 0.53 while the African Independent Churches(legio Maria/roho/others) have a value of 0.66. For mothers who were at risk of infant and child loss in the last five years, the index shows that the protestants have a low infant and child mortality as compared to the catholic. They show a infant and child mortality index of 0.39 as compared to 0.43 for the catholics and o.68 for the African Independent Churches (Legio Maria/Roho/Others) religious sects.

The main reason for the high infant and child mortality for some of the African Independent Churches (e.g. Roho sect) could be due to their belief of not utilizing the modern medical facilities. They belief mostly on the spirits for cure and only seek health services when it is too late to save the infant or child's life.

TABLE 4.3

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY RELIGION

Religion	$M_{ij}40$	$M_{ij}5$
Catholic	0.53	0.43
Protestants	0.53	0.39
Legio/Roho/Others	0.66	0.68

4.3.4 **Ownership of a Transistor Radio**

A transistor radio can be used as a source of acquiring informal education on the general hygiene and other related programme measures that can help reduce infant and child mortality. Table 4.4 shows that mothers who own radios have a higher infant and child mortality than those without radios. The lifetime mortality index shows a difference of 0.04 (7%) while the mothers at risk of losing a child in the last five years has a difference of 0.02 (4.2%). The results are contrary to the expectation that ownership of a transistor radio would enable the mother to learn some modern ways of infant/child caring. The unexpected trend could be as a result of under-utilisation of the radio.

TABLE 4.4

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY OWNERSHIP OF A RADIO

Owns a radio	$M_{ij}40$	$M_{ij}5$
Yes	0.57	0.47
No	0.53	0.45

3.5 Work Status of the Mother

omen were interviewed on their labour participation and those who ad participated in the labour force were asked whether it was self r wage employed. Table 4.5 shows that the infant and child ortality was slightly lower for mothers who had ever worked as ompared to those who have never worked as shown by the lifetime ortality index. The difference was only 0.05 (10%) which is not ignificant. For the recent mortality experience (mothers who are t risk of infant/child loss in the last five years), the infant nd child mortality index shows that mothers who have ever worked xperience a higher infant and child mortality than the ones who ave not worked. The difference in the mortality index is 0.12 (21.4%).

TABLE 4.5

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MOTHER'S LABOUR PARTICIPATION

Ever worked	M_{40}	M_{5}
Yes	0.51	0.56
No	0.56	0.44

The mothers who had ever worked were asked whether it was wage or self employment. Table 4.6 shows that mothers who get wages experience a low infant and child mortality than those who were self employed. For the lifetime mortality, the infant and child mortality index is 0.38 for the wage employed and 0.75 for the self employed. The infant and child mortality index for the recent mortality experience is 0.43 for the wage employed and 0.74 for the self employed. The mortality indices shows that the wage employed experience low infant and child mortality than the self employed.

TABLE 4.6

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MOTHER'S TYPE OF OCCUPATION

Type of occupation	$M_{ij}40$	$M_{ij}5$
Wage	0.38	0.43
Self	0.75	0.74

4.3.6 **Work Status of the Father**

The women who were married were asked to state their husband's occupation. This variable was categorized as wage employed, working in his or somebody's farm and business. The recent mortality index shows mother's whose husbands are wage employed have a better chance of child survival than any other type of occupation. The mortality index for the wage employed is 0.35 compared to 0.48 for those who worked in their own farm, 0.63 for the ones who worked in somebody's farm, and 0.84 for those who are in business (Table 4.7). For the lifetime mortality index, the wage employed still exhibit a low infant and child mortality although the mortality index for mothers whose husbands are involved in business is lower than those who work in their (or somebody's) farm.

TABLE 4.7

RATIO OF EXPECTED TO THE OBSERVED MORTALITY BY THE FATHER'S WORK STATUS.

Work Status	$M_{ij}40$	$M_{ij}5$
Wage	0.50	.35
Own farm	0.69	.48
Somebody's farm	0.84	.63
Business	0.57	.84

It is clear from this that paternal occupation has an impact on infant and child mortality. The wage employed are likely to have surance of earning some money which can be used to elevate the onomic status of their households. Those who worked in another rson's farm experience a high infant and child mortality compared , those who worked in their own farm. By working in another erson's farm, the father tends to reduce the household's farm roductivity for the little amount that he earns after a day's ork.

.3.7 Marital Status

able 4.8 shows that single mothers experience a lower risk of nfant and child death as compared to the other marital status as hown by the lifetime and recent infant and child mortality ndices. The lifetime mortality index shows further that the urrently married women had a slightly higher infant and child leaths as compared to the widowed/divorced/separated. The recent nortality index shows that the currently married women have a low infant and child mortality than the widowed/divorced/separated combined.

Single women experience low infant and child mortality despite the disadvantages they have such as early age at infant birth and low birth weight which could lead to high infant and child mortality. The reason for this low infant and child mortality could be that, single women are less inclined to mention a child who died than women who have been, or are currently married. Another reason is that they have had a shorter period of exposure than the ever married mothers.

TABLE 4.8

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MARITAL STATUS

Marital Status	$M_{ij}40$	$M_{ij}5$
Single	0.17	0.25
Married	0.59	0.48
Wid/Div/Sep	0.56	0.54

4.3.8 Ownership of Domestic Animals

The ownership of cattle is taken as a measure of the traditional wealth in a rural society. The recent mortality measure shows that infant and child mortality is inversely proportional to the number of cattle the household owns (Table 4.9). Households which owns 0-3 cows had a mortality index of 0.47 and those with 4 cows and above have a mortality index of 0.38.

The lifetime mortality index shows that infant and child mortality is directly proportional to the number of cattle in the household. This suggests that the ownership of the cattle may be a recent phenomenon in the household and cannot have been there at the time the infant/child died.

TABLE 4.9

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY OWNERSHIP OF CATTLE

Number of cows	$M_{ij}40$	$M_{ij}5$
0-3	.54	.47
4-6	.61	.38
7+	.61	.38

.4 ENVIRONMENTAL AND HEALTH FACTORS

n this section we are going to look at antenatal, natal, and ostnatal care accorded to pregnant mothers and the treatment ccorded to the sick infant/child for the health care factors; the ondition of the dwelling unit; the water source and the treatment f the water; the availability and utility of the toilet. Our iscussion focuses on the recent mortality experience since most of hese factors could have been recent developments that would not ecessarily be there during an infant/a child death, although the lifetime mortality index are also given for comparison purposes.

4.4.1 Visits to Antenatal Clinic

Table 4.10 shows the relationship of infant and child mortality and whether the mother visited an antenatal clinic while pregnant. The Table shows that mothers who had visited an antenatal clinic during their pregnancy experience a low infant and child mortality. The recent mortality experience for the mothers who visited a clinic during their pregnacy shows an infant and child mortality index of 0.46 and those who did not visit a clinic have an index of 0.58. This difference between those who attended and those who did not attend antenatal clinic is 26%. The lifetime mortality index shows a difference of 0.59 (109%) which is high compared to the recent mortality experience.

TABLE 4.10

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY VISITS TO ANTENATAL CLINIC

Visits to a clinic	$M_{ij}40$	$M_{ij}5$
Yes	.54	.46
No	1.13	.58

4.4.2 Place of Delivery

The place of delivery which is an important characteristic of infant and child mortality showed a marked difference in the infant and child death. (Table 4.11).

TABLE 4.11

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY PLACE OF DELIVERY

Place of Delivery	$M_{ij}40$	$M_{ij}5$
Hospital	0.41	0.34
Home	0.65	0.57
Others	1.67	-

Mothers who deliver in hospital experience a lower infant and child mortality than those who deliver at home or any other place. The recent mortality experience shows that mothers who delivered in the hospital shows an infant and child mortality index of 0.34 while delivery at home shows an index of 0.57, a difference of 0.23 (67.6%). The lifetime mortality index shows that mothers who gave birth in other places apart from their homes or hospital or other health centres had a very high infant and child mortality (1.67) followed by deliveries at home (0.65) and finally deliveries in the hospital (0.41).

4.4.3 Immunization

Mothers were asked whether they had taken their children for a complete immunization particularly for those born in the last five years.

TABLE 4.12

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY IMMUNIZATION

Immunized	$M_{ij}40$	$M_{ij}5$
Yes	0.54	0.45
Yes but not complete	0.50	0.44
No	1.07	1.15

others who reported a complete immunization had a slightly higher infant and child mortality than those who had not completed immunization (Table 4.12). Those who had not completed the vaccination were usually the young infants who were yet to complete immunization. The infant and child mortality index for mothers whose children completed the immunization is 0.45 and those who have not completed is 0.44. Mothers who did not take the infant or child for immunization have a very high infant and child mortality showing an index of 1.15. This shows that there is a marked difference, 0.7 (156%), for those who completed immunization and those who did not attend at all. The results indicate that complete immunization is important for infant and child survival.
A similar pattern is observed for the lifetime mortality.

4.4.4 **Duration of Breast-feeding.**

Table 4.13 shows that there is a general reduction in infant and child mortality with increased duration of breast-feeding.

TABLE 4.13

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY DURATION OF BREAST-FEEDING

Duration of Breast-feeding	$M_{ij}40$	$M_{ij}5$
1-6 months	0.87	0.81
6-12 months	0.45	0.40
12-18 months	0.70	0.52
18-24 months	0.49	0.43
24+ months	0.38	0.32

The infant and child mortality index for the recent mortality experience show that mothers who breast fed for 24 and above months had the lowest infant and child mortality while those who breast fed for 1-6 months had the highest infant and child mortality. Their infant and child mortality index are 0.32 and 0.81

respectively. Although the infant and child mortality decreases with increased duration of breast-feeding, mothers who breast-fed for 6-12 months had the second lowest infant and child mortality. Most women who reported to be breast-feeding for this period were those who were working, mostly teachers, who could supplement the early weaning by other nutritious food. Most of the mothers who breast-feed for 1-6 months reported that they could not continue further because of lack of breast milk. This is an evidence of the poor nutrition level that these women experience.

The general trend is that, the longer the duration of breast-feeding the lower the infant and child mortality and, that, women who breast-feed for 1-6 months have almost double the infant and child mortality rates as compared to those who breast-feed for 24 and above months.

4.4.5 Age at which Supplementary Food are Introduced.

The age at which supplementary food is introduced and the type of food given to the infant is important in that, it determines the hygienic condition and child care of a household. This is the period when the environmental factors such as poor quality of water and food start showing their effect on the infant's health. The solid foods given during the weaning period become a major cause of diarrhea among the young children. For the recent mortality experience, the infant and child mortality index indicates that mothers who introduce the food at age 1-3 months have a value of 0.53 as compared to 0.34 for those who started at age 4-6 months and 0.39 for 7+ months (Table 4.14). This shows that the age at which supplementary food is introduced is U-shape related to infant and child mortality for the recent mortality experience. This signifies that supplementary food should not be introduced at an early or late ages. For the lifetime mortality index, an inverse relationship is observed signifying that infant and child mortality is inversely related to the age at which supplementary food is introduced.

TABLE 4.14

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY AGE AT WHICH SUPPLEMENTARY FOOD IS INTRODUCED

Age	$M_{ij}40$	$M_{ij}5$
1-3 mths	0.60	0.53
4-6 mths	0.49	0.34
7+ mths	0.47	0.39

4.4.6 Type of Treatment accorded to a Sick Child

The mothers were asked to state the treatment they undertake when their children are sick. Table 4.15 shows that those who visited formal health facilities (dispensaries, health centres, hospitals or private clinics) had a lower infant and child mortality than those who did not sort any treatment (modern or traditional) or visited a traditional healer.

TABLE 4.15

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY TYPE OF TREATMENT TAKEN

Type of Treatment	$M_{ij}40$	$M_{ij}5$
Traditional Healer	1.06	0.56
Dispensary	0.54	0.46
Didn't Care	0.61	1.51

The recent infant and child mortality index indicates that mothers who did not sort any treatment had the highest infant and child death with an index of 1.51 followed by those who visited a raditional healer. Those who visited a traditional healer had an index of 0.56 while mothers who visited a formal health facility for treatment had an index of 0.46. A different trend is observed for the lifetime mortality where visits to a traditional healer resulted in high infant and child mortality than mothers who decided not to seek any remedy.

4.4.7 Number of Houses in a Compound.

The number of houses in a homestead is used to measure the overcrowding in the home. Table 4.16 shows that homesteads with 4-6 houses have a lower infant and child mortality than those with 1-3 and 7 and above houses.

TABLE 4.16

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY NUMBER OF HOUSES IN THE COMPOUND

Number of Houses	M_{40}	M_{5}
1-3	0.67	0.61
4-6	0.50	0.37
7+	0.56	0.49

In general, we would expect infant and child mortality to be directly related to the number of houses in the compound since overcrowding can ease the transmission of the infectious diseases, such as cholera, menegitis, to mention but a few. Mothers who live in homes with 1-3 houses could be using their houses for cooking and keeping their domestic animals. This can be one of the contributing factors for the high infant and child mortality that is observed.

4.4.8 Source of Energy for Cooking

The mothers were asked to state what source of energy they use for cooking their food. Table 4.17 shows that women who use paraffin as source of energy have a high infant and child mortality than those who use firewood. The infant and child mortality index for the recent mortality experience shows that mothers who use paraffin for cooking have a value of 0.94 compared to 0.45 for those using firewood.

TABLE 4.17

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY ENERGY SOURCE FOR COOKING

Source of energy	$M_{ij}40$	$M_{ij}5$
Paraffin	0.86	0.94
Firewood	0.55	0.45

4.4.9 Energy Source for Lighting

Table 4.18 shows that mothers who reported that they use paraffin as their source of lighting experienced a lower infant and child mortality than those who use firewood.

TABLE 4.18

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY ENERGY SOURCE FOR LIGHTING

Source of energy	$M_{ij}40$	$M_{ij}5$
Paraffin	0.53	0.45
Firewood	1.69	1.08

The recent infant and child mortality index indicates a value of 0.45 for mothers who use paraffin for lighting and 1.08 for those using firewood. The same trend is observed for the lifetime mortality. This implies that mothers who use firewood for lighting experience a high infant and child mortality than those who use paraffin. The use of firewood as a source of lighting shows the adverse poverty that is experienced in a rural household and therefore the observed high infant and child mortality could be as a result of lack of the basic necessity for human survival such as food, proper shelter and clothing.

4.4.10 Materials used for Roofing

Roofing material is one of the several indicators of good housing, and its quality can have an effect on infant and child mortality. Table 4.19 shows that mothers who live in grass thatched houses had a higher infant and child mortality than those living in the iron sheet houses.

TABLE 4.19

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY ROOFING MATERIAL

Material for Roofing	$M_{ij}40$	$M_{ij}5$
Grass thatched	0.57	0.49
Iron Sheet	0.43	0.25

The recent mortality index for mothers living in houses with grass thatched roofs was 0.49 and those living in houses with an iron sheet roof is 0.25. This shows that women who live in grass thatched houses experience infant and child mortality rates which is twice as high as their counterparts in the iron sheet houses. This indicates that the type of roofing material have an effect on infant and child mortality. The same trend is observed for the lifetime mortality.

4.4.11 Materials used for Walls

Table 4.20 shows that the mothers who live in houses with walls made of mud and stick have a high infant and child mortality compared to those living in houses made of brick walls. The infant and child mortality index for those living in houses with mud and stick walls is 0.46 and 0.36 for those living in houses made of stone. A similar trend is shown for the lifetime mortality.

TABLE 4.20

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MATERIALS FOR THE WALL

Wall Material	M_{ij}40	M_{ij}5
Mud and Stick	0.56	0.46
Brick	0.46	0.36

4.4.12 Materials of the Floor

TABLE 4.21

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY MATERIALS FOR THE FLOOR

Floor Material	M_{ij}40	M_{ij}5
Concrete	0.43	0.26
Cowdung	0.56	0.47
Mud	0.57	0.55

Table 4.21 shows that mothers who live in houses with concrete floors have almost 100% better chance of infant and child survival as compared to those living in houses with floors made of cow-dung and mud. The infant and child mortality index for mothers having concrete floors is 0.26 while those living in houses with cow-dung and mud floors are 0.47 and 0.55 respectively. This shows that mothers who live in houses with concrete floors have a low infant

and child mortality than those living in houses with floors that cannot be cleaned.

4.4.13 Toilet Facilities

The respondents who were interviewed were required to state whether they have a toilet facility or not. The availability of a toilet facility was measured as a dichotomous variable because there is only one type of toilet facility in this area, namely the pit latrine, meaning that the respondent who do not have a toilet facility use bush (open ground) to dispose the waste.

TABLE 4.22

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY AVAILABILITY OF A TOILET

Availability of a Toilet	$M_{ij}40$	$M_{ij}5$
Yes	0.52	0.42
No	0.69	0.69

The recent infant and child mortality index shows that women with pit latrines have a low infant and child mortality than those who did not have a toilet facility. The difference in the index is 0.27 (64%). A similar trend is observed for the lifetime mortality.

The mothers were also asked to state the age at which their children begin using or the age they thought was appropriate to start using a toilet. Table 4.23 shows that infant and child mortality is directly related to the age at which the child begins using the toilet. The use of a toilet facility at an early age ensures proper disposal of the waste and hence the hygienic condition of the surrounding is maintained or improved.

TABLE 4.23

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY
AGE AT WHICH THE CHILD BEGINS USING THE TOILET

Age(years)	$M_{ij}40$	$M_{ij}5$
1-3	0.44	0.35
4-5	0.54	0.49
6+	0.68	0.51

The mortality index for those at risk of losing a child in the last five years were 0.35, 0.49, and 0.51 for ages 1-3, 4-5, and 6+ respectively. Therefore, children should be encouraged to start using toilets at an early age.

4.4.14 Source of Water

There were two sources of water in this area namely boreholes and the wells (springs). Boreholes are mainly covered and a pipe dug into the ground while most of the wells (springs) were uncovered. Table 4.24 shows that those who use water fetched from boreholes for domestic purposes have better chance of infant and child survival than those who depend on spring (well) water. The infant and child mortality index for mothers using well water is 0.50 as compared to 0.39 for the borehole water. The index shows that use of a covered source of water have a negative influence on infant and child death.

TABLE 4.24

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY WATER SOURCE

Water Source	$M_{ij}40$	$M_{ij}5$
Well	0.59	0.50
Borehole	0.49	0.39

he quality of water was further measured by asking the respondents hether they had been boiling drinking water before being used. Table 4.25 shows that those who had been boiling water have a better chance of child survival. For mothers who are at risk of losing a child in the last five years, the mortality index for those who boil and those who do not boil are 0.30 and 0.50 respectively. Most of the mothers who boil drinking water also reported that they filtered using a clean piece of cloth before storing in a pot. There is a slight difference in the lifetime mortality index. This slight difference indicate that the treatment of water can be a recent phenomenon that can only be having an influence on the recent mortality and not the lifetime mortality experience.

TABLE 4.25

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY TREATMENT OF WATER

Treatment(Boil)	$M_{ij}40$	$M_{ij}5$
Yes	0.54	0.30
No	0.55	0.50

4.4.15 **Places Where Animals are Kept**

Domestic animals such as cows, sheep and goats are still considered as a measure of wealth in most of the rural societies. The care accorded to these animals particularly the place they sleep and the way in which their waste is disposed can affect infant and child mortality. Table 4.26 shows that mothers who share their residential units with some of these animals have the highest infant and child death. They use their residential units to keep animals such as chicken, goats, sheep or calves.

Those using open ground to keep their animals have the second highest infant and child death followed by those using their itchen. A separate place for this animals ensured a better chance f infant and child survival.

TABLE 4.26

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY PLACE WHERE ANIMALS ARE KEPT.

Place	$M_{ij}40$	$M_{ij}5$
Residential Unit	0.72	0.72
Kitchen	0.57	0.45
Separate Place	0.44	0.39
Outside (open air)	0.67	0.50

The difference in infant and child mortality for those using residential unit and separate place is 0.33 (85%). This difference has an implication that sharing a residential unit with the domestic animals can increase infant and child mortality and therefore it should be discouraged.

4.4.16 **Cooking Place**

The mothers were asked to state the place where they usually cook their food. Table 4.27 shows that there is a marked difference in mortality index by place of cooking.

TABLE 4.27

RATIO OF OBSERVED TO THE EXPECTED DEATHS BY COOKING PLACE

Place	$M_{ij}40$	$M_{ij}5$
Kitchen	0.45	0.36
Living house	0.77	0.61
Outside (open air)	0.91	1.15

Mothers who cook outside their living houses or outside (open air) experience a higher infant and child death than any other group. Mothers who use kitchen for cooking experience a low infant and child mortality followed by those who use their living houses. The difference between the mothers using a kitchen and those using open air for cooking is 0.79 (219%) suggesting that the use of a kitchen as a cooking place reduces infant and child mortality.

4.5 DISCUSSION

4.5.1 Socioeconomic Factors

Infant and child mortality shows a strong negative relationship with the level of education attained by a mother in the univariate analysis. Although maternal education level is negatively related to infant/child mortality, the difference in infant and child mortality rates between the primary and secondary school leavers is higher than that for mothers with no education level and those with primary school level of education.

A father's education does not show any consistent pattern with infant and child mortality except that those with secondary level of education had the lowest infant/child mortality while those with no education had a lower infant and child mortality than those who have attained primary school education. The inconsistency in the educational level suggests that paternal education works through other factors in lowering infant and child mortality. Paternal education appears to complement rather than substitute for a healthy environment. Education is expected to be positively related to income level but in a rural set-up a given increment in paternal education does not produce adequate income that can improve the family's well being. Moreover, even when income is relatively high in the rural areas, there is less opportunity to purchase such items as health services, which are scarcely distributed and poorly equipped. In most of the societies, child caring is solely a mother's responsibility and their educational level has been hypothesized as a replacement to the unhygienic conditions that are caused by poor environment such as lack of sanitation, poor quality of water and poor housing conditions. Fathers are expected to contribute indirectly by improving the sanitation, housing conditions, clothes and quality of food and this in turn requires a good income which is expected to be directly related to his educational level.

The mortality differentials by religious affiliations shows that catholics and protestants have a lower infant and child mortality than the African Independent Churches (Legio Maria, Roho and others). As has been stated earlier, utilization of modern medical facilities varies with religious beliefs of different sects. Some of these African Independent Churches do not belief in the modern treatment and only sort help from them as a last resort. The difference in utilization of the modern health facilities and acceptance of other modern technological changes such as use of modern contraceptive for birth spacing can be the main reason for the differences in mortality among different religious affiliations.

The differentials of infant and child mortality by the marital status of the mother reveal that single mothers have a lower infant and child mortality than the ever married women. The widowed/divorced/separated women show an unexpectedly low infant and child mortality as shown by lifetime mortality index. This could show some inaccuracy in the data particularly in reporting the right marital category by elderly women. The infant/child mortality index for mothers who are at risk of losing a child in the last five years shows that single women have a lower infant and child mortality than the ever married. The currently married women have a low infant and child mortality than the widowed,divorced and arated combined. This findings are similar to those found at the trict and divisional levels in chapter 2 and other studies that e been conducted at the national, provincial and divisional el (Kichamu, 1986; Ndede, 1988; Omurundo, 1989).

 low infant and child mortality exhibited by the single mothers ggests that there are some advantages that this group enjoy which lps reduce infant/child death. Single mothers are expected to ve several disadvantages such as low age at birth (teenage) and w birth-weight that are associated with high infant and child ath.

e participation of mothers in the labour force shows that mothers o have ever worked have a higher infant and child mortality than ose who have never worked. The participation of mothers in the abour force is indicative of the time spent in child rearing and omestic activities. Mothers who work usually have little time to ttend to their children. Reductions in maternal time devoted to hildrearing may be directly related to infant and child mortality hrough loss of specific elements in desirable infant and child are such as breast-feeding. The health hazards caused by type of ccupation the mother is involved in can also have an effect on nfant and child mortality. In this study, mothers who participated in the labour force and were wage employed experience a lower infant and child mortality than those who were self employed. It is expected that the wage employed earn more and can always replace the time they spend away by improving the household income.

A father's occupation have shown a marked difference in infant and child mortality. Those who are in the labour force experience a low infant and child mortality while the businessmen have the highest separated combined. This findings are similar to those found at the district and divisional levels in chapter 2 and other studies that have been conducted at the national, provincial and divisional level (Kichamu, 1986; Ndede, 1988; Omurundo, 1989).

The low infant and child mortality exhibited by the single mothers suggests that there are some advantages that this group enjoy which helps reduce infant/child death. Single mothers are expected to have several disadvantages such as low age at birth (teenage) and low birth-weight that are associated with high infant and child death.

The participation of mothers in the labour force shows that mothers who have ever worked have a higher infant and child mortality than those who have never worked. The participation of mothers in the labour force is indicative of the time spent in child rearing and domestic activities. Mothers who work usually have little time to attend to their children. Reductions in maternal time devoted to childrearing may be directly related to infant and child mortality through loss of specific elements in desirable infant and child care such as breast-feeding. The health hazards caused by type of occupation the mother is involved in can also have an effect on infant and child mortality. In this study, mothers who participated in the labour force and were wage employed experience a lower infant and child mortality than those who were self employed. It is expected that the wage employed earn more and can always replace the time they spend away by improving the household income.

A father's occupation have shown a marked difference in infant and child mortality. Those who are in the labour force experience a low infant and child mortality while the businessmen have the highest infant and child mortality. A father's labour participation, particularly his income, can improve the socio-economic position in the household. Its effect on the quality and quantity of nutritional input; the quality of the dwelling unit and the use of medical care can improve the infant and child survival chances in the household.

4.5.2 Health Care Factors

It is reasonable to expect infant/child survival to be associated with the availability of health care services. Access to modern medical facilities throughout a mother's pregnancy, at delivery, and during infancy and early childhood is thought to be particularly important in reducing mortality.

The analysis has shown that the use of modern medical care facilities, from the time of conception to early childhood, have an inverse relationship to infant and child mortality. In the univariate, mothers who visit antenatal clinic; place of delivery; immunization; duration of breast-feeding; age at which supplementary food is introduced; the type of medical attention sorted for a sick infant/child have an inverse relation with infant and child mortality. Visits to antenatal clinic during pregnancy reduces the effect of neonatal tetanus, which is a major cause of death for neonatal in the developing countries. The place of delivery can determine the treatment accorded to the umbilical cord. The unhygienic treatment accorded at home can increase the neonatal deaths due to tetanus. Immunization of infants/children against DPT, BCG, and Polio reduces the infant and child mortality. Lack of immunization from these diseases has diverse effects on infant/child survival. Duration of breast-feeding and the age at which supplementary food are introduced are important in etermining the health of the infant. Breast-feeding is inversely elated to infant and child mortality. Breast-feeding, is very mportant in the first six months before the introduction of upplementary food. It is the best food for babies at this age and elps to prevent and stop infections including diarrhoea. The iming of introduction of supplementary feeding showed a U-shaped elation with infant/child mortality. Infants who were introduced o supplementary food during the first three months and after 6 onths from the time of birth have a high infant and child mortality rates than those who start at ages 4-6 months. This shows that introducing supplementary foods at an early and late ages influence infant and child mortality. The effect of breast-feeding in sustaining infants health is only effective in the early months and a timely introduction of supplementary food is required to reduce the chances of the infant/child to suffer from malnutrition. During this period, episodes of diarrhea, and infections of the respiratory tract as well as malaria, which result from a contaminated water supply, inadequate feces disposal and unhygenic conditions at home begin influencing the infant's health.

4.5.3 Environmental Risk Factors

The univariate analysis shows that the characteristics of the dwelling-place have important influence on infant and child mortality. The role of infectious disease in mediating the effect of the family dwelling on infant and child mortality has been noted by others. Feachem (1981) pointed out that, of the infectious diseases related to water-supply and lavatory facilities, diarrhoeal diseases are of greatest importance and that the reduction of these diseases would be the major benefit of programmes launched to improve dwelling units and the facilities therein.

The observed effect of all environmental factors is to reduce the risk of infant and child mortality. Availability of safe drinking water, toilet facilities, and modern type of housing are associated with a lower infant and child mortality. In the developing countries, a much greater proportion of deaths is due to disease borne by water, food and feces, the prevention of which appears to be responsive to improved personal hygiene and this requires improvement in educational.

The importance of safe drinking water in reducing infant and child mortality need not be emphasized. A significant proportion of infant and child mortality is attributable to water-borne diseases and thus provision of safe drinking water can bring down infant and child mortality to a noteworthy level. The marginal difference in mortality level between the two sources of water could be due to the fact that the borehole is a recent phenomena and the water drawn from them is not free from infections.

The material used in the construction of roof, wall, and floor of a house shows a substantial effect on the level of infant and child mortality. Infant and child mortality is lowest among families who live in houses with a concrete floor, stone/brick walls, and iron sheet roofs and highest among families who live in mud houses with grass thatched roofs. The reason for such a difference could be that, infants/children in grass thatched-roof houses are more exposed to the risk of respiratory and other infectious diseases. However, these differences in mortality levels could also be due to socio-economic conditions of the family which is reflected by the type of housing.

CHAPTER 5

ULTIPLE LINEAR ANALYSIS OF INFANT AND CHILD MORTALITY AT NDIVIDUAL LEVEL

.1 INTRODUCTION

n this chapter, our main aim is to look at the multiple regression nalysis of the factors that affect infant and child mortality at icro-level for mothers who are at risk of losing an infant/a child. The analysis uses SPSS package and the selection of ariables is determined by using a method known as STEPWISE.

5.2 MULTIPLE LINEAR ANALYSIS

Multiple linear regression, can be used to fit models involving the main effects of categorical and/or interval scaled regressors, and specified interactions between them.

The data for regression analysis consist of values for each individual i of a response variable Y_i and a set of regressors, X_{i1}, X_{i2}, X_{i3},....,X_{ik}. Multiple linear regression calculates a fitted value $\hat{Y}_i$ for each individual i which is a linear combination of the regressor values for that individual. that is, it takes the form

$$Y_i = b_0 + \sum_{j=1}^{K} (b_j * X_{ij}) \text{. ....} \quad (5.1)$$

and is as close as possible to the observed value, Y_i. Specifically, values of the intercept b_0 and the slopes b_1, b_2......b_K are chosen so that the fitted values minimize the sum of squared deviations

$$SS = \sum_i (Y_i - Y_i)^2 \text{ ....} \quad (5.2)$$

Associated with this calculation is a decomposition of the response Y_i into the fitted value, $\hat{Y}_i$, and the residual, $Y_i - \hat{Y}_i$. If Y_i is asured as a deviation from the sample mean $\bar{Y}$, we have

$$Y_i-\bar{Y} = (Y_i-\hat{Y}_i) + (\hat{Y}_i-Y) \quad \text{.................. (5.3)}$$

uaring and summing over the observations, the cross-product terms $(Y_i - \bar{Y}) * (Y_i - \hat{Y}_i)$ sum to zero and we obtain the analysis of riance decomposition

$$\sum_i (Y_i - \bar{Y})^2 = \sum_i (Y_i - \hat{Y}_i)^2 + \sum (\hat{Y}_i - Y)^2 \quad \text{.....................(5.4)}$$

$$SS_T = SS_{RES} + SS_{REG}$$

hat is, the total corrected sum of squares, SS_T, with n-1 degrees f freedom, decomposes into sum of squares for the regression, S_{REG}, with k degrees of freedom, and the residual sum of squares, S_{RES}, with n-k-1 degrees of freedom. The basic output of regression s the set of regression coefficients, b_0, b_1,..., b_k.

.2.1 Treatment of factors in Regression

.2.1a A Single Factor

nterval scaled covariates, such as age and number of years an ndividual has completed in school, are introduced directly into a regression without recoding. On the other hand, the treatment of categorical variables, and the interpretation of the regression coefficients obtained for them requires more care.

We first consider a simple regression on a dichotomous variable, that is, a variable with two categories. For example, suppose that the response Y_i is the mortality index for individual i and X_i is a variable taking the value one for women with formal education and zero otherwise i.e.

$$X_i = \begin{cases} 1 \text{ if woman have formal education} \\ 0 \text{ otherwise} \end{cases} \quad \text{........ (5.5)}$$

then, the fitting equation, specifies that predicted mean mortality dex $\hat{Y}_i$ takes the form

$$\hat{Y}_i = b_0 + b_1X_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5.6)$$

here b_1 is the slope and b_0 is the intercept. Hence the predicted ean mortality index for women with no education and for women with ormal education are obtained by substituting $X_i = 0$ and $X_i = 1$ espectively in equation 5.6 :

$$(\hat{Y}_i / X_i = 0) = b_0, \quad (\hat{Y}_i / X_i = 1) = b_0 + b_1 \ldots\ldots(5.7)$$

Hence b_0 is the predicted mean for individuals with $X_i = 0$ and b_1 is the difference in predicted means between individuals with $X_i = 1$ (that is, educated women) and individuals with $X_i = 0$ (that is, uneducated women). Note that the original interpretation of regression coefficients still remains. The slope, b_1, represents the increase in the fitted mean obtained by changing $X = 0$ and $X = 1$, which is equivalent to switching from the uneducated to the educated group.

Now consider a factor with $K > 2$ groups. For example, let us consider the factor level of education (LVED) with K=4 groups, NO EDUCATION, 1-5 YEARS, 6-9 YEARS and 10 OR MORE YEARS. Suppose these levels are coded 1 to 4 and the variable introduced into the regression as a covariate, then the regression model will predict means for the four groups which are equally spaced. That is, if the intercept and slope are b_0 and b_1 respectively the predicted means for the four groups are $b_0 + b_1$, $b_0 + 2b_1$, $b_0 + 3b_1$, $b_0 + 4b_1$, and thus adjacent groups all differ by the quantity b_1. This procedure effectively assumes an ordering between the categories, which is justified for this variable but does not make sense for unordered factors such as Religion. The imposition of equal spacing betweer he category means is often less desirable and implies that the regression is not analogous to the cross-tabulation of mean mortality index, as was the case for a binary factor. We now give an alternative treatment of factors which does correspond to cross-tabulation in the simple case when a single factor is included in the regression. For a K-category variable, one category is selected and called the *reference* category. For each of the (K-1) other categories, a *dummy* or *indicator* variable is defined, taking value one for individuals falling in that category and zero otherwise. Here we chose NO SCHOOLING as the reference category, and define K-1 = 3 variables

$$PRIM = \begin{cases} 1 & \text{1-5 years education,} \\ 0 & \text{otherwise;} \end{cases} \quad \text{.........(5.8)}$$

$$RSEC = \begin{cases} 1 & \text{6-9 years of education,} \\ 0 & \text{otherwise;} \end{cases} \quad \text{........(5.9)}$$

$$HIGH = \begin{cases} 1 & \text{10 or more years of education,} \\ 0, & \text{otherwise.} \end{cases} \quad \text{.............(5.10)}$$

The factor is represented in the regression by the set of dummy variables defined thus, in this case PRIM, RSEC and HIGH.

To see the effect of this, note that the fitted values from the regression are

$$\hat{Y}_i = b_0 + b_1 PRIM_i + b_2 RSEC_i + b_2 HIGH_i, \quad \text{..............(5.11)}$$

where $PRIM_i$, $RSEC_i$ and $HIGH_i$ are the values of PRIM, RSEC and HIGH for respondent i. For individuals with no education, $PRIM_i = RSEC_i = HIGH_i = 0$. Hence the predicted mean is

$$(\hat{Y}_i / LVED=1) = b_0, \quad \text{....................(5.12)}$$

e intercept of the regression. For individuals with 1-5 years ucation, PRIM = 1 and RSEC = HIGH = 0. Hence the predicted mean

$$(\hat{Y}_i /LVED=2) = b_0 + b_1, \qquad (5.13)$$

milarly for the categories of education we obtained predicted ans

$$(\hat{Y}_i /LVED=3) = b_0 + b_2, \quad (\hat{Y}_i /LVED=4) = b_0 + b_3. \qquad (5.14)$$

ence *the intercept b_0 is the fitted mean for the reference ategory, and the slope b_j is the difference in the fitted mean etween category j+1 and the reference category*. These properties re of central importance in the interpretation of regressions with actors.

.2.1b **Two or More Factors**

ow suppose we add another factor to the regression. As with LVED, his is represented in the regression by a set of dummy variables. reference category is chosen, and dummy variables are defined for he other categories e.g. in religion, we can take Catholic as a eference category and then define Protestants and Muslims as dummies. If this is added to the equation, the regression model is given by

$$b_0 + b_1 PRIM + b_2 RSEC + b_3 HIGH + b_4 PROT + b_5 MUS. \qquad (5.15)$$

5.2.2 Assumptions of Multivariate Regression

The assumption of multivariate regression implies linearity in the parameters (homogeneity of the error variances) and the additivity of effects, i.e. the covariance matrix for the dependent variable employed is a constant function of the remaining variables of the system.

ltiple regression analysis gives the values of the estimates of ie regression weights and also their standard errors. Hence the edicted criterion, ($\hat{Y}_i$), can be obtained and the relationship tween the predicted value and the actual values gives us the iltiple correlation coefficient, R. This is obtained from the elation

$$R^2 = 1 - \frac{\Sigma(Y_i - \hat{Y}_i)^2}{\Sigma(Y_i - \bar{Y})^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.15)$$

here R^2 is the coefficient of determination. R^2 measures the oodness of fit. If all the observations fall in the same line the R^2 is 1 and if there is no linear relationship then $R^2 = 0$.

5.2.3 Testing Hypotheses

A frequently tested hypothesis is that there is no linear relationship between X and Y - that the slope of the population regression line is 0. The statistic used to test this hypothesis is

$$t = \frac{b_1}{S_{b_1}}$$

Where, b_1 is regression coefficient and S_b is the standard deviation of b_1.

The distribution of the statistic, when the assumptions are met and the hypothesis of no linear relationship is true, is Student's t distribution with N-2 degrees of freedom. The statistics for testing the hypothesis that the intercept is

$$t = \frac{b_0}{S_{b_0}}$$

where, b_0 is the constant coefficient of regression and S_b is the

tandard deviation of b_j.
ts distribution is also Student's t with N-2 degrees of freedom.

he results from multivariate analysis are examined to enable us stimate mortality differentials by the variable of interest when ther variables are controlled. The method employed for this urpose is the ordinary least square (OLS) multiple regression nalysis. The dependent variable of the regression is the child ortality ratio.

The form of the regression equation is

$$M_{ij} = A + \Sigma B_k * X_{ij} + e$$

Where

X_{ij} = value of kth variable for woman i

B_k = coefficient of variable k

A = constant term

e = error term, assumed normally distributed.

5.3 STEPWISE REGRESSION ANALYSIS

A stepwise regression procedure is an option that enters variables into the equation in their order of importance (that is amount of additional variation is explained). This procedure is stopped when the F-value or t-value for the inclusion of an additional variable is no longer significant.

In this study we are going to regress the health care and the environmental risk factors first before adding the socioeconomic factors. This is considered appropriate because it is assumed, from the Mosley and Chen Model which is applied in this study, that the socieconomic factors act through the proximate determinants to influence infant and child mortality. The multiple regression analysis is carried out for both the lifetime and the recent infant and child mortality indices. The infant and child mortality index is taken as the dependent variable and all the variables that were considered in the last chapter, are entered in the equation and a stepwise regression analysis is carried out. As stated earlier, the model used is of the form

$$Y_i = b_0 + b_1*X_1 + \ldots\ldots + b_k*X_k + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.17)$$

where X_is' are the variables in the equation and b_is' are the regression coefficients. They indicate the association between the dependent variable (infant and child mortality index) and the independent variables.

By fitting this model to the Ordinary Least Square (OLS), the regression of the health care and environmental risk factors at 0.05 level of significance for the t-value, shows that only the cooking place is significant with a R^2 value of 0.01935 for mothers who are at risk of losing an infant/child in the last five years. When we take the infant and child deaths for those who cook in the open air as the reference category, mothers who use kitchen (which is denoted by PLCOOK1) have a negative influence on infant and child mortality as shown in Table 5.1 below.

TABLE 5.1

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR RECENT MORTALITY EXPERIENCE AT 0.05 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.28323	0.10871	-0.13910	-2.605	0.0096
Constant	0.64674	0.08921		7.249	0.0000

From Table 5.1, the interpretation is that,

Y_i = 0.64674 - 0.28323(PLCOOK1).

Where Y_i = the mortality index (dependent variable).

PLCOOK1 = cooking in the kitchen.

At 0.1 level of significance, cooking place; source of cooking energy; and place of delivery have an effect on infant and child mortality. For the source of cooking energy, we took other sources (charcoal) as our reference category and found that mothers who use paraffin (which is denoted by COOKM1) for cooking experience a high infant and child mortality. Delivery at home (denoted by PLODE2) shows a high infant and child mortality with the deliveries in the hospital as the reference category. The overall R^2 for these three categories is 0.03793. Table 5.2 shows the variables with their coefficients and the t-values.

TABLE 5.2

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR THE RECENT MORTALITY EXPERIENCE AT 0.10 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.25737	0.10962	-0.12640	-2.348	0.0194
COOKM1	0.54653	0.27724	0.10473	1.971	0.0495
PLODE1	- 0.17943	0.10308	0.09380	1.741	0.0826
constant	0.52584	0.18010		4.864	0.0000

From Table 5.2, the interpretation is that,

Y = 0.52584 - 0.25737(PLCOOK1) + 0.54653(COOKM1) + 0.17943(PLODE1).

Where Y_i = mortality index.

PLCOOK1 = cooking in the kitchen.

COOKM1 = cooking with paraffin.

PLODE1 = delivering in a medical centre (hospital).

For the lifetime infant and child mortality index, at 0.05 level of significance, cooking place; lighting energy; visits to antenatal clinic; place of delivery; and duration of breast-feeding are significant. For lighting energy, mothers who use paraffin is taken as a reference category and those who use firewood (denoted by LIGHM2) have a high infant and child mortality compared to those using paraffin. Women who visited antenatal clinic (ANTCL1) experience a low infant and child mortality compared to those who did not, which is taken as a reference category. Duration of breast-feeding 12-18 denoted by BREFEED3 shows a high infant and child mortality as compared to the reference category which is 24 and above months. This shows that the duration of breast-feeding is inversely related to infant and child mortality. The overall R^2 value is 0.08700. Table 5.3 shows these variables and their coefficients with respect to their reference categories.

TABLE 5.3

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR THE LIFETIME MORTALITY AT 0.05 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.27736	0.08558	-0.15704	-3.241	0.0013
LIGHM2	0.94566	0.35836	0.12648	2.639	0.0086
ANTCL1	-0.63122	0.26584	-0.11272	-2.374	0.0180
PLODE1	-0.17845	0.07885	-0.10835	-2.263	0.0241
constant	1.37674	0.27319		5.039	0.0000

At 0.1 level of significance, the same variables are still significant.

After analysing using only the proximate determinants, we introduce the socioeconomic factors which are at a higher level to see if the proximate determinants which are explained in this study ave taken care of their effect on infant and child mortality. For the recent mortality index, it was found that place of cooking; paternal educational level; and paternal occupation have a significant effect on infant and child mortality at 0.05 level of significance. The attainment of secondary school education (denoted by MEDUC3) have a negative influence on infant and child mortality when the reference category is taken as 'none'. Fathers who were involved in business (PAWOR4) showed a high infant and child mortality than the wage employed which is the reference category. The R^2 value for these three variables which are shown in Table 5.4 is 0.05157.

TABLE 5.4

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF SOCIO-ECONOMIC, ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR THE RECENT MORTALITY EXPERIENCE AT 0.05 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.25891	0.10746	-0.12716	-2.409	0.0165
PAWOR4	0.38344	0.16532	0.12260	2.319	0.0210
MEDUC3	-0.40420	0.17428	-0.12263	-2.319	0.0210
constant	0.62785	0.09139		6.870	0.0000

At a 0.1 level of significance, other variables such as cooking place; age at which supplementary food is introduced; and place where animals are kept are added and the R^2 value rises to 0.07580. Cooking place is defined as in the previous case. The introduction of supplementary food at an early age increases the infant and child mortality as shown in Table 5.5. Mothers who keep their domestic animals in their living units (ANPLAC1) experience a high infant and child mortality as compared to the reference category (open air). It is worth mentioning that the effect of place of delivery (PLODE2) is not significant when the socioeconomic factors are added (compare Table 5.2 and Table 5.5).

TABLE 5.5

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF SOCIO-ECONOMIC, ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR THE RECENT MORTALITY EXPERIENCE AT 0.10 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.22738	0.10838	-0.11167	-2.098	0.0366
PAWOR4	0.43829	0.16530	0.14014	2.651	0.0084
MEDUC3	-0.36699	0.17334	-0.11134	-2.117	0.0350
COOKM1	0.54337	0.27403	0.10412	1.983	0.0482
SUPPF	-0.03126	0.01801	-0.09114	-1.736	0.0834
ANPLAC1	0.28112	0.16919	0.08877	1.662	0.0975
constant	0.67570	0.11762		5.745	0.0000

TABLE 5.6

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF SOCIOECONOMIC, ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR LIFETIME MORTALITY AT 0.05 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.29931	0.08394	-0.16947	-3.566	0.0004
MEDUC3	-0.43503	0.13605	-0.15011	-3.198	0.0015
LIGHM2	0.89792	0.35488	0.12010	2.530	0.0118
ANTCL1	-0.62516	0.26256	-0.11164	-2.381	0.0177
BREFEED3	0.19535	0.08926	0.10242	2.189	0.0292
PAWOR3	0.29477	0.14150	0.09777	2.083	0.0379
constant	1.32323	0.27045		4.893	0.0000

Table 5.6 shows the regression statistics obtained by regressing the socioeconomic, environmental risk and the health care factors at 0.05 level of significance for the lifetime mortality. It is observed that the effect of delivering in the hospital (PLODE1) that was significant when only environmental risk and health care factors was regressed with the lifetime mortality index is eliminated when the socioeconomic factors are added. Cooking in the kitchen (PLCOOK1), using Firewood for Lighting (LIGHM2) and Visits to an Antenatal Clinic (ANTCL1) are still significant. Apart from

the three, attainment of Secondary school education for the mother (MEDUC3), Father's occupation, working in somebody's farm (PAWOR3) and Breast-feeding for 12-18 months (BREFEED3) are significant. The effect of attainment of secondary school education for the mother has a negative effect compared to the reference category which is No Education (none). The reference category for breast-feeding is 24+ months and that of Father's occupation is wage employed. The R^2 value is 0.10920. This implies that the six variables contribute to 10.920% of the difference.

TABLE 5.7

STATISTICS FOR VARIABLES IN EQUATION FOR THE EFFECT OF SOCIOECONOMIC, ENVIRONMENTAL RISK AND HEALTH CARE FACTORS ON INFANT AND CHILD MORTALITY FOR LIFETIME MORTALITY AT 0.10 LEVEL OF SIGNIFICANCE.

Variable	B	SE B	Beta	T	sig T
PLCOOK1	-0.28934	0.08387	-0.16382	-3.450	0.0006
MEDUC3	-0.38245	0.13967	-0.13197	-2.738	0.0064
LIGHM2	0.88006	0.35193	0.11771	2.501	0.0128
ANTCL1	-0.65153	0.26176	-0.11634	-2.489	0.0132
BREFEED3	0.18932	0.08866	0.09929	2.135	0.0333
PAWOR3	0.29936	0.14205	0.09929	2.107	0.0357
MARST1	0.32871	0.13322	0.15425	2.467	0.0140
MARST4	0.32164	0.18054	0.11099	1.782	0.0756
RADOW1	0.14577	0.07888	0.08851	1.848	0.0653
PLODE1	-0.13780	0.07905	-0.08366	-1.743	0.0821
constant	1.03743	0.29209		3.552	0.0004

For 0.1 level of significance, apart from the variables that are significant at 0.05 level, Married women (MARST1); Widowed/Divorced/Separated (MARST4); Ownership of a Transistor radio (RADOW1) and Delivery in the hospital (PLODE1) are significant (Table 5.7). The reference category for marital status is Single, for ownership of a transistor radio is Not having one and that of place of delivery is Delivery at Home. The R^2 value is 0.13621 which implies that these variables contribute to 13.621%.

5.4 DISCUSSION

The univariate analysis can only show the effect of a given variable on infant and child mortality but cannot measure the level of significance of the variable. In order to determine the strength of a given variable, a multivariate regression analysis was carried out.

In this study, we observe that maternal level of education and, in particular, the attainment of secondary school education have a negative influence on infant and child mortality compared to the reference category. The significance of the secondary school education in this study shows that it does not influence infant and child death entirely through the environmental risk and the health care factors.

In general, maternal education is expected to work through other household factors such as health care and hygienic conditions in influencing infant and child mortality.

Father's level of education shows no significant effect on the infant and child mortality. In most societies, men are discouraged from day-to-day child-caring and their educational contribution can only work through other household factors such as improved medical care, sanitation and dwelling unit. The direct relationship between infant and child mortality and businessmen (PAWOR4) as compared to the wage employed (reference category) for the recent mortality experience and working in somebody's farm (PAWOR3) for the lifetime mortality shows that the economic return for businessmen and those working in somebody's farm is low and cannot improve the health care and environmental factors.

Age at which supplementary food is introduced and the visits to the antenatal clinic are and negatively related to infant and child mortality as indicated by the coefficients and their influence on infant and child mortality is significant at 0.1 level. Since an infant can not depend on breast-feeding alone for a long period i.e. over six months, a timely introduction of supplementary food is required inorder to reduce infant and child mortality.

Place of cooking which has a significant effect at 0.05 level is an important dwelling unit variable that can determine the hygienic condition of the household and hence its cleanliness is essential for infant and child survival. Poor cooking place such as unventilated houses and poor cooking energy source such as wood can increase the chances of contracting respiratory diseases.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY

6.1.1 Introduction

The purpose of this study was to investigate the effect of socioeconomic and environmental risk factors on infant and child mortality at divisional and individual level in Siaya District. The investigation involved the use of 1979 census data and field data collected in Jera sub-location situated in Ukwala Division, a Division which showed the highest infant and child mortality.

The 1979 census data was used to determine the levels and differential of infant and child mortality at the divisional level. Trussell's technique of estimating child mortality levels along with the Coale-Demeny life tables were used to calculate the mortality levels. Further analysis was done at individual level using the field data collected by the use of a coded questionnaire. The sample size obtained was 415 women aged 15-49 years and have given birth at least once. Out of these (415), 346 had given birth in the last 5 years and thus being at a risk of losing an infant/child during that period. In this analysis, the effect of socioeconomic and environmental risk factors on infant and child mortality was determined using descriptive, univariate, and multiple regression analysis. A stepwise regression was done to determine significant determinants of infant and child mortality differential at the individual level. The dependent variable at individual level is an infant and child mortality index, M_{ij}, developed by Trussell and Preston in 1982. The index is a ratio of the actual to expected deaths for a woman i in age group j. The expected deaths is q(x)/G(j) values calculated by Trussell's technique for estimating child mortality for a recent data which in this case was 1979 census data for Ukwala Division.

Some of the limitations in this study are misreporting and under-reporting of age and children ever born and children dead in Siaya district during the 1979 census. In the case of field data, lack of adequate funds and time forced us to fix the sample size in advance.

6.1.2 Mortality Differentials By All Cases Combined

Despite the limitations, several findings were made both at divisional and individual levels.

Table 6.1 gives a summary of infant and child mortality estimates based on the 1979 census data in Siaya District at the divisional level.

TABLE 6.1

INFANT, CHILD MORTALITY RATES AND LIFE EXPECTANCY AT BIRTH AT DIVISIONAL LEVEL IN SIAYA DISTRICT USING 1979 CENSUS DATA

	$_1q_0$	$_4q_1$	e_0
Siaya	172.7	103.6	41.21
Bondo	157.7	92.4	43.43
Yala	167.1	100.4	41.96
Boro	179.8	108.7	40.20
Ukwala	190.4	116.2	38.74

Bondo Division had the lowest infant and child mortality in Siaya District. Yala Division had the second lowest levels of $_1q_0$ and $_4q_1$ while Ukwala had the highest values of $_1q_0$ and $_4q_1$. The life expectancy at birth which takes into consideration the values of q(2), q(3) and q(5) showed that Bondo had the highest life expectancy with a value of 43.43 years and Ukwala had the lowest with a value of 38.74 years. Generally, Bondo and Yala Divisions had a low infant and child mortality than that of the district.

Ukwala and Boro have a higher value compared to the district's average. There are several hypotheses that have been used to explain the differences in the district's mortality differentials among them being that the sugarcane plantation in Ukwala and Yala is one of the contributing factors in the high infant and child mortality. The poor road communication and high population density in Ukwala can also be a contributing factor. In general Siaya district has a low socioeconomic development which can be the major contributing factors to the high infant and child mortality.

Since the infant and child mortality levels observed occurred in the previous years, a time reference period was calculated for different values of q(x). The findings in this study was that Bondo and Yala had a drastic decline in infant and child mortality between 1963 and 1967 while Boro and Ukwala showed a slight decline during this period. Thereafter there was a steady increase in infant and child mortality in the later periods. This decline and rise in infant and child mortality coincides with the socioeconomic and political development in the district.

6.1.3 Differential by Educational Level

Table 6.2 gives a summary of the probability of dying at age 5, q(5), by educational levels in Siaya District.

TABLE 6.2

INFANT AND CHILD MORTALITY RATES AT DIVISIONAL LEVEL IN SIAYA DISTRICT BY MOTHER'S EDUCATIONAL LEVEL USING 1979 CENSUS DATA

	None		Primary		Secondary	
	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$
Siaya	195.4	119.8	147.4	85.6	107.5	54.2
Bondo	175.9	105.9	143.8	83.1	89.3	41.3
Yala	183.8	111.6	142.1	81.7	96.6	46.3
Boro	195.6	120.0	148.1	86.1	109.6	55.7
Ukwala	206.0	127.3	158.7	93.7	131.4	73.1

The Table shows an inverse relationship between mother's level of education and infant and child mortality levels. The attainment of secondary school education reduces the infant and child mortality by a considerable level. Ukwala experiences the highest infant and child death for mother's with no formal and primary education while Boro experience the lowest at the secondary school level. However; the life expectancy at birth which takes into consideration q(2), q(3), and q(5); shows that Bondo has a better chance of infant and child survival while Ukwala has the lowest chance of infant/child mortality in all the educational levels (Table 6.3). Yala has a slight advantage over Boro.

TABLE 6.3

LIFE EXPECTANCY AT BIRTH AT DIVISIONAL LEVEL IN SIAYA DISTRICT BY MOTHER'S EDUCATIONAL LEVEL USING 1979 CENSUS DATA

	None	Primary	Secondary
Siaya	38.06	45.03	51.86
Bondo	40.75	45.58	55.27
Yala	39.64	45.87	53.90
Boro	38.04	44.92	51.49
Ukwala	36.70	43.26	47.67

The difference in life expectancy at birth between mothers with no formal education and those with secondary level education is at least 11 years in all the divisions. This difference is large enough to suggest an improvement in maternal education as a means of reducing infant and child mortality in the district.

6.1.4 Differential by Place of Residence

Table 6.4 and 6.5 shows the differential in the infant and child mortality rates and life expectancies at birth by mother's place of residence. Generally, mothers who reside in an urban area experience a lower chance of infant and child death than those esiding in the rural areas. However, in Bondo Division the rural esidents have a lower probability of infant and child death than he urban residents.

TABLE 6.4

INFANT AND CHILD MORTALITY RATES AT DIVISIONAL LEVEL IN SIAYA DISTRICT BY MOTHER'S PLACE OF RESIDENCE USING 1979 CENSUS DATA

	Rural		Urban	
	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$
Siaya	173.1	103.9	148.4	86.3
Bondo	157.6	92.9	168.7	100.8
Yala	163.7	97.2	132.0	73.5
Boro	190.4	116.2	145.7	84.4
Ukwala	189.8	115.8	157.0	92.5

TABLE 6.5

LIFE EXPECTANCY AT BIRTH AT DIVISIONAL LEVEL IN SIAYA DISTRICT BY MOTHER'S PLACE OF RESIDENCE USING 1979 CENSUS DATA

	Rural	Urban
Siaya	41.15	44.87
Bondo	43.43	41.80
Yala	42.52	47.58
Boro	38.74	45.29
Ukwala	38.38	43.53

6.1.5 **Differential by Marital Status**

The differentials in the probability of dying at age 5, q(5), by marital status shows that the single have a better chance of child survival than the ever married women (currently married; widowed; and divorced and separated). Among the ever married women, the widowed experience a higher infant and child mortality rates as shown by $_0q_1$ and $_4q_1$ and a low life expectancies at birth. Table 6.6 and 6.7 give a summary of the infant and child mortality rates and the life expectancy at birth respectively among the divisions.

TABLE 6.6

INFANT AND CHILD MORTALITY RATES AMONG THE DIVISIONS IN SIAYA DISTRICT BY MOTHER'S MARITAL STATUS USING 1979 CENSUS DATA

	Single		Married		Widowed		Divorced & Sep.	
	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$	$_1q_0$	$_4q_1$
Siaya	164.9	98.0	166.0	98.8	207.5	128.4	176.0	106.0
Bondo	147.9	86.0	151.2	88.3	176.4	106.3	172.0	103.1
Yala	141.9	81.5	157.6	92.9	224.1	140.3	158.0	93.2
Boro	165.1	98.2	173.7	104.3	189.1	236.5	163.7	97.2
Ukwala	160.0	94.6	182.3	110.7	228.7	143.6	217.3	135.4

TABLE 6.7

LIFE EXPECTANCY AT BIRTH AMONG THE DIVISIONS IN SIAYA DISTRICT BY MOTHER'S MARITAL STATUS USING 1979 CENSUS DATA

	Single	Married	Widowed	Divorced & Sep.
Siaya	42.85	42.19	36.49	40.73
Bondo	44.95	44.43	40.67	41.67
Yala	45.90	43.44	34.44	43.37
Boro	42.33	41.07	34.91	42.52
Ukwala	43.08	39.80	33.88	35.27

6.1.6 Infant and Child Mortality at Micro level

At the micro-level, it was found that infant and child mortality is inversely related to the socioeconomic and environmental risk factors in the household. Variables used to identify the most important factors were: maternal educational level; marital status; religion; labour participation; father's occupation; antenatal, natal and postnatal care; type of housing; availability and use of a toilet; source of water and cooking place have an influence on infant and child mortality. Using stepwise method of multiple regression, it was found that the effect of place of cooking, mother's level of education and father's occupation on infant and child mortality were significant at 0.05 level for recent mortality experience. At a level of 0.1, place of cooking; mother's level of education; father's occupation; source of energy used for cooking;

ge at which supplementary food are introduced; and visits to ntenatal clinic has a significant effect on infant and child ortality.

t 0.05 level of significance, the regression equation is as ollows:-

Y_1 = 0.62785 - 0.25891(KITCHEN) + 0.38344(BUSINESSMAN) - 0.40420(SEC. EDUC. for mothers).

and at 0.1 level of significance,

Y_1 = 0.67570 - 0.22738(Cooking in the KITCHEN) + 0.43829(BUSINESSMAN) - 0.36699(SEC. EDU. for mothers) + 0.54337(PARAFFIN as a source for cooking) - 0.03126(AGE AT WHICH SUPPLEMENTARY FOOD IS INTRODUCED) + 0.28112(ANTENAL VISITS during pregnancy).

For the lifetime mortality index, the correlation coefficients are as follows:-

Y = 1.32323 - 0.29931(Cooking in the KITCHEN) - 0.43503(SEC. EDU. for mothers) + 0.89792(PARAFFIN as a source for cooking) - 0.62516(ANTENATAL VISITS during pregnancy) + 0.19535(BREAST-FEEDING for 12-18 months) + 0.29477(WORKING IN SOMEBODY'S FARM).

and at 0.1 level of significance,

Y_1 = 1.03743 - 0.28934(Cooking in the KITCHEN) + - 0.38245(SEC. EDU. for mothers) + 0.88006(PARAFFIN as a source for cooking) - 0.65153(ANTENAL VISITS during pregnancy) + 0.18932(BREAST-FEEDING for 12-18 months) + 0.29936(WORKING IN SOMEBODY'S FARM)

- 0.32871(CURRENTLY MARRIED) +0.32164(WIDOWED/DIVORCED/SEPARATED) - 0.14577(OWNERSHIP OF A TRANSISTOR RADIO) - 0.13780(DELIVERY AT HOSPITAL).

5.2 CONCLUSIONS

Within the limitations of this study, the following conclusions can be drawn at the divisional level:

(a) Using the 1979 census data and the Trussell's child mortality technique, the level of infant and child mortality in Siaya District is very high. Infant mortality rate, $_1q_0$; child mortality rate, $_1q_1$; and the probability of dying at age 2, q(2), are 172.7, 103.6 and 208.8 per 1000 live births respectively. This high infant and child mortality in the district results into a low life expectancy at birth, e_0, of 41.21 years. Ukwala Division has the highest infant and child mortality rate with $_1q_0$, $_1q_1$ and q(2) values of 190.4, 116.2 and 234.0 respectively and a life expectancy at birth of 38.74 years while Bondo Division has the lowest with $_1q_0$, $_1q_1$ and q(2) values of 157.7, 92.4 and 192.7 respectively and a life expectancy at birth of 43.43 years.

(b) The differences in maternal education, marital status and place of residence have an effect on infant and child mortality. Maternal education is inversely related to infant and child mortality showing a difference of at least 11 years between those with no formal and those with secondary level education. Single women have a lower infant and child mortality than the ever married. In the ever married category the widowed experiences a higher infant and child mortality rate. The differential on infant and child mortality by place of residence shows that, the rural residents have a higher infant and child mortality than the urban wellers except for Bondo where the converse holds.

At the individual level, the mechanism which influences infant and child mortality and helps sustain it at a high level in Siaya District can be divided into two parts:

(i) the social and economic environment in which births take place, and

(ii) the physical environment in which infants/children live following birth.

One of the most important factors influencing infant and child mortality is the rampant poverty among the rural masses. Most of the people in the rural areas live below the poverty line and do not get the minimum required calorie intake.

Some of the cultural beliefs and practices which restrain them from eating certain type of foods during pregnancy also put women in a disadvantageous position and aggravate the problem of malnutrition among them. Our observations shows that the work schedule of women in rural Siaya is very strenuous and that they have to work for long hours even during their pregnancy. Thus, the strenuous work and the low calorie intake can lead to high infant and child mortality.

While lack of medical care, low income and low educational level are part of the social environmental that interact to set the stage for the common killers of infants/children, the elements of physical environment which play a vital role in aggravating the situation are the poor housing condition, sanitation and water supply.

n Siaya District, a large number of villages are still without any otable source of water. Even when water is available, the gnorance and carelessness in its management, like the use of nclean utensils for taking water out of the pots and dipping dirty ands in water containers, contaminates the water and defeats the ery purpose of clean water supply.

In the absence of sanitary facilities, waste food products, rags, and human and animal stools litter the surroundings. When infants and children walk around bare-footed in the surroundings, they are exposed to the risk of hookworms and other parasitic diseases.

Thus the risk of infant and child mortality is determined by a complex set of mutually reinforcing conditions where the effect of the physical and social environment on the chance of survival depends on the parents' economic and personal resources, their knowledge of available resources and their skill in using them effectively. It is far more complex than what we generally believe and see and, hence needs more serious thinking and deliberation.

6.3 RECOMMENDATIONS

From the results obtained both at the divisional and individual level, the following recommendations can be made:-

(i) Emphasis should focus on the improvement of female education. Secondary level of education have shown a substantial decline in infant and child mortality rate.

(ii) Community Primary health care programmes be encouraged in community gatherings like village barazas and in people's homes. Mothers, should be advised on the importance of breast-feeding.

iii) Establish Primary Health Care (PHC) programmes based on illage health. Although in the long run, diseases must be reduced most effectively through improving economic conditions leading to improved levels of education; nutrition and sanitation, rapid improvements in the state of young children's health may depend upon the extension of PHC programmes in the rural areas.

(iv) Public health policies should target towards alleviating the health problems of the population, primarily those in rural areas. The stress should be on preventive and primary health care.

(v) Traditional birth attendants, health workers and mothers should be educated and trained on the treatment of the umbilical cord and sick infants/children. Efforts should be made to ensure that the messages conveyed through the various channels of communication are mutually reinforcing, and not contradictory and confusing. These messages for health personnel and mothers should include the importance of immunizing pregnant mothers against tetanus, immunization of children against DPT and measles and training the mothers to treat diarrhea with oral rehydration salts.

(vi) A food policy should be introduced such that a certain percentage of the produce are processed and consumed in the area so as to improve the economic and nutrition level of the area community. (According to statistics from the fisheries department, over 90% of the fish produced in Siaya District are sold out of the district. The same source shows that Siaya district has the largest fish landings among the districts surrounding Lake Victoria although, no fish processing industry has been put up in the district).

For further research, We recommend that

i) a research should be conducted on the time trends observed in the district so as to determine the factors that could have caused a drastic decline in infant and child mortality immediately after independence and then an increase in later years with no sign of decline.

(ii) an intensive study on infant and child mortality differentials by marital status should be carried out since no specific pattern have been established in the studies that have been done.

(iii) a study should be conducted in Bondo D ivision (currently Bondo and Rarieda Divisions) to find out what has caused the low infant and child mortality contrary to the expectation and emphasis should be placed on fishing in terms of nutrition and economic gain. This will require the knowledge and life-style of the fishermen and their families.

(iv) a study should be carried out on the roles of women participation in the development projects (intervention programmes) among the divisions on infant and child mortality.

(v) studies should be conducted on the household-level and community factors. The household factors include; indices of socio-economic status of the family such as parent's education, occupation and income; and indices of household environment such as water, sanitation, and housing condition. The community-level factors include: indices of the availability of such social amenities as schools, transportation and communication and medical facilities; indices of nature and type of the community and indices of social and economic institutions. In addition to understanding he relative importance of these factors from the policy perspective, it is important to understand the mechanisms through which these factors influence the risk of infant death at the individual level and determine the infant mortality rate at the community level.

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APPENDIX I

CONSTRUCTION OF LIFE TABLES AND THE REFERENCE TIME FOR THE DIVISIONS IN SIAYA DISTRICT USING 1979 CENSUS DATA.

BONDO DIVISION.

Age grp	i	FPOP	CEB	CD	P(i)	D(i)	K(i)
15-19	1	7929	3304	552	.4166982	.1670702	1.025399
20-24	2	5936	12248	2361	2.063342	.1927662	.9994555
25-29	3	5184	19036	4207	3.672068	.2210023	.9631772
30-34	4	4190	21909	5497	5.228878	.2509015	.9792327
35-39	5	3399	20811	5601	6.122683	.2691365	.9985428
40-44	6	3355	22030	6469	6.566319	.2936450	.9865923
45-49	7	3437	22411	7553	6.520512	.3370220	.9791195

P(1)/P(2) = .2019530 P(2)/P(3) = .5619020

Age grp	x	q(x)	p(x)	lower l(x)	upper l(x)	lower mort. level	interpola mort. level
15-19	1	.1713136	.8286864	.82447	.8408	10	10.25820
20-24	2	.1926612	.8073388	.80019	.81963	11	11.36774
25-29	3	.2128644	.7871356	.78220	.80345	11	11.23226
30-34	5	.2456909	.7543091	.73733	.76173	10	10.69586
35-39	10	.2687443	.7312557	.71540	.74139	10	10.61007
40-44	15	.2897079	.7102921	.69937	.72647	10	10.40303
45-49	20	.3299848	.6700152	.6486	.67802	9	9.72791

(p(2)+p(3)+p(5))/3= .7829278

mean mortality level = 11.09862

Age x	l(x) level 11	l(x) level 12	actual l(x)
0	1	1	1
1	0.84080	0.85617	0.8423158
5	0.76173	0.78503	0.7640278
10	0.74139	0.76632	0.7438486
15	0.72647	0.75255	0.7290420
20	0.70642	0.73385	0.7091251
25	0.68028	0.70935	0.6831469
30	0.65222	0.68299	0.6552545
35	0.62154	0.65403	0.6247442
40	0.58800	0.62211	0.5913639
45	0.55092	0.58642	0.5544210
50	0.51015	0.54648	0.5137329
55	0.46076	0.49743	0.4643764
60	0.40311	0.43911	0.4066603
65	0.33196	0.36605	0.3353220
70	0.25212	0.28221	0.2550875
75+	0.16699	0.19068	0.1693263

Life Table for Bondo Division

Age x	nqx	nPx	nlx	ndx	nLx	Tx	ex
0	.1576842	.8423158	100000	15768.42	88962.11	4342755.	43.42755
1	.0929437	.9070563	84232.59	7828.794	315788.6	4253793.	50.50117
5	.0264117	.9735883	76402.78	2017.925	376969.1	3938005.	51.54268
10	.0199054	.9800946	74384.86	1480.659	368222.7	3561036.	47.87312
15	.0273192	.9726808	72904.20	1991.686	359541.8	3192813.	43.79463
20	.0366342	.9633658	70912.51	2597.826	348068.0	2833271.	39.95446
25	.0408292	.9591708	68314.69	2789.235	334600.4	2485203.	36.37875
30	.0465626	.9534374	65525.45	3051.037	319999.7	2150603.	32.82087
35	.0534302	.9465698	62474.42	3338.024	304027.0	1830603.	29.30164
40	.0624707	.9375293	59136.39	3694.292	286446.2	1526576.	25.81449
45	.0733885	.9266115	55442.10	4068.815	267038.5	1240130.	22.36802
50	.0960742	.9039258	51373.29	4935.647	244527.3	973091.3	18.94158
55	.1242873	.8757127	46437.64	5771.608	217759.2	728564.0	15.68908
60	.1754249	.8245751	40666.03	7133.836	185495.6	510804.8	12.56097
65	.2392760	.7607240	33532.20	8023.448	147602.4	325309.2	9.701400
70	.3362030	.6637970	25508.75	8576.117	106103.4	177706.9	6.966507
75+	1	0	16932.63	16932.63	71603.43	71603.43	4.228724

Age grp	i	x	q(x)	Ref. peri	Years	MTHS.	act. per.
15-19	1	1	q(1)	1.099093	1	1.189110	1978.632
20-24	2	2	q(2)	2.597049	2	7.164589	1977.134
25-29	3	3	q(3)	4.797230	4	9.566762	1974.934
30-34	4	5	q(5)	7.368768	7	4.425219	1972.362
35-39	5	10	q(10)	10.15633	10	1.875912	1969.575
40-44	6	15	q(15)	13.04327	13	0.519285	1966.688
45-49	7	20	q(20)	15.90335	15	10.84017	1963.8280

DETERMINING q(x) FOR MORTALITY LEVEL 10.25820

x	l(x) for lev. 11	l(x) for lev. 10	act. l(x)	q(x)
1	.84080	.82447	.8286864	.1713136
2	.80019	.77972	.7850054	.2149946
3	.78220	.75989	.7656504	.2343496
5	.76173	.73733	.7436301	.2563699
10	.74139	.71540	.7221106	.2778894
15	.72647	.69937	.7063672	.2936328
20	.70642	.67802	.6853529	.3146471

DETERMINING q(x) FOR MORTALITY LEVEL 11.36773

	l(x) for x	l(x) for lev.12	act. l(x) lev.11	q(x)
	.85617	.84080	.8464520	.1535480
2	.85617	.80019	.8207755	.1792245
3	.85617	.78220	.8094010	.1905990
5	.85617	.76173	.7964584	.2035416
10	.85617	.74139	.7835980	.2164020
15	.85617	.72647	.7741646	.2258354
20	.85617	.70642	.7614876	.2385124

DETERMINING q(x) FOR MORTALITY LEVEL 11.23226

	l(x) for lev. 12	l(x) for lev.11	act. l(x)	q(x)
1	.85617	.84080	.8443698	.1556302
2	.85617	.80019	.8131919	.1868081
3	.85617	.78220	.7993803	.2006197
5	.85617	.76173	.7836646	.2163354
10	.85617	.74139	.7680488	.2319512
15	.85617	.72647	.7565941	.2434059
20	.85617	.70642	.7412009	.2587991

DETERMINING q(x) FOR MORTALITY LEVEL 10.69586

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.84080	.82447	.8358334	.1641666
2	.80019	.77972	.7939643	.2060357
3	.78220	.75989	.7754146	.2245854
5	.76173	.73733	.7543090	.2456910
10	.74139	.71540	.7334854	.2665146
15	.72647	.69937	.7182278	.2817722
20	.70642	.67802	.6977824	.3022176

DETERMINING q(x) FOR MORTALITY LEVEL 10.61006

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.840800	.824470	.8344323	.1655677
2	.800190	.779720	.7922079	.2077921
3	.782200	.759890	.7735004	.2264996
5	.761730	.737330	.7522155	.2477845
10	.741390	.715400	.7312555	.2687445
15	.726470	.699370	.7159026	.2840974
20	.706420	.678020	.6953457	.3046543

DETERMINING q(x) FOR MORTALITY LEVEL 10.40302

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.84080	.82447	.8310513	.1689487
2	.80019	.77972	.7879698	.2120302
3	.78220	.75989	.7688814	.2311186
5	.76173	.73733	.7471637	.2528363
10	.74139	.7154	.7258745	.2741255
15	.72647	.69937	.7102918	.2897082
20	.70642	.67802	.6894658	.3105342

DETERMINING q(x) FOR MORTALITY LEVEL 9.727912

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8197384	.1802616
2	.77972	.75813	.7738456	.2261544
3	.75989	.73645	.7535123	.2464877
5	.73733	.71176	.7303727	.2696273
10	.71540	.68828	.7080210	.2919790
15	.69937	.67119	.6917026	.3082974
20	.67802	.64860	.6700152	.3299848

TIME TRENDS

REFERENCE PERIOD	q(1)	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)
1963.827	.171313	.214994	.234349	.256369	.277889	.293632	.314647
1966.687	.153547	.179224	.190599	.203541	.216401	.225835	.238512
1969.574	.155630	.186808	.200619	.216335	.231951	.243405	.258799
1972.362	.164166	.206035	.224585	.245691	.266514	.281772	.302217
1974.933	.165567	.207792	.226499	.247784	.268744	.284097	.304654
1977.134	.168948	.21203	.231118	.2252836	.274125	.289708	.310534
1978.632	.180261	.226154	.246487	.269627	.291979	.308297	.329984

YALA DIVISION

Age grp	i	FPOP	CEB	CD	P(i)	D(i)	K(i)
15-19	1	5150	2189	373	.4250485	.1703974	1.021249
20-24	2	3645	7202	1466	1.975857	.2035546	1.004146
25-29	3	3168	12288	2809	3.878788	.2285970	.9685741
30-34	4	2688	15090	4088	5.613839	.2709079	.9843764
35-39	5	2458	16279	4961	6.622864	.3047484	1.003761
40-44	6	2561	17818	5892	6.957439	.3306768	.9918713
45-49	7	2512	17519	6516	6.974124	.3719390	.9842908

P(1)/P(2)= .2151211 P(2)/P(3) = .5094007

Age grp	x	q(x)	p(x)	lower l(x)	upper l(x)	lower mort. level	interpola mortality level
15-19	1	.1740183	.8259817	.82447	.84080	10	10.09257
20-24	2	.2043985	.7956015	.77972	.80019	10	10.77584
25-29	3	.2214131	.7785869	.75989	.78220	10	10.83805
30-34	5	.2666753	.7333247	.71176	.73733	9	9.505282
35-39	10	.3058946	.6941054	.68828	.71540	9	9.214800
40-44	15	.3279889	.6720111	.67119	.69937	9	9.029139
45-49	20	.3660962	.6339038	.61811	.64860	8	8.518001

mean mortality level = 10.373057

Age x	l(x) level 10	l(x) level 11	actual l(x)
0	1	1	1
1	.82447	.8408	.8278116
5	.73733	.76173	.7423230
10	.71540	.74139	.7207183
15	.69937	.72647	.7049155
20	.67802	.70642	.6838315
25	.65032	.68028	.6564507
30	.6207	.65222	.6271499
35	.58844	.62154	.5952133
40	.55346	.58800	.5605279
45	.51521	.55092	.5225173
50	.47384	.51015	.4812701
55	.42442	.46076	.4318563
60	.36778	.40311	.3750096
65	.29891	.33196	.3056730
70	.22337	.25212	.2292531
75+	.14479	.16699	.1493328

Life Table for Yala Division

Age x	nqx	nPx	nlx	ndx	nLx	Tx	ex
0	.1671884	.8328116	100000	16718.84	87946.81	4196431.	41.96431
1	.1002706	.8997294	82781	8548.864	308042.7	4040484.	48.80922
5	.0291041	.9708959	74232	2160.464	365760.3	3732441.	50.28055
10	.0219265	.9780735	72071	1580.286	356408.5	3366681.	46.71285
15	.0299099	.9700901	70491	2108.398	347186.7	3010272.	42.70402
20	.0400402	.9599598	68383	2738.078	335070.6	2663086.	38.94359
25	.0446352	.9553648	65645	2930.078	320900.2	2328015.	35.46367
30	.0509235	.9490765	62714	3193.668	305590.8	2007115.	32.00375
35	.0582738	.9417262	59521	3468.533	288935.3	1701524.	28.58680
40	.0678121	.9321879	56052	3801.058	270761.3	1412589.	25.20104
45	.0789394	.9210606	52251	4124.722	250946.9	1141827.	21.85243
50	.1026739	.8973261	48127	4941.386	228281.6	890880.5	18.51103
55	.1316333	.8683667	43185	5684.668	201716.5	662598.9	15.34304
60	.1848928	.8151072	37500	6933.656	170170.6	460882.5	12.28989
65	.2500054	.7499946	30567	7641.991	133731.5	290711.8	9.510549
70	.3486117	.6513883	22925	7992.033	94646.47	156980.3	6.847466
75+	1	0	14933	14933.28	62333.82	62333.82	4.174155

Age grp	i	x	q(x)	Ref. peri	Years	MTHS.	act. per.
15-19	1	1	q(1)	1.058531	1	1.702369	1978.618
20-24	2	2	q(2)	2.531170	2	6.374037	1977.150
25-29	3	3	q(3)	4.714551	4	8.574607	1975.005
30-34	4	5	q(5)	7.281102	7	3.373226	1972.495
35-39	5	10	q(10)	10.072537	10	0.870332	1969.771
40-44	6	15	q(15)	12.969560	12	11.634690	1966.926
45-49	7	20	q(20)	15.842420	15	10.109000	1964.062

DETERMINING q(x) FOR MORTALITY LEVEL 10.09257

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.84080	.82447	.8259817	.1740183
2	.80019	.77972	.7816149	.2183851
3	.78220	.75989	.7619552	.2380448
5	.76173	.73733	.7395887	.2604113
10	.74139	.71540	.7178059	.2821941
15	.72647	.69937	.7018786	.2981214
20	.70642	.67802	.6806490	.3193510

DETERMINING q(x) FOR MORTALITY LEVEL 10.77584

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.84080	.82447	.8329644	.1670356
2	.80019	.77972	.7903679	.2096321
3	.78220	.75989	.7714950	.2285050
5	.76173	.73733	.7500221	.2499779
10	.74139	.71540	.7289192	.2710808
15	.72647	.69937	.7134666	.2865334
20	.70642	.67802	.6927928	.3072072

DETERMINING q(x) FOR MORTALITY LEVEL 10.83804

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.84080	.82447	.8381552	.1618448
2	.80019	.77972	.7968747	.2031253
3	.78220	.75989	.7785867	.2214133
5	.76173	.73733	.7577782	.2422218
10	.74139	.71540	.7371807	.2628193
15	.72647	.69937	.7220809	.2779191
20	.70642	.67802	.7018203	.2981797

DETERMINING q(x) FOR MORTALITY LEVEL 9.505282

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8158669	.1841331
2	.77972	.75813	.7690390	.2309610
3	.75989	.73645	.7482938	.2517062
5	.73733	.71176	.7246801	.2753199
10	.71540	.68828	.7019832	.2980168
15	.69937	.67119	.6854288	.3145712
20	.67802	.6486	.6634654	.3365346

DETERMINING q(x) FOR MORTALITY LEVEL 9.214800

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8108154	.1891846
2	.77972	.75813	.7627675	.2372325
3	.75989	.73645	.7414849	.2585151
5	.73733	.71176	.7172524	.2827476
10	.71540	.68828	.6941054	.3058946
15	.69937	.67119	.6772431	.3227569
20	.67802	.64860	.6549194	.3450806

DETERMINING q(x) FOR MORTALITY LEVEL 9.029138

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8075867	.1924133
2	.77972	.75813	.7587591	.2412409
3	.75989	.73645	.7371330	.2628670
5	.73733	.71176	.7125051	.2874949
10	.71540	.68828	.6890702	.3109298
15	.69937	.67119	.6720111	.3279889
20	.67802	.64860	.6494572	.3505428

DETERMINING q(x) FOR MORTALITY LEVEL 8.518000

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.8020219	.1979781
2	.75813	.73530	.7519182	.2480818
3	.73645	.71175	.7297294	.2702706
5	.71176	.68492	.7044572	.2955428
10	.68828	.65994	.6805690	.3194310
15	.67119	.64184	.6632042	.3367958
20	.64860	.61811	.6403040	.3596960

TIME TRENDS FOR YALA DIVISION

REFERENCE PERIOD	q(1)	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)
1963.827	.174018	.218385	.238044	.260411	.282194	.298121	.319350
1966.687	.151204	.170690	.179323	.189145	.198904	.198904	.206060
1969.574	.161844	.203125	.221413	.242221	.262819	.279190	.298179
1972.362	.192920	.241870	.263550	.288240	.311720	.328810	.351400
1974.933	.189184	.237232	.258515	.282747	.305894	.322756	.345080
1977.150	.192413	.241240	.262867	.287494	.310929	.327988	.350542
1978.632	.197978	.248081	.270270	.295542	.319430	.336795	.359695

BORO - DIVISION

Age grp	i	FPOP	CEB	CD	P(i)	D(i)	K(i)
15-19	1	6514	2639	454	.4051274	.1720349	1.026981
20-24	2	4863	9969	2171	2.0499690	.2177751	1.005270
25-29	3	4283	16002	3882	3.7361660	.2425947	.9684253
30-34	4	3643	19455	5585	5.3403790	.2870727	.9838673
35-39	5	3166	19703	6494	6.2233100	.3295945	1.0030960
40-44	6	3571	23749	8554	6.650518	.3601836	.9911562
45-49	7	3236	21414	8578	6.617429	.4005791	.9836022

P(1)/P(2) = .1976261   P(2)/P(3) = .5486825

Age grp	x	q(x)	p(x)	lower l(x)	upper l(x)	lower mort. level	interpola mort. level
15-19	1	.1766766	.8233234	.80708	.82447	9	9.934065
20-24	2	.2189228	.7810772	.77972	.80019	10	10.06630
25-29	3	.2349348	.7650652	.75989	.7822	10	10.23197
30-34	5	.2824415	.7175585	.71176	.73733	9	9.231862
35-39	10	.3306148	.6693852	.65994	.68828	8	8.333283
40-44	15	.3569982	.6430018	.64184	.67119	8	8.039584
45-49	20	.3940105	.6059895	.58646	.61811	7	7.617047

(p(2)+p(3)+p(5))/3= .7545670

mean mortality level = 9.766090

Age x	l(x) level 9	l(x) level 10	actual l(x)
0	1	1	1
1	.80708	.82447	.8202019
5	.71176	.73733	.7310543
10	.68828	.71540	.7087438
15	.67119	.69937	.6924537
20	.6486	.67802	.6707993
25	.61945	.65032	.6427435
30	.58838	.6207	.6127676
35	.55471	.58844	.5801615
40	.51849	.55346	.5448772
45	.47932	.51521	.5064014
50	.43763	.47384	.4649528
55	.38850	.42442	.4156040
60	.3332	.36778	.3592929
65	.26699	.29891	.2910757
70	.19605	.22337	.2166647
75+	.12413	.14479	.1397193

Life Table for Boro Division

Age x	nqx	nPx	nlx	ndx	nLx	Tx	ex
0	.1797981	.8202019	100000	17979.81	87414.13	4020305.	40.20305
1	.1086899	.8913101	82020.19	8914.765	304010.9	3932891.	47.95027
5	.0305181	.9694819	73105.43	2231.042	359949.5	3628880.	49.63899
10	.0229846	.9770154	70874.38	1629.016	350299.4	3268930.	46.12287
15	.0312719	.9687281	69245.37	2165.434	340813.3	2918631.	42.14911
20	.0418245	.9581755	67079.93	2805.588	328385.7	2577818.	38.42904
25	.0466374	.9533626	64274.35	2997.588	313877.8	2249432.	34.99735
30	.0532111	.9467889	61276.76	3260.606	298232.3	1935554.	31.58708
35	.0608181	.9391819	58016.15	3528.434	281259.7	1637322.	28.22183
40	.0706137	.9293863	54487.72	3847.580	262819.6	1356062.	24.88748
45	.0818492	.9181508	50640.14	4144.854	242838.6	1093243.	21.58846
50	.1061373	.8938627	46495.28	4934.882	220139.2	850404.0	18.29011
55	.1354922	.8645078	41560.40	5631.112	193724.2	630264.8	15.16503
60	.1898650	.8101350	35929.29	6821.715	162592.2	436540.5	12.14999
65	.2556414	.7443586	29107.57	7441.100	126935.1	273948.4	9.411584
70	.3551358	.6448642	21666.47	7694.541	89096.02	147013.3	6.785288
75+	1	0	13971.93	13971.93	57917.25	57917.25	4.145257

Age grp	i	x	q(x)	Ref. peri	Years	MTHS.	act. per.
15-19	1	1	q(1)	1.101404	1	1.216849	1978.630
20-24	2	2	q(2)	2.569042	2	6.828503	1977.162
25-29	3	3	q(3)	4.721456	4	8.657478	1975.010
30-34	4	5	q(5)	7.241405	7	2.896862	1972.490
35-39	5	10	q(10)	9.978819	9	11.74582	1969.752
40-44	6	15	q(15)	12.83355	12	10.00258	1966.898
45-49	7	20	q(20)	15.70018	15	8.402190	1964.031

DETERMINING q(x) FOR MORTALITY LEVEL 9.934065

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8233234	.1766766
2	.77972	.75813	.7782965	.2217035
3	.75989	.73645	.7583445	.2416555
5	.73733	.71176	.7356440	.2643560
10	.71540	.68828	.7136118	.2863882
15	.69937	.67119	.6975120	.3024880
20	.67802	.64860	.6760802	.3239198

DETERMINING q(x) FOR MORTALITY LEVEL 10.06630

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.8408	.82447	.8255527	.1744473
2	.80019	.77972	.7810772	.2189228
3	.7822	.75989	.7613692	.2386308
5	.76173	.73733	.7389477	.2610523
10	.74139	.7154	.7171231	.2828769
15	.72647	.69937	.7011667	.2988333
20	.70642	.67802	.6799029	.3200971

DETERMINING q(x) FOR MORTALITY LEVEL 10.23196

x	l(x) for lev. 11	l(x) for lev.10	act. l(x)	q(x)
1	.8408	.82447	.8282579	.1717421
2	.80019	.77972	.7844682	.2155318
3	.7822	.75989	.7650650	.2349350
5	.76173	.73733	.7429898	.2570102
10	.74139	.7154	.7214286	.2785714
15	.72647	.69937	.7056561	.2943439
20	.70642	.67802	.6846077	.3153923

DETERMINING q(x) FOR MORTALITY LEVEL 9.505282

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8158669	.1841331
2	.77972	.75813	.7690390	.2309610
3	.75989	.73645	.7482938	.2517062
5	.73733	.71176	.7246801	.2753199
10	.71540	.68828	.7019832	.2980168
15	.69937	.67119	.6854288	.3145712
20	.67802	.6486	.6634654	.3365346

DETERMINING q(x) FOR MORTALITY LEVEL 8.333282

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.7946857	.2053143
2	.75813	.7353	.7429088	.2570912
3	.73645	.71175	.7199821	.2800179
5	.71176	.68492	.6938653	.3061347
10	.68828	.65994	.6693852	.3306148
15	.67119	.64184	.6516218	.3483782
20	.6486	.61811	.6282718	.3717282

DETERMINING q(x) FOR MORTALITY LEVEL 8.039584

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.7892259	.2107741
2	.75813	.7353	.7362037	.2637963
3	.73645	.71175	.7127277	.2872723
5	.71176	.68492	.6859824	.3140176
10	.68828	.65994	.6610618	.3389382
15	.67119	.64184	.6430018	.3569982
20	.64860	.61811	.6193169	.3806831

DETERMINING q(x) FOR MORTALITY LEVEL 7.617047

x	l(x) for lev.8	l(x) for lev.7	act. l(x)	q(x)
1	.78849	.76856	.7808577	.2191423
2	.7353	.71111	.7260364	.2739636
3	.71175	.68566	.7017588	.2982412
5	.68492	.65669	.6741092	.3258908
10	.65994	.6303	.6485893	.3514107
15	.64184	.61125	.6301255	.3698745
20	.61811	.58646	.6059895	.3940105

TIME TRENDS FOR BORO DIVISION

REFERENCE PERIOD	q(1)	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)
1963.827	.176676	.221703	.241655	.264356	.286388	.302488	.323919
1966.687	.174447	.218922	.23863	.261052	.282876	.298833	.320097
1969.574	.171742	.215531	.234934	.25701	.278571	.294343	.315392
1972.362	.19292	.24187	.26355	.28824	.31172	.32881	.351400
1974.933	.205314	.257091	.280017	.306134	.330614	.348378	.371728
1977.134	.210774	.263796	.287272	.314017	.338938	.356998	.380683
1978.632	.219142	.273963	.298241	.32589	.35141	.369874	.394010

UKWALA DIVISION

Age grp	i	FPOP	CEB	CD	P(i)	D(i)	K(i)
15-19	1	7212	2475	445	.3431780	.1797980	1.106085
20-24	2	4791	9942	2269	2.075141	.2282237	1.025446
25-29	3	4337	16729	4330	3.857275	.2588320	.9708536
30-34	4	3947	22348	6839	5.662022	.3060229	.9808888
35-39	5	3513	23262	7704	6.621691	.3311839	.9979264
40-44	6	3722	26591	9734	7.144277	.3660637	.9853233
45-49	7	3490	25103	10221	7.192837	.4071625	.9780601

P(1)/P(2) = .1653758   P(2)/P(3)= .5379811

Age grp	x	q(x)	p(x)	lower l(x)	upper l(x)	lower mort. level	interpola mortality level
15-19	1	.1988718	.8011282	.78849	.80708	8	8.679839
20-24	2	.2340311	.7659689	.75813	.77972	9	9.363080
25-29	3	.2512879	.7487121	.73645	.75989	9	9.523125
30-34	5	.3001744	.6998256	.68492	.71176	8	8.555348
35-39	10	.3304971	.6695029	.65994	.68828	8	8.337433
40-44	15	.3606911	.6393089	.61125	.64184	7	7.917257
45-49	20	.3982294	.6017706	.58646	.61811	7	7.483748

(p(2)+p(3)+p(5))/3= .7381688

mean mortality level = 9.147185

Age x	l(x) level 9	l(x) level 10	actual l(x)
0	1	1	1
1	.80708	.82447	.8096395
5	.71176	.73733	.7155235
10	.68828	.7154	.6922716
15	.67119	.69937	.6753376
20	.6486	.67802	.6529302
25	.61945	.65032	.6239936
30	.58838	.6207	.5931370
35	.55471	.58844	.5596745
40	.51849	.55346	.5236370
45	.47932	.51521	.4846024
50	.43763	.47384	.4429595
55	.38850	.42442	.3937868
60	.33320	.36778	.3382896
65	.26699	.29891	.2716881
70	.19605	.22337	.2000711
75+	.12413	.14479	.1271708

Life Table for Ukwala Division

Age x	nqx	nPx	nlx	ndx	nLx	Tx	ex
0	.1903605	.8096395	100000	19036.05	86674.77	3874178.	38.7417
1	.1162444	.8837556	80963.95	9411.603	298444.5	3787503.	46.780
5	.0324963	.9675037	71552.35	2325.186	351948.8	3489059.	48.7623
10	.0244615	.9755385	69227.16	1693.398	341902.3	3137110.	45.3161
15	.0331797	.9668203	67533.76	2240.749	332066.9	2795208.	41.3897
20	.0443180	.9556820	65293.02	2893.658	319230.9	2463141.	37.7244
25	.0494502	.9505498	62399.36	3085.658	304282.6	2143910.	34.3579
30	.0564161	.9435839	59313.70	3346.247	288202.9	1839627.	31.0152
35	.0643901	.9356099	55967.45	3603.749	270827.9	1551424.	27.7201
40	.0745451	.9254549	52363.70	3903.459	252059.9	1280597.	24.4558
45	.0859321	.9140679	48460.24	4164.290	231890.5	1028537.	21.2243
50	.1110094	.8889906	44295.95	4917.268	209186.6	796646.2	17.9846
55	.1409321	.8590679	39378.68	5549.723	183019.1	587459.7	14.9182
60	.1968772	.8031228	33828.96	6660.151	152494.4	404440.5	11.9554
65	.2636002	.7363998	27168.81	7161.705	117939.8	251946.1	9.27335
70	.3643718	.6356282	20007.11	7290.025	81810.47	134006.3	6.69794
75+	1	0	12717.08	12717.08	52195.83	52195.83	4.10439

Age grp	i	x	q(x)	Ref. peri	Years	MTHS.	act. per.
15-19	1	1	q(1)	.9433532	0	11.32024	1978.788
20-24	2	2	q(2)	2.386308	2	4.63570	1977.345
25-29	3	3	q(3)	4.586732	4	7.04078	1975.144
30-34	4	5	q(5)	7.208057	7	2.49668	1972.523
35-39	5	10	q(10)	10.07681	10	.921699	1969.654
40-44	6	15	q(15)	13.04452	13	.5342144	1966.687
45-49	7	20	q(20)	15.94400	15	11.32794	1963.787

DETERMINING q(x) FOR MORTALITY LEVEL 8.679838

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.8011282	.1988718
2	.75813	.7353	.7508207	.2491793
3	.73645	.71175	.7285420	.2714580
5	.71176	.68492	.7031669	.2968331
10	.68828	.65994	.6792066	.3207934
15	.67119	.64184	.6617932	.3382068
20	.64860	.61811	.6388383	.3611617

DETERMINING q(x) FOR MORTALITY LEVEL 9.363079

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8133939	.1866061
2	.77972	.75813	.7659689	.2340311
3	.75989	.73645	.7449606	.2550394
5	.73733	.71176	.7210439	.2789561
10	.71540	.68828	.6981267	.3018733
15	.69937	.67119	.6814216	.3185784
20	.67802	.64860	.6592818	.3407182

DETERMINING q(x) FOR MORTALITY LEVEL 9.523125

x	l(x) for lev.10	l(x) for lev.9	act. l(x)	q(x)
1	.82447	.80708	.8161771	.1838229
2	.77972	.75813	.7694243	.2305757
3	.75989	.73645	.7487121	.2512880
5	.73733	.71176	.7251363	.2748637
10	.71540	.68828	.7024672	.2975329
15	.69937	.67119	.6859317	.3140683
20	.67802	.64860	.6639903	.3360097

DETERMINING q(x) FOR MORTALITY LEVEL 8.555348

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.7988139	.2011861
2	.75813	.7353	.7479786	.2520214
3	.73645	.71175	.7254671	.2745329
5	.71176	.68492	.6998255	.3001745
10	.68828	.65994	.6756786	.3243214
15	.67119	.64184	.6581395	.3418605
20	.64860	.61811	.6350426	.3649574

DETERMINING q(x) FOR MORTALITY LEVEL 8.337433

x	l(x) for lev.9	l(x) for lev.8	act. l(x)	q(x)
1	.80708	.78849	.7947629	.2052371
2	.75813	.73530	.7430036	.2569964
3	.73645	.71175	.7200846	.2799154
5	.71176	.68492	.6939767	.3060233
10	.68828	.65994	.6695029	.3304971
15	.67119	.64184	.6517437	.3482563
20	.64860	.61811	.6283983	.3716017

DETERMINING q(x) FOR MORTALITY LEVEL 7.917257

x	l(x) for lev.8	l(x) for lev.7	act. l(x)	q(x)
1	.78849	.76856	.7868409	.2131591
2	.73530	.71111	.7332984	.2667016
3	.71175	.68566	.7095912	.2904088
5	.68492	.65669	.6825842	.3174158
10	.65994	.6303	.6574875	.3425125
15	.64184	.61125	.6393089	.3606911
20	.61811	.58646	.6154912	.3845088

DETERMINING q(x) FOR MORTALITY LEVEL 7.483748

x	l(x) for lev.8	l(x) for lev.7	act. l(x)	q(x)
1	.78849	.76856	.7782011	.2217989
2	.7353	.71111	.7228119	.2771881
3	.71175	.68566	.6982810	.3017190
5	.68492	.65669	.6703462	.3296538
10	.65994	.63030	.6446383	.3553617
15	.64184	.61125	.6260479	.3739521
20	.61811	.58646	.6017706	.3982294

TIME TRENDS FOR UKWALA DIVISION

REFERENCE PERIOD	q(1)	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)
1963.827	.198871	.249179	.271458	.296833	.320793	.338206	.361161
1966.687	.186606	.234031	.255039	.278956	.301873	.318578	.340718
1969.574	.183822	.230575	.251287	.274863	.297532	.314068	.336009
1972.362	.201186	.252021	.274532	.300174	.324321	.34186	.364957
1974.933	.205237	.256996	.279915	.306023	.330497	.348256	.371601
1977.134	.213159	.266701	.290408	.317415	.342512	.360691	.384508
1978.632	.221798	.277188	.301719	.329653	.355361	.373952	.398229

APPENDIX II

UNIVERSITY OF NAIROBI
POPULATION STUDIES AND RESEARCH INSTITUTE

ENVIRONMENTAL RISK AND SOCIOECONOMIC FACTORS INFLUENCING INFANT AND CHILD MORTALITY IN SIAYA DISTRICT: A CASE STUDY OF JERA SUB-LOCATION.

INTERVIEWER...

NAME OF HOMESTEAD.................................

NAME OF HOUSEHOLD OWNER....... ....

	SECTION 1: RESPONDENT'S BACKGROUND. Questions and Filters	coding categories	SKIP TO
1.1	Have you ever lived in a town or city?	Town ---------1 City ---------2 None ---------3	If none goto 1.3
1.2	How long did you live in the town or city?	State in completed months or years ------------	
1.3	In what month and year were you born?	Month ---------1 year ----------2	
1.4	How old are you?	Age in completed years.	
1.5	Have you ever attended school?	Yes -----------1 No ------------2	If no go to 1.7
1.6	What was your highest level of schooling ?	Prim 0-4 ------1 Prim 5-8 ------2 Secondary -----3 above Sec -----4	
1.7	Do you own a radio?	Yes............1 No 2	
	SECTION 2: MARRIAGE		
2.1	Have you ever been married or lived with a man?	Yes -----------1 No ------------2	If no go to 2.6

2.2	Are you now married, widowed, divorced, or not living together?	married -------1 widowed -------2 divorced ------3 not living together ------4	
2.3	Does your husband live with you here or is he living elsewhere?	Yes -----------1 No ------------2	
2.4	Does your husband have any other wife/wives now staying elsewhere?	Yes -----------1 No ------------2	
2.5	When you were married, how old were you?	Record age in completed years --------	
2.6	What is your religion?	Catholic ------1 Protestant ----2 Legio-maria ---3 Roho ----------4 Others (specify) -----5	
	SECTION 3: REPRODUCTION		
3.1	Have you ever given birth?	Yes ---------1 No ----------2	
3.2	How many children have you had?	No.of sons -- No.of daughters ---	
3.3	How many children are living with you here?	sons -------- daughters ---	
3.4	How many are living elsewhere?	sons -------- daughters ---	
3.5	How many have died?	Boys dead --- Girls dead --	

SECTION 4 : BIRTH HISTORY

4.1	Name (starting with the first born then next until the last born)	sex write 1 if a boy and 2 if a girl.	date of birth state the month and the year)	still alive? (if yes write 1 and if No write 2	if dead how old was(name) when he/ she died? (months or years)	if alive how old is he/she? (months or years)

SECTION 5: WORK STATUS OF MOTHER AND FATHER'S BACKGROUND

5.1	Have you ever worked regularly to earn money?	Yes --------1 No ---------2	
5.2	What type of job was it?	wage employed ---1 self employed ---2	
5.3	Have your husband attended any school?	Yes --------1 No ---------2	If no go to 4.5
5.4	What was the highest level of school ?	Prim 0-4 ---1 Prim 5-8 ---2 Secondary ---3 above sec --4	
5.5	What kind of work does your husband mainly do?	wage employed ---1 working in the form -------2 working in somebody's farm -------3 business ---4 other (specify)	

5.6	How many cows, goats, sheep do you have?	cows........ goats....... sheep......
	SECTION 6: PREGNANCIES AND BREASTFEEDING (BIRTHS IN THE LAST FIVE(5) YEARS)	
6.1	How old were you when you first gave birth? Which year was it?	State in complete years ---------- year ----------
6.2	When did you have your last birth?	state in complete months ---------
6.3	What type of food do you eat while pregnant?	Ugali----------1 meat ----------2 fish ----------3 vegetables-----4 sweet potatoes--5 cassava --------6 beans ----------7 bananas --------8 others ---------9
6.4	What kind of activities do you perform while pregnant?	digging -------1 fetching water--2 fetching firewood-3 Trading -------4
6.5	While pregnant do you attend an antenatal clinic?	Yes ----------- 1 No ---------- 2
6.6	Where do you usually deliver your children?	hospital------- Home ---------- Other(specify)- 3
6.7	Do you take your child for immunization?	Yes----------- 1 Yes but not complete----- 2 No------------ 3
6.8	How long do you breastfeed?	1-6 months ---- 1 6-12 months --- 2 12-18 months--- 3 18-24 months----4 24+ months ---5

SECTION 7: WEANING AND ASSOCIATED ILLNESS.
(BIRTHS IN THE LAST FIVE(5) YEARS)

7.1	At what age do you start giving supplementary food to your baby?	state in complete months.	
7.2	what was the composition of your weaning food?	Porridge ------1 milk ---------2 eggs ----------3 meat ----------4 vegetables ----5 fruits --------6	
7.3	What did you use to give the weaning food to the baby?	cup -----------1 feeding bottle-2 plate ---------3 other(specify)-4	
7.4	Did the health status of the child change after weaning?	Yes -----------1 No ------------2 can't tell ----3	If no go to 7.6
7.5	If yes which changes?	The colour of hair changed --1 thinness ------2 diarrhoea ------3 swollen stomach -------4 other(specify)-5	
7.6	Has your child suffered from the following in the last one month?	warms ---------1 diarrhoea ------2 malaria -------3 kwashiorkor ----4 marasmus ------5 measles -------6 respiratory problems ------7	
7.7	What did you do in that case?	saw a traditional healer --------1 visited dispensary ----2 withdrew food -3 didn't care ---4	

	SECTION 8: ENVIRONMENTAL CONDITIONS		
8.0	How many houses are in this home?	record the number	
8.1	What do you use for cooking?	paraffin ------1 firewood ------2 other(specify -3	
8.2	What do you use for lighting?	paraffin ------1 firewood ------2 other(specify)-3	
8.3	Materials used for roofing	grass thatch --1 iron sheets ---2 tiles ---------3 concrete ------4	
8.4	Materials used for the wall	mud + sticks --1 stone + brick cement --------2 wood ----------3 other(specify)-4	
8.5	Materials used for the floors	concrete ------1 wood ----------2 cowdung -------3 mud -----------4	
8.6	Do you have a toilet?	Yes -----------1 No ------------2	if No go to 8.8
8.7	At what age do children start using toilet?		
8.8	Where do you get water?	well ----------1 borehole ------2	
8.9	Do you boil the water ?	Yes -----------1 No ------------2	
8.10	Where do cook your food?	separate kitchen -------1 living house---2 outside -------3	
8.11	where do you keep your domestic animals (e.g cows, goats, sheep	residential unit ----------1 kitchen -------2	

	chicken etc)?	separate place ---------3 outside (open air) ----4

DHOLUO VERSION OF THE QUESTIONNAIRE

1.1	Ne ise thi kapango Nairobi kata e town moro amoro?	Town.......1 Nairobi....2 Pok adhi...3
1.2	Ne idak kuro kuom kinde maromo nadi?	Dweche adi...... higni adi......
1.3	Onyuoli higa mane,dwe mar adi?	Dwe .... Higa ....
1.4	In kod higni adi sani?	....
1.5	Ne idhiye e school?	Ne adhi......1 Ne ok adhi...2
1.6	To kane idhi, ne ichopo e class adi?	Prim 0-4 ....1 Prim 5-8 ....2 Sec. ....3 Sec+. 4
1.7	In kod radio?	an Kodo .....1 aonge kodo ..2
	KAR KEND MARI	
2.1	Nene ise dhi tedo kose ise dakie kod dichuo?	ase dhi .....1 pok adhi.....2
2.2	E sani, pod in kod jaodi, ne otho, ne uweru kose ok udak kode?	Pod wadak....... 1 Ne otho......... 2 Ne wawere....... 3 Ok wadak kode... 4
2.3	Udak kod jaodi e dala kani kose odak kama achielo?	Wan kode ka........1 Odak kama achielo..2
2.4	Jaodi ni gi mon moko kose?	En gi mon moko.....1 an mana kenda......2
2.5	Kane e dhi tedo, ne in gi higni adi?	....

2.6	In e din mane?	Catholic.......... 1 Protestant (CMS)..2 Legio Maria........3 Roho ....4 Mamoko............5
	KAR NYUOL MARI	
3.1	Ne ise nyuol ?	Ne ase nyuol......1 Pok ne anyuol.....2
3.2	Kane ise nyuol, in gi nyithindo adi?	Yawuoyi adi....... Nyiri adi ....
3.3	Kuom nyithindi duto, adi emi dak kodo ka?	Yawuoyi adi....... Nyiri adi........
3.4	Adi ema odak kama achielo?	Yawuoyi adi....... Nyiri adi........
3.5	Adi ema ose dok (otho)?	Yawuoyi adi...... Nyiri adi.......

KAR NYITHINDO MISE NYUOLO

	Aduaro mondo ivisa nyinge nyithindi duto mise nyuolo kichako kod makayo nyaka chogo	En wuoyi kose nyako? wuoyi...1 nyako...2	Onyuole dwe mar adi,higa man	Pod entie Entie..1 Osedok..2	Kane osedok ne otho ka en kod higni adi?	Ka pod entie, en gi higni adi?
4.1						

KORO ADUARO PENJI WACH TICH KOD WECHE MODOK KOKA JAODI

5.1	E gimani, ne ise tiye kama iyude pesa?	Ne ase tiyo......1 Pok ne atiyo.....2

5.2	Kane ise tive, ne en tich mi ichuli kose ne en tiji iwuon?	Ne ichula.........1 Ne en tija awuon..2
5.3	Jaodi ne odhi e skul?	Ne odhi...........1 Pok ne odhi.......2
5.4	Kane odhi, ne ochopo e class adi?	Prim 0-4 ....1 Prim 5-8..........2 Secondary ....3 Above Sec 4
5.5	Tich man ema jaodi tivo?	Mi chule pesa ....1 Otiyo e puothe ....2 Otiyo e puoth ng'ato..3 Oloko ohala...........4 Tije mamoko 5
5.6	In kod dhok, diek, rombe adi?	dhok........ Diek .... Rombe ....
	SANI ADUARO PENJI KAKA E DHODHO NYITHINDI KOD GIK MITIMO GA DALO MI EPEK	
6.1	Kane iyuolo nyathini makayo ne in kod higni adi?, ne en higa mane?	Higni............. Higa ....
6.2	Nyathini machogo, ne iyuole higa mane, e dwe mar adi?	Higa.............. Dwe ....
6.3	Ka ipek, ichamo ga chiemo mag?	Kuon...........1 Ring'o ....2 Rech ....3 Alot ....4 Rabuon ....5 Omuogo ....6 oganda ....7 Rabolo ....8 Chiemo mamoko..9
6.4	Ka ipek, itivo ga tije machalo gi magi?	Pur ....1 Dhi kulo......2 Dhi moto .....3 Loko ohala....4
6.5	Ka ipek ne idhiga e clinic?	Adhi ga.......1 Ok adhiga 2
6.6	Ikonyiri ga kure?	E hospital ...1 E dala ....2 Kuonde mamoko..3

6.7	Itero ga nyithindi e clinic?	Atero ga ....1 Atero mak mana okotiek sidade duto...2 Ok aterga 3
6.8	Nyithindi we ga thuno kod dweche adi?	Dweche 1-6 ....1 6-12 ....2 12-18 ......3 18-24 ......4 24+ 5

PENJO MODOK KORKA TUOCHE MACHANDO NYITHINDO NDALO MAGIWEYO THUNO

7.1	Ichako ga miyo nyithindi chiemo ma opogre kod thuno ka gin gi dweche adi?	
7.2	Ne imiye chiemo mage?	Nyuka ....1 Chak ....2 Tong' ....3 Ring'o ....4 Alot ....5 Olemo 6
7.3	Itiyo ga kod ang'o emiyo nyathi chiemo ?	Okombe.........1 Chupa ....2 San ....3 gik mamoko.....4
7.4	Ne ngima ne olokre?	Ne ok olokre...1 Ne olokre .....2 Odak awach 3
7.5	Kane nitie pogruok, ne en mane?	Yie wiye ne olokre....1 Ne odhero ....2 Ne odiewo ....3 Iye ne okuot ....4 Tuoche mamoko.........5
7.6	Tuoche mage ma nyathini ose bedo go e dwe achiel mokalo?	Njokni ....1 Diewo ....2 Malaria ....3 Kwashiokor ....4 Sursur ....5 Anyiew ....6 Tuoche mag kor......7
7.7	Kane otuo, ne itere chieth kama	Ajuoga...............1

	nadi?	E dispensary.........2 Aweyo miye chiemo....3 Ok ne obadha 4
	PENJO MODOK KORKA ODI	
8.0	Un gi udi adi e dala ka	
8.1	Itiyo ga kod ang'o e chuako?	Mafuta ....1 Yien ....2 Gik mamoko (Gin mage)...3
8.2	Itiyo ga kod ang'o e neno saache mag otieno?	mafuta taa..........1 yien ....2 Gik mamoko 3
8.3	Tado olos kod gima chal nadi?	Lum ....1 mabat ....2 matakla................3 Simit 4
8.4	Kor ot olos kod gima chal nadi?	Yien gi lowo ....1 Kidi gi simit ....2 Bao ....3 Gik mamoko(gin mage)..4
8.5	Dier ot olos kod gima chal nadi?	Simit ....1 Bao ....2 Omuon kod owoyo .....3 Pok omuon 4
8.6	In gi choo?	An go ....1 Onge 2
8.7	Nyithindi chako ga dhi e choo ka gin kod higni adi?	
8.8	Ituomoga pi kure	ekulo ....1 Naikonda (pump).......2
8.9	Echuako ga pi ka pok itiyo go?	Achuako ga ....1 Ok achuak ga 2
8.10	Etedo ga kure?	e jokon ....1 Ot ma adakie ....2 OKo 3
8.11	Dhok, diek, rombe kod gwen nindo kama nadi?	e ot madakie ....1 e jokon ....2 e duol ....3 Oko 4