DETERMINANTS OF INFANT AND CHILD MORTALITY IN KILIMANJARO: LOGISTIC REGRESSION APPROACH

BY

ROSE NATHAN

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS (DEMOGRAPHY) IN THE UNIVERSITY OF DAR ES SALAAM.

JUNE, 1994

ABSTRACT

This study attempts to identify socio-economic and demographic factors which influence infant and child mortality in Kilimanjaro. The extent to which socio-economic factors operate through proximate determinants to bring the influence is also examined. The variables covered in the study are: Maternal education, maternal occupation, household income, residence, source of water, type of toilet facility, duration of breast-feeding, maternal age, parity and birth interval.

Data on mortality and related variables were collected in a retrospective survey conducted in Kilimanjaro in July 1993. Logistic regression analysis is utilized to identify variables which have a significant effect on infant and child mortality.

Maternal demographic status (an index of age and parity), breast-feeding duration and birth interval were found to have statistically significant effect on infant and child mortality. Maternal education and occupation had little significant effect on infant and child mortality. The significance however, disappeared when the intervening and proximate determinants were controlled for.

The absence of significant effects on child survival of residence, source of water and type of toilet facility was also noticed.

Like any other sub-Saharan country, Tanzania is still experiencing high infant and child mortality levels. The government of Tanzania expressed concern on the issue right after independence by placing priority to the Ministry of Health and provision of several social services aimed at improving health status of its people.

The government's efforts together with the aid of foreign donors have managed to gradually decrease the infant and under five mortality rates over years. The trend is shown in Table 1.2.

Table 1.2. National levels and trends of infant and under five mortality rates

YEAR	Tanzania mainland		Zanzibar	
	IMR	U5MR	IMR	U5MR
1957	190	-	-	-
1967	155	260	-	-
1978	137	231	125	209
1988	115	191	120	202
1991	92	141	-	-

Source: Population censuses; 1957, 1967, 1978, 1988 and Tanzania Demographic and Health Survey (1991/92).

As the data indicate, the most recent survey (TDHS) reports the national infant mortality rate of 92 and under five mortality rate of 141 for Tanzania mainland. This is still quite high and quite far above the set target of IMR (50) and U5MR (70) by the year 2,000.

The trend for Kilimanjaro is as indicated in Table 1.3.

Comparing these levels with those of the nation, they appear to be relatively low but according to the world's standards they are still very high. Several factors have contributed to the observed levels of infant and child mortality. Among the factors are socio-economic and demographic.

Table 1.3. Infant and under five mortality rates trend for Kilimanjaro region.

YEAR	IMR	U5MR
1978	76	119
1988	67	104
1991	55.5	78.6

Source: Population censuses, 1978, 1988 and TDHS (1991/92).

The variables covered in this study are: maternal education, maternal occupation, maternal usual place of residence, maternal demographic status (Index for CEB and age), household income, duration of breast-feeding, birth interval, water supply, and toilet facility.

1.3. GENERAL OBJECTIVE OF THE STUDY

The study intends to investigate the infant and child mortality differentials in Kilimanjaro region with regard to socio-economic and demographic factors. An attempt is also made to examine the interaction between one set of variables with another to influence infant and child mortality. Better knowledge of the conditions determining higher child mortality and of the mechanisms through which they act can provide the basis for more rational and effective policies to improve child survival.

1.4. SPECIFIC OBJECTIVES OF THE STUDY

The following are the specific objectives of this study:

- To estimate the current infant and child mortality levels in Kilimanjaro.
- To ascertain the extent to which maternal education influences infant and child mortality.
- To find the magnitude of the effect of household income on infant and child mortality.

- To establish empirical evidence of maternal demographic status influence on infant and child mortality.

- To examine the influence of maternal occupation on infant and child mortality.

- To measure the influence of residence on infant and child survival.

- To assess the impact of birth interval on infant and child mortality.

- To establish the correlation between safe water availability and infant and child mortality.

- To measure the effects of sanitation on infant and child mortality.

1.5. SIGNIFICANCE OF THE STUDY

Infant and child mortality remains as one of major concerns for most developing countries including Tanzania. It has been an area of interest to many researchers. Thus this study will add more knowledge to the vast literature which already exists. Moreover it will help in identifying the groups in the population which experience high levels of infant and child mortality.

This study is also a contribution to the ever existed efforts of the government to reduce mortality. The findings and recommendations made in the study will be an

Table 1.4. Definition of variables used in the study

Variable	Description and categories
Mortality	Child death experience by a woman who has had at least one live birth. 1 = a woman has had experienced at least one child death. 0 = a woman has had no child death experience.
Socio-economic variables	
Maternal education	The highest level of education attained. 1 = None 2 = Primary* 3 = Secondary and post secondary
Maternal occupation	Current occupation 1 = Professional 2 = Clerical 3 = Agricultural 4 = Others*
Household income	Income/year in Tsh. 1 = 00000 - <30,000 (low)* 2 = 30,000<100,000 (medium) 3 = 100,000+(high)
Residence	Rurality 1 = Urban 2 = Rural
Intervening variables	
Water source	Type of water source for the household 1 = Piped inside the house 2 = Piped for public use* 3 = Other sources
Household toilet	Type of toilet facility used by the household 1 = Flush inside the house 2 = Flush outside the house 3 = Pit*

Table 1.4. (continued)

Variable	Description and categories
Proximate determinants	
Maternal demographic status	Index combining age and parity of the mother 1 = 0.000000 - 0.229999 (low risk)* 2 = 0.23 - 0.429999 3 = 0.43 - 0.639999 4 = 0.64+(high risk)
Birth interval	Number of months in the last closed birth interval 1 = <24 months 2 = 24 - <36 months* 3 = 36+ months
Breast-feeding	Number of months breast-fed in last feeding closed - birth interval 1 = 0 - 12 months 2 = 13 - 24 months* 3 = 24+ months

* Reference category.

1.8. RESEARCH QUESTIONS

The following research questions guided the study.

1. Can child survival chances be raised by increasing mother's education?
2. Does the occupation status of the mother influence infant and child mortality?
3. Does high household income decrease death risks of a child?
4. Does a child born in a rural setting share equal survival chances with her/his counterpart born in urban setting?
5. Is the type of toilet facility one of sources of mortality differentials among children?
6. Do different sources of water for domestic use create differentials on child survival chances?
7. Is duration of breast-feeding a determinant of infant mortality?
8. Does a child born to a mother at risk age (<20 or>35 years) or of a high parity (6+) suffer a reduced survival chance?
9. Does birth interval have any influence on child mortality?

Table 2.1 indicates variations of infant and child mortality within some selected sub Saharan countries. It has been reported that the decline in the developing countries had been very fast especially in the 1960s but the rate has declined in most countries and in some an upward trend was reported in 1970s (Gwatkin, 1980).

Table 2.1. Infant and child mortality rates for some selected countries

COUNTRY	IMR	CMR
Tanzania	100	50
Botswana	60	20
Nigeria	90	110
Burundi	80	80
Senegal	90	110
Kenya	70	30

Source: Tanzania Demographic and Health Survey (1991/92).

Literature confirms that various studies on mortality levels and associated factors were pursued in several underdeveloped countries including sub Saharan as early as 1940s. UN (1953) reports that, Nkomo (1949) in his analysis of the factors contributing to the high mortality of the natives in Zimbabwe; found out that inadequate and overcrowded housing; poor sanitation, lack of sufficient

Table 3.2. Trend of some demographic characteristics for Kilimanjaro region

YEAR	POPULATION	TFR	IMR	eo
1967	653,000	8.9	-	53
1978	902,000	7.6	76	58
1988	1,108,699	-	58	-

Source: Population censuses, 1967, 1978 and 1988.

The Tanzania Demographic Health Survey ,1991/1992 reported the region's TFR as 6.01 and an infant mortality rate (IMR) of 55.5.

3.1.5. Selection of the Area

The area was chosen for three main reasons:

(i) Socio-economically Kilimanjaro is one of the most developed regions in Tanzania. For example the study conducted by TDHS (1991/92) reported that Kilimanjaro had the lowest percentage (9%) of women who had no education while it ranked second from Arusha for women who had secondary or higher education.

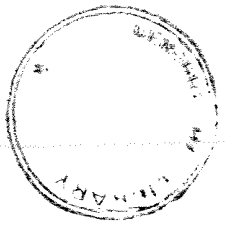
(ii) The 1978 and 1988 census reports, together with the recently conducted TDHS (1991/92) indicated that Kilimanjaro region experiences comparatively the lowest infant and child mortality nationally. For this reason it

was thought necessary to look into infant and child mortality differentials with regard to socio-economic and demographic characteristics, hoping that other parts of the country may benefit from the experience of this area.

(iii) Logistics convenience. The region is easily accessible by road from Dar es Salaam and within the region.

3.2. PILOT SURVEY

The importance of preparation for data collection was accorded its due gravity. All necessary steps were taken to ensure that data to be collected would be reliable and relevant for the intended purpose. This included a pilot survey which was carried out in the same region some three months prior to the survey in hand. The aim of the study was to give a chance for the researcher to gather experience in the household data collection techniques and to get an overall view of the response to questions on mortality and fertility. Interviews guided by a questionnaire were utilized.



3.3. RESEARCH INSTRUMENT

The instrument used for this study is a questionnaire. This was thought to be the most ideal instrument given the limited time and finance we had and its comparatively higher degree of reliability and precision.

The questionnaire was jointly prepared by eight Demography students of 1992/93 academic year. Each student prepared her/his questions for the variables she/he needed to measure, then a joint questionnaire was constructed. The questionnaire focused on fertility and mortality with associated variables. The extract of the questionnaire used for this study is attached as appendix II. The questionnaire was essentially divided into two main parts. The first part was introductory including particulars of a household composition. The second part had questions on fertility history, mortality and socio-economic information. Most of the questions were closed and coded.

The questionnaire was prepared in Kiswahili which was later translated into English version. This had to be the case because the interview was conducted in Kiswahili. The interview was handled as a confidential matter, so it was conducted in households.

3.4. RESEARCH PERMISSION

The research clearance was collected from the University Vice-chancellor's office. The clearance was submitted to Kilimanjaro Regional Development Officer who in turn granted a permission addressed to the District Development Directors concerned. On receiving the permit the Directors communicated with Ward Executive Secretaries requiring them to facilitate our research work. The secretaries informed the ten-cell leaders.

3.5. SAMPLING PROCEDURE

Two districts were selected. One to represent urban setting and the other rural setting. Moshi urban was selected purposefully for urban whereas Mwanga district was selected randomly from the remaining districts. The targeted sample was women of age 15-49 years irrespective of marital status. The survey covered 1054 households; out of which 540 came from urban setting and 514 from rural setting.

Methods used to select wards from the two populations were different as explained below.

over to another leader. The questionnaires completed each day were edited in the evening.

3.7. DATA EVALUATION

Before we embark on the exercise of data processing the assessment of the quality of the data is indispensable. This part reports the possible types and sources of errors in the data and efforts made to minimize them. However, the study does not attempt to compute these errors.

The problem of reporting errors documented for all three Tanzanian population censuses offers a clue on the type of errors which are likely to be contained in the data for this study. The main sources of error are thus:

(i) Age misstatement.

(ii) under reporting deaths and births.

Age misstatement: For several reasons, mainly due to non-numeracy and illiteracy, digit preference and depending on socio-cultural patterns women misstate their ages. This phenomena leads to distorted children ever born (CEB) estimates. Understatement of ages leads to over estimation of CEB whereas overstatement causes underestimation of CEB. This problem extends to statement of age of a child at death.

Under reporting deaths and births: Under reporting on CEB especially by older mothers due to memory lapse is a known experience. Attention tends to shift from less recent period to most recent period. Long dead children particularly those who die briefly after birth tend to be forgotten by their mothers and those who live away from home. To facilitate recall exercise the following questions were included: (i) How many children have you ever borne alive? (ii) How many live in the household? (iii) How many live somewhere else? (iv) How many are dead?

Another source of underestimation of CEB is the omission of children born before marriage, some women who happened to have borne children before marriage do not report these children. The same tendency applies to women who have had more than one marriage, they tend to report about children borne to the current husband only.

Classification of women into five-year age groups was done to reduce the effect of age misreporting. At this stage misclassification errors are expected to arise but as UN manual X (1983) states 'random errors in reporting age are likely to have a slight equalizing effect on average parities, since a transfer upward that probably reduces the average parity of the higher group is likely to be matched by a transfer downward that probably increases the average

parity of the lower groups'. This is revealed to be the case for the Kilimanjaro data as Table 3.2 indicates. As would be expected the average parity rises with increasing age.

Table 3.3. Mean CEB by age groups

AGE GROUP	WOMEN POPULATION	CEB	AVERAGE PARTY
15 - 19	74	24	0.324
20 - 24	195	332	1.703
25 - 29	252	594	2.357
30 - 34	211	727	3.446
35 - 39	177	824	4.655
40 - 44	107	620	5.794
45 - 49	38	233	6.132
TOTAL	1054	3354	

Source: Kilimanjaro survey 1993.

Moreover the quality of age data by age groups was evaluated by comparing age ratios and finally calculation of an age-accuracy index was done. The procedure and results are presented in Table 3.4.

The mean deviations from 100 is 10.59 which is the age accuracy index for the Kilimanjaro survey data. UN defines age data as 'accurate' 'inaccurate' or 'highly inaccurate'

depending upon whether the index is less than 20, from 20 to 40, or greater than 40 (UN Manual X). According to this definition the age data was accurate.

Table 3.4. Calculation of age-accuracy index, for Kilimanjaro

Age group	(1) Population	(2) Age ratio	deviation from 100. (2) - 100
15 - 19	74	-	-
20 - 24	195	119.63	19.63
25 - 29	252	124.13	24.13
30 - 34	211	98.36	-1.64
35 - 39	177	111.32	11.32
40 - 44	107	99.53	-0.47
45 - 49	38	-	-

Source: Kilimanjaro survey 1993.

Information on duration of breast-feeding appeared to be distorted by a rounding off tendency. Most mothers reported a duration of months to the nearest six. This resulted into a heaping on one year, one and a half years, two years etc. To lessen the effect of the error introduced to the data, this variable was classified as shown in chapter one.

Data on the last closed birth interval seemed to be affected by the same tendency of rounding off, this time to the nearest year. An interval of one and half years for instance was reported as two years. This problem was minimized by grouping the intervals into three classes namely; less than two years, between two and three years and more than three years.

The most difficult variable to measure was the household income. In order to get a good estimate of this variable several questions including paternal occupation and education, house rent status and ownership of several items like, a radio, a bicycle, a car etc. were asked. Furthermore, errors were minimized by putting the information on the income into three categories; low income, medium income and high income.

3.8. LIMITATION

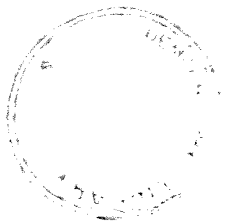
Problems in data collection is part and parcel of the exercise and this study is no exception. Several problems were encountered and the major ones are discussed below:

- The duration of stay was determined by financial state rather than the study requirement. The field allowance remitted by the University was so minimal that it could hardly sustain one for a month. Had not

this been the case the exercise would last longer thus more wards could be covered for a larger and better sample.

- Some ten-cell leaders perceived their involvement in the exercise as a bother to them. It was so difficult and impossible in some cases to get into cells of such leaders. This created incoveniences on our part and time wastage.
- Some women were reluctant to grant interview on the ground that they had been interviewed in countless number of times, but the findings and implementation part of the studies were never communicated to them.
- Interviews conducted after working hours appeared to interfere with mothers household chores. Owing to this, some did not respond altogether and for those who responded supplied information in rather a rush manner.

After the presentation of the methods used for data collection, types of errors, efforts made to minimize them and the quality of data, the next chapter therefore presents the study findings.



CHAPTER FOUR

FINDINGS

4.1. INTRODUCTION

This chapter presents the research findings. The first part gives a summary of the study population characteristics followed by an estimation of infant and underfive mortality.

The analysis of the data is carried out at two levels. The first one is a univariate analysis where cross-tabulations of mortality by variables included in the study are performed. This is followed by multivariate analysis and here logistic regression is applied.

A detailed discussion of the results is done and similar findings by other researches are cited whenever necessary. Finally research questions are reviewed to ascertain whether or not the findings provide answers.

4.2. SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

It is thought necessary to know the characteristics of a study sample before embarking into data analysis as this may give some insight into findings. This section therefore, is devoted for that purpose. Details for each study variable are presented in Table 4.1 followed by a brief discussion.

Table 4.1 depicts a high literacy rate in Kilimanjaro region. Only 2.9% of all the respondents in this study had not attended school. The education category which had the highest number of respondents was primary level where 73.1% of all the respondents had attained primary education. The secondary and post secondary category comprised 24% of the sample.

Concerning occupation, most mothers were categorized as 'others'. This category included among others those women who were homemakers and those engaged in petty business. This category had 41.1% of all women covered in the study. Women in agricultural sector were 30%. Professional women were only 178 (16.9%). Residence was almost balanced between rural and urban settings; 51.2% of the sample were from urban area.

Table 4.1. Socio-economic and demographic profile of the study population

Variable and categpru	Total number of women	Percentage
Educational level		
None	31	2.9
Primary	770	73.1
Secondary and post secondary	253	24.0
Residence		
Urban	540	51.2
Rural	514	48.8
Occupation		
Professional	178	16.9
Clerical/sales	126	12.0
Agricultural	316	30.0
Others	434	41.1
Household income		
Low	607	57.6
Medium	305	28.9
High	102	9.7
N.A.	40	3.8
Source of water		
Piped into house	312	29.6
Public tap	526	49.4
Others	218	20.5
Type of toilet		
Flush inside	211	20.0
Flush outside	101	9.6
Pit latrine	742	70.4
Breast-feeding		
<1 year	134	12.7
1 - 2 years	754	71.5
>2 years	110	10.4
N.A.	56	5.4
Age		
15 - 34	732	69.4
34 - 49	322	30.6

Table 4.1. (continued)

Variable and categpru	Total number of women	Percentage
CEB (Parity)		
1	223	22.3
2 - 6	688	68.8
6+	89	8.9
Birth interval		
<2 years	71	9.1
2 - 3 years	525	67.6
3+	181	23.3

Source: Kilimanjaro survey 1993.

As regards household income; most women belonged to households which were categorized as "low income' which included 57.6% of all women concerned. Few women 102 (9.7%) had their households in the high income category.

The main source of water, for most of the households was public taps. Mothers who were using this type of source were 526 (49.9%). Few mothers lived in houses fitted with water inside; only 29.6% of all the respondents fell into this category. Those who were categorized as 'others' collected water from different sources including wells, rivers, springs and dams. This consisted of 20.5% of the sample.

The majority of mothers 754 (71.5%) reported a breast-feeding duration of between one to two years, with an overall mean duration of twenty one months.

The dominant type of toilet facility was pit latrine; 70.4% of all the respondents had this type of toilet facility. Flush toilets inside houses ranked second where 20.0% of the sample used this type of toilet. The minority (9.6%) had flush toilets outside house.

Most of the respondents aged between 15-34 years which accounted for 69.4% of all the respondents. The parity variable indicated women of parity 2-6 to be the majority, this comprised 68.8% of all the respondents who have had at least one live birth. Only 8.9% had a parity of 6+. The last closed birth interval of the majority was between two to three years, where 81.9% reported this interval. Those who belonged to the risk category of less than two years interval were 71 (9.1%).

4.3. ESTIMATION OF INFANT AND UNDERFIVE MORTALITY RATES

The indirect technique for estimating infant and child mortality developed by Brass (1964) was used. The version modified by Trusell (1975) in (UN, 1983) was adopted since it takes into account that mortality has been falling

whereas Brass assumed a constant mortality in the recent past. The demographic computer package LOTPAK was used for computations. The North family of Coale and Demeny Model life table has been used in view of its suitability proved by other studies including Egero and Henin (1973) in analyzing the 1967 Tanzania population census data; Sembajwe (1983b) in the analysis of 1978 Tanzania population census data and Mturi (1992) in the analysis of 1988 Tanzania population census data. Results are presented in Table 4.2.

Table 4.2. Estimation of Child Mortality using data classified by age

AGE GROUP	(i)	NUMBER OF WOMEN	CHILDREN EVER BORN	CHILDREN DEAD	PROPORTION DEAD	PARITY P(i)
15-19	1	74	24	1	0.0417	0.3243
20-24	2	195	332	24	0.0723	1.7026
25-29	3	252	594	30	0.0505	2.3571
30-34	4	211	727	49	0.0674	3.4456
35-39	5	177	824	38	0.0461	4.6554
40-44	6	107	620	37	0.0597	5.7944
45-49	7	38	233	05	0.0215	6.1316
TOTAL		1054	3354	184	0.0548	

x	q(x)	REFERENCE PERIOD	TIME TRENDS IN	
			q(1)	q(5)
1	0.0487	0.7	0.0487	0.0722
2	0.0658	2.5	0.0553	0.0836
3	0.0416	5.3	0.0322	0.0464
5	0.0576	8.5	0.0404	0.0576
10	0.0416	12.2	0.0229	0.0377
15	0.0543	15.7	0.0303	0.0446
20	0.0195	18.7	-	-

Note: q(x) is the probability of dying at exact age x.

Source: Kilimanjaro survey 1993.

The final infant mortality rate was obtained by computing the mean implied infant mortality rates for women in age group 20-24 and 25-29, resulting into infant mortality rate of 43.75. The same procedure was adopted for under five mortality Rate. The result obtained was 64.9.

Comparing these results with those calculated by Tanzania Demographic and Health Survey (1991/92) which is the most recent; the survey reported an infant mortality rate of 55.5 and under five mortality rates of 78.6 for the Northern highland zone, which includes Kilimanjaro. The slight difference can be explained by the fact that,

Northern highland zone covers other areas which have higher infant and underfive mortality rates than Kilimanjaro thus resulting into an overall upward shift.

4.4. DIFFERENTIALS IN CHILD LOSS EXPERIENCE

The choice of child death experience as the dependent variable is in view of the fact that data on deaths are defective. Since this variable requires only information on child death occurrence, it minimizes errors due to omission.

This section examines child mortality differentials by socio-economic and demographic characteristics included in this study namely; maternal education, maternal occupation, household income, place of residence, source of water, type of toilet facility, duration of breast-feeding, maternal current age, parity and birth interval.

Percentage of women having experienced a child death is used as a child mortality indicator. Crosstabulations are carried out to establish the association between child death experience and variables examined. At this stage only women who have had at least one live birth at the time of the survey are considered. Results in percentages of women who had experienced a death of at least one child by each variable are presented in Tables 4.3, 4.4, and 4.5.

4.4.1 Socio-economic characteristics

Table 4.3. Crosstabulations of mortality by socio-economic variables

VARIABLE AND CATEGORY	TOTAL NUMBER OF WOMEN	MOTHERS WITH AT LEAST ONE DEAD CHILD	PERCENTAGE OF MOTHERS WITH AT LEAST ONE DEAD CHILD
Education level			
None	26	7	26.92
Primary	730	125	17.12
Secondary and post secondary	244	22	9.02
Residence			
Urban	509	82	16.11
Rural	491	72	14.66
Occupation			
Professional	178	18	10.11
Clerical/Sales	125	12	9.60
Agricultural	308	47	15.26
Others	389	77	19.79
Household income			
Low	594	107	18.01
Medium	304	38	12.50
High	102	09	8.80

Source: Kilimanjaro survey 1993.

Table 4.3 depicts a systematic decline of child death experience as maternal education increases. The percentage of mothers who had experienced a child loss ranges from 26.92% for those with no education to 9.02% for those with secondary or post secondary education. This is quite within expectation as it is generally known that education

Table 4.4 Crosstabulations of mortality by Intervening variables

VARIABLE AND CATEGORY	TOTAL NUMBER OF WOMEN	MOTHERS WITH AT LEAST ONE DEAD CHILD	PERCENTAGE OF MOTHERS WITH AT LEAST ONE DEAD CHILD
Water source			
Piped into house	293	34	11.60
Public tap	498	86	17.23
Others	209	34	16.27
Toilet facility			
Flush inside house	193	19	9.84
Flush outside	90	9	10.00
Pit latrine	717	126	17.57

Source: Kilimanjaro survey 1993.

to boil it. Children who consume water from these sources then stand a higher risk of infection which can lead to death. Similar findings have been established by other researchers (Mohan, op. cit; Casterline et al., op. cit).

Sewage disposal systems affect the prevalence of pathogenic organisms in the environment. Toilets are among such systems, whose importance is through its effect on sanitation. In this study all households in the sample had access to one type of toilet facility, so the analysis is based on the effect of different types on child mortality.

The results reveal that mothers with flush toilets inside house were least likely to experience a child death (9.84%) followed by those with flush toilets outside (10.00%), a very slight difference is noted. The largest percentage of mothers who had experienced a child death fell in the category of those who used pit latrines. This pattern is within expectation since pit latrines are more likely to be a source of food contaminating vectors such as flies if they are not properly cared for. Furthermore pit latrines are associated with several other factors which are unconducive to child survival. One such factor may be low household income.

4.4.3 Proximate determinants

Breast-feeding has been found by many researchers to be an important variable in reducing the occurrence of diseases particularly those related to intestinal infections (Da Vanzo et al., op. cit). The study in Kilimanjaro (Table 4.5) reveals that mothers who breast-fed for more than two years had the highest risk of child death experience (19.98%), followed by those who breast-fed for less than a year. Those who breast-fed for one to two years had the lowest risk. These results are a bit puzzling. A plausible explanation that can be offered for the highest risk to the longest breast-fed children is that poor mothers tend to breast-feed longer thus other

confounding factors like education and household income become important in determining mortality. This argument is supported by other studies as well (Da Vanzo et al., op. cit; Adair et al., 1993).

Table 4.5. Crosstabulations of mortality by proximate determinants.

VARIABLE AND CATEGORY	TOTAL NUMBER OF WOMEN	MOTHERS WITH AT LEAST ONE DEAD CHILD	PERCENTAGE OF MOTHERS WITH AT LEAST ONE DEAD CHILD
Breast-feeding			
< 1 year	136	25	18.38
1 - 2 years	754	108	14.32
2+ years	110	21	19.09
Age			
15 - 19	22	1	4.5
20 - 34	656	88	13.4
35 - 49	322	65	20.2
Parity			
1	223	7	3.13
2 - 6	688	114	16.60
6+	89	33	37.10
Birth interval*			
< 2 years	71	52	73.24
2- 3 years	525	78	14.86
3+ years	181	17	9.39

* Covers only women who have had at least two children at the time of the survey.

An alternative argument is that breast-feeding is associated with infant mortality only for a fixed length of life, beyond which it becomes insignificant. It is also

stage. The data are therefore subjected to a multivariate analysis for a plausible conclusion.

4.5. LOGISTIC REGRESSION ANALYSIS

This section attempts to quantify the influence of the factors included in this study on child mortality. The variable, residence which showed a weak association with mortality is not included in the analysis.

4.5.1 The Model

Logistic regression was considered convenient for multivariate analysis since the dependent variable is a dummy one.

The general fitted model is:

$\log(p/(1-p)) = \mu + \Sigma\beta_i x_i$

$\log(p/(1-p))$ is a linear function of the variables x_i where p is the probability of an experience of a child death by each woman,

x_1, x_2 , x_3 -------- x_k are set of independent predictors.

All predictors are treated as categorical factors in the regression.

μ and β_1 , β_2 , β_3 ----- β_k are the parameters to be

estimated. Odds ratios ($\exp(\beta_1)$ are used as indicators of the risk of a child death relative to the reference category of the variable, when all other factors included in the model are held constant.

The following equations were used to examine the effects of the three sets of factors, namely socio-economic, intervening and proximate determinants which are considered to influence infant and child mortality.

Mortality = f(Education, Occupation, Household income) - - - - - - - - - - - - - - - - (1)

Mortality = f(Education, Occupation, Household income, Source of water, Toilet facility) ------- (2)

Mortality = f(Education, Occupation, Household income, Source of water, Toilet facility, Breast-feeding, Maternal demographic status*, Birth interval) ---------- (3).

The three equations allow for estimation of gross effect of the socio-economic variables, education, occupation and household income on child mortality and the determination of the extent to which this set of variables operate through the set of intervening variables (source of water, toilet facility) and of proximate determinants (breast-feeding, maternal demographic status, birth interval) to influence child mortality.

Note: The computation of the variable 'maternal demographic status' is attached as an Appendix I. (see also Mbago, 1994).

4.5.2. Results of the regression

Logistic regression equations were estimated using SPSS software package. The coefficients together with the corresponding levels of significance are calculated for each category and for the whole construct.
Results are presented in Table 4.6.

Table 4.6 suggests that maternal education has a gross significant effect on child mortality at 5% level. A mother with secondary or post secondary education is roughly 2 times less likely to experience a child death than her counterpart with only primary education. However, when intervening and proximate determinants are controlled for, the effect becomes quite insignificant. Thus it appears that the association of education with proximate determinants ie. age, CEB, birth interval and breast-feeding is responsible for the association with child mortality. This result was not anticipated because mothers with high education could be more likely to belong to the

Table 4.6 Estimated logistic regression equations

Variable and Category	Equation (1) coefft.	S.E.	O.R.	Equation(2) coefft.	S.E.	O.R.	Equation (3) coefft.	S.E.	O.R.
Maternal Education	(p = 0.0463)*			(p = 0.2293)			(p = 0.9821)		
None	0.4670	0.4564	1.5952	0.4177	0.4590	1.5185	0.1003	0.6008	1.1055
Primary	0.0000	-	1.0000	0.0000	-	1.0000	0.0000	-	1.0000
Secondary and post sec.	-0.7257*	0.3296	0.4840	-0.5324	0.3740	0.5872	-0.0387	0.45231	0.9621
Occupation	(p = 0.0833)+			(p = 0.0565)*			(p = 0.2661)		
Proffesional	-0.2365	0.3646	0.7894	-0.5553	0.4519	0.5739	-0.5478	0.5137	0.5782
Clerical/Sales	-0.7370*	0.3324	0.4786	-0.2632	0.4055	0.7686	-0.3150	0.4723	0.7298
Agricultural	-0.3705	0.2057	0.6904	0.1986	0.3776	1.2197	0.0961	0.4463	1.1008
Others	0.0000	-	1.0000	0.0000	-	1.0000	0.0000	-	1.0000
Household income	(p = 0.5055)			(p = 8265)			(p = 0.3771)		
Low	0.0000	-	1.0000	0.0000	-	1.0000	0.0000	-	1.0000
Medium	-0.2318	0.2234	0.7931	-0.1410	0.2350	0.8685	-0.3409	0.2698	0.7111
High	-0.3728	0.4404	0.6888	-0.1839	0.4917	0.8321	-0.5961	0.5512	0.5509
Toilet facility				(p = 2421)			(p = 0.8279)		
Pit latrine				0.0000	-	1.0000	0.0000	-	1.0000
Flush outside				-0.2563	0.4180	0.7739	-0.2730	0.4443	0.7611
Flush inside				-0.6281	0.3804	0.5336	-0.0525	0.4331	0.9489
Water source				(p = 0.9748)			(p = 8540)		
Tap inside				-0.0067	0.2929	1.0076	-0.0141	0.3486	0.9860
Public tap				0.0000	-	1.0000	0.0000	-	1.0000
Others				0.0525	0.2345	1.0539	0.1491	0.2803	1.1608
Breast-feeding							(p = 0.0315)*		
< 1 year							0.83337**	0.3182	2.3017
2 years							0.00000	-	1.0000
2+ years							0.1910	0.2968	1.2104
Demographic status							(p = 0.0004)***		
1 (low risk)							0.0000	-	1.0000
2							0.8908**	0.2574	2.4370
3							1.146	0.9020	3.0484
4 (high risk)							1.3227**	0.4259	3.7536
Birth interval							(p = 0.0000)***		
< 2 years							2.5887***	0.3071	13.3131
2-3 years							0.0000	-	1.0000
3+ years							-0.2024	0.3026	0.8167
Model chi square	19.807 (p = 0.0014)			24.461 (p = 0003)			149.374 (p = 0.0000)		
Intercept	-1.3472			-1.4240			-2.0448		
df	7			11			18		
No. of cases	1,000			997			777		

O.R. Odds Ratio + significant at 0.1 level * significant at 0.05 level
** significant at 0.01 level *** significant at 0.001 level

low risk category of demographic status, thus when proximate determinants are controlled for, the effect would be expected to be even more significant. Nevertheless similar results have been documented elsewhere. Bakari (1991) in his study on infant mortality in Mbeya found that education as a determinant of infant mortality, turned out to be insignificant when other variables were controlled for. A study in Malaysia by Butz and Da Vanzo (1978) reported by Cochrane (1979) noted a disappearance of the significance of education on child mortality when income and housing quality were controlled for.

The occupation variable showed a marginal gross significant effect on infant mortality at 10% level. A mother who belonged to the occupation category `others' was roughly 2 times more likely to experience a child death than one working in clerical/sales job. Again when the intervening and proximate determinants were controlled for, the significance disappeared.

Though the estimated effects of household income on child mortality are not statistically significant, the coefficients in all the three equations indicate that mortality does decline with increased income. A study in Brazil (Merrick, 1985), revealed that from 1970 to 1976 income differentials on child survival in urban Brazil

declined as a consequence primarily of increases in maternal education and secondarily of increases in access to piped water.

As far as water source is concerned no significant effect was observed. A similar finding has been documented by Mohan (op. cit) in his study in Dodoma where regression analysis failed to support the argument that infant and child mortality rates are associated with poor accessibility to safe and clean water supply. Furthermore, other studies in Malaysia (Butz et al., op. cit; Da Vanzo et al., op. cit) reported that a linear regression coefficient of piped water was significant only in the last three weeks of the first month of life. Likewise, the effect of toilet facility showed no significant effect on child mortality.

As regards breast-feeding, its effect on child mortality is significant at 5% level. Mothers who breast-fed for less than a year were roughly 2.3 times more likely to experience a child death than those who breast-fed for one to two years. This agrees with findings by other researchers (Golberg et al., 1984, Palloni and Tienda, op. cit, among others).

Results for maternal demographic status (an index for age and parity) confirms a very strong positive association with child mortality. The net effect of maternal demographic status on infant and child mortality is highly significant ($p = 0.0004$). A mother in the high risk category is 3.75 times more likely to experience a child death than one in the low risk category.

The birth interval variable turns out to have the most significant effect on child mortality. The coefficient for the variable in the category of less than two years birth interval appear as the most significant. Mothers whose birth intervals are less than two years are roughly 13.3 times more likely to experience a child death than those in the two to three years category.

The implication of the observed results are discussed in chapter five, meanwhile the next section is a review of research questions.

4.7. RESEARCH QUESTIONS

This section makes an assessment of the extent to which the findings answer the questions.

Research question one: Can child survival chances be raised by increasing mothers education?

An inverse relationship between maternal education and child mortality has been observed from the univariate analysis level to a multivariate one where a significant effect was observed. However, the significance disappeared when intervening variables and proximate determinants were controlled for. A strong association between these sets of variables is suggested, therefore increasing education alone will not suffice to raise child survival chances. This is in agreement with a comment that "it is not education per se that influences child mortality, but rather the mechanism through which it operates".

Research question two: Does occupation status of the mother influence infant and child mortality?

In this study maternal occupation showed a relatively weak effect on child mortality. There was no significant effect up to 5% level. It can be concluded that this study could not establish a statistical evidence of the influence of maternal occupation on infant and child mortality up to 5% significance level. However, the variable was significant at 10% level in equations (1) and (2), but the significance disappeared in equation (3). This observation

may be due to the association between occupation and breast-feeding.

Research question three: Does high household income decrease death risks of a child?

A linear association between household income and child mortality was established, but in the multivariate analysis the variable did not seem to have any significant effect on infant and child mortality. However, it was noted that death risks decreased with increasing income. Statistically, household income does not decrease death risks of a child up to a reasonable level of significance.

Research question four: Does a child born in a rural setting share equal survival chances with her/his counterpart born in urban setting?

The study established weak association between residence and child survival in the univariate analysis. From the cross-tabulations there was no evidence of any effect of residence on child survival.

Research question five: Is the type of toilet facility one of the sources of mortality differentials among children?

A linear negative relationship between child mortality and type of toilet facility was observed, but no significant effect was established. It can be stated that for this study in Kilimanjaro region, the type of toilet facility is not one of the sources of mortality differentials among children.

Research question six: Do different sources of water for domestic use create differentials on child survival chances?

As in the case of toilet facility variable, water source did not show any significant effect on child mortality. From these findings it can be stated that water source does not influence child survival in Kilimanjaro.

Research question seven: Is duration of breast-feeding a determinant of infant and child mortality?

The effect of breast-feeding on infant and child mortality was significant at 5% level. It can be stated that duration of breast-feeding is a determinant of infant and child mortality in Kilimanjaro.

Research question eight: Does a child born to a mother at risk age (< 20 or > 35 years) or of a higher parity (6+) suffer a reduced survival chance?

The age and parity variables were summarized to an index named `maternal demographic status'. The study clearly showed that at 1% significance level a child born to a mother in the highest risk category of maternal demographic status suffers a much reduced survival chance.

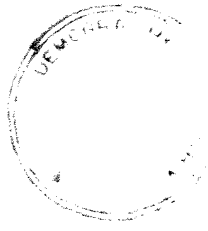
Research question nine: Does birth interval have any influence on infant and child mortality?

The study revealed a very strong influence of birth interval on child mortality at 0.1% significance level.

4.8. SUMMARY

The variables covered in this study are: maternal education, maternal occupation, household income, residence, water source, toilet facility, breast-feeding, "maternal demographic status and birth interval". Maternal education and maternal occupation showed a statistical significance on child mortality but disappeared when intervening and proximate determinants were controlled for.

Breast-feeding also appeared to have a statistical significant effect on child mortality. Similarly the remaining proximate determinants proved to have a very strong significant effect on child mortality . Birth interval was singled out as the most significant variable.



CHAPTER FIVE

CONCLUSION AND IMPLICATIONS

5.1. INTRODUCTION

The study has attempted to examine and identify determinants of infant and child mortality in Kilimanjaro region. The main objective was the estimation of the effect of socio-economic, environmental and proximate determinants on child mortality. Maternal characteristics and few household characteristics have been included in the analysis. These are, maternal education, maternal occupation, household income, residence, source of water, type of toilet facility, duration of breast-feeding, current maternal age, parity and birth interval. The unit of analysis used in this micro-level study is the mother. The indicator for the dependent variable is the mother's experience of a child death.

5.2. CONCLUSION

Consistent with other studies in Tanzania and other societies, the maternal demographic status and the birth interval showed the most substantial impacts on infant and child mortality among the set of variables examined.

Maternal age and parity which was measured by an index 'maternal demographic status' indicated that children borne to mothers in the high risk category had the highest death risk. However, mothers who had children born at an interval of less than two years proved to have a very high chance of experiencing a child death irrespective of their socio-economic status.

Breast-feeding appeared to have a significant effect on child survival. Mothers who breast-fed for less than a year happened to be much more likely to experience a child loss compared to those who breast-fed for a period between two and three years. This suggests a breast-feeding duration of at least a year.

Maternal educational level had a modest effect on child mortality. Secondary or post secondary level was implied by the results. Mothers who had acquired secondary or post secondary education were less likely to experience a child death compared with those who had attained up to primary education level. There was no significant difference in child death experience between mothers with primary education and the illiterate ones. This is in conformity with findings by Casterline et al. (op. cit) in a study in Egypt. Contrary to findings from many localities the significance of the effect of education on

child mortality disappeared when proximate determinants were controlled for. Nevertheless, maternal education beyond primary level is suggested for improvement of child survival.

Maternal occupation was marginally significantly related to child mortality. Children borne to mothers categorized as clerical/sales indicated the highest survival chances. Though studies have shown that household income may play a significant role on survival of children, this study failed to establish statistically significant association between the two.

There is no evidence of a significant association between the household's type of toilet facility and source of water on child mortality.

Certain policy measures emerge from this study which can be undertaken to improve the survival chances of the children. The next section contains some recommendations.

5.3. RECOMMENDATIONS TO POLICY MAKERS

The findings suggest that the reduction of infant and child mortality will be enhanced if the following recommendations are looked into:

- Demand for higher level (beyond primary) education for women has been reflected by the results of this study. More education opportunities at the mentioned level for women need to be granted. The Ministry of Education and other responsible parties should try to increase the number of girls enrolled into secondary schools. The government should review the education cost sharing programmes especially in favour of girls/women. Since there is a possibility that education opportunities may go disproportionately to those from relatively advantaged economic and social backgrounds. However, these are long term solutions; for current mothers who had not attained secondary education, health education programmes could prove useful. Strengthening of news media including the 'Adult Education Zonal papers' is advocated.

- The effect of birth interval on child survival is appreciable. A lengthy birth interval increases survival chances of a child. So attention should be directed towards promotion of lengthy birth intervals. The family planning services should be intensified to aid mothers to space their children to an interval of at least three years. This measure is also an important health-promoting family planning strategy in high-fertility environments since long birth intervals automatically reduce the number of children born to a woman who starts child bearing early. The Ministry of Health through its organizations including

Maternal and Child Health (MCH) and other Non-governmental Organizations (NGO's) like UMATI (Uzazi na Malezi bora Tanzania) should educate and make provision of Family Planning services to mothers to avoid risk fertility to the grass roots.

- Community-based child monitoring systems advocated by UNICEF (1990) should receive government and public support.
- Breast-feeding of less than a year has been proved by this study to mitigate child survival chances. A system which enables employed mothers to breast-feed their children should be devised. One alternative is to extend maternity leave up to a year.

5.4. RECOMMENDATION FOR FURTHER RESEARCH

While the study has identified some of the factors associated with child mortality and their relative strength, it cannot claim to have exhausted every detail, therefore more studies are called for.

The following are suggestions for further research:

The main causes of infant and child death as reported by Kilimanjaro regional MCH office were in ascending order of frequency, Diarrhoea, Malaria, Acute Respiratory Infection and Anaemia. UNICEF (1990) reveals that diarrhoea is caused by bacterial, viral and other parasitic

agents transmitted through water and poor sanitation. This study however, could not find out any statistical significant effect of water supply and sanitation on child mortality. It is therefore, recommended that a study should be done in Kilimanjaro region devoted solely on the impact of water and sanitation on infant child mortality.

This study did not explore the mechanism through which the proximate determinants (maternal age, parity and birth interval) operate to influence infant and child mortality. A study which includes illness, injury and nutritional status of a child may add a useful knowledge.

5.5. LIMITATION OF THE STUDY

Most socio-economic variables share the reference time problem. The variables are measured at the time of the survey whereas the mortality being analyzed has occurred earlier. However, as Preston (1985) states it is not as serious a setback as is commonly believed; from the fact that social mobility in developing countries is not generally rapid. Therefore, the present functions as a good indicator of the past.

Appendix I

Computation of the maternal demographic status variable.

The maternal demographic status index was computed for each woman who have had at least one live birth by the time of the survey.

In the first step a logistic regression on whether or not a mother has had a child death on the variables mother's current age and parity was performed. The second step was computation of the predicted probabilities of a child death. Results were grouped into four categories in the order of magnitude as shown below.

The fitted model is:

$\log(p/(1-p)) = \beta_o + \beta_1 CEB + \beta_2 Age$

Thus $p = \exp(\beta_o + \beta_1 CEB + \beta_2 Age)/(1 + \exp(\beta_o + \beta_1 CEB + \beta_2 Age))$.

where p is the probability of a child death.

The results were:

$\beta_o = -1.6027$ $\beta_1 = 0.5149$ and $\beta_2 = -0.0661$.

so the fitted model was

$\log(p/(1+p)) = -1.6027 + 0.5149CEB + (-0.0661)Age$

The values of p were categorized as follows:

0-<0.23, 0.23-<0.43, 0.43-<0.63 and 0.63 and above.

The frequency distribution for the categories is presented in the table below.

category	Frequency
0-<0.23	620
0.23-<0.43	187
0.43-<0.63	107
0.63+	86
Total	1000