THE EFFECT OF INDIVIDUAL AND CONTEXTUAL VARIABLES ON INFANT MORTALITY IN KENYA

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A Dissertation submitted to the
Department of Sociology
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

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December, 1984

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(Publication No.)

Zibeon Sore Muganzi, Ph.D.,
The Florida State University, 1984

Major Professor: Charles B. Nam, Ph.D.

In this study an attempt is made to examine the effects of various factors on infant mortality in Kenya. These factors are grouped into two general categories - those associated with the individual woman/child and those associated with the social and environmental setting within which they live. The first set of variables is identified as "individual variables" and includes variables such as age of woman, education, sex of child, etc. The second set of variables constitute the "contextual variables" and includes variables such as availability of health facilities, water supply, sanitation and prevalence of malaria.

The objective is to examine the combined effect of all the factors on infant mortality, a deviation from most studies which have only focused on individual factors. The study employs two statistical models, the ordinary Least Squares and the logistic regressions

in examining the relationships between these two sets of variables and mortality.

The findings indicate that while most variables included in the model were significantly related to mortality, breast feeding and the number of pregnancies to a woman in particular are major determinants of mortality in the country.

Even more important, the findings show that the effect of the contextual variables on infant mortality is stronger at the regional level where for some regions large percentages of population have poor access to such facilities as health services, water supply and sanitation. Thus infants born in such regions have lower chances of survival given that their individual characteristics already exposes them to higher mortality.

One important contextual variable is the high prevalence of malaria in some regions. It has a strong positive effect on mortality in those areas.

The findings point to the fact that efforts aimed at reducing infant mortality in Kenya must focus, not only on individual characteristics of the population, but also with greater emphasis on the distribution of essential facilities, water supply, health services, as well as eradication of malaria.

To my parents for their care in all days of my school. And in memory of those infants who never survive the first year of life in the developing world.

ACKNOWLEDGEMENTS

The successful completion of this work was made possible by a number of individuals for whom I am very grateful.

First, I wish to thank the Kenya Government, the University of Nairobi (Population Studies and Research Institute) and the Agency for International Development for offering me the scholarship to enable me to go through the training.

I also wish to thank the members of my Advisory Committee for their keen interest in the work, as well as for their constant and helpful advice at all stages of writing. I am especially grateful to Dr. Charles Nam, my major professor, whose critical evaluative comments greatly enhanced the usefulness of this work. My thanks also go to Drs. David Sly, Isaac Eberstein, and William Serow for their constructive comments and encouragement.

My special thanks also go to the staff and students in the Sociology department whose friendship I enjoyed and cherished throughout my stay at Florida State University. I am also grateful to the African Students

Association for the moral and psychological support. I also found unfailing support in my fellow Kenyan friends.

Finally, the patience and dedication of Mary Lou Richey in typing this dissertation is very much appreciated.

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CHAPTER I

INTRODUCTION

Problem Statement

Attempts to explain recent dramatic mortality declines in the developing countries have generated two schools of thought. The most widely accepted view is that this decrease was largely independent of socio-economic factors but due mainly to factors associated with government actions, which included improved medical technology, disease control through antimalaria campaigns, immunization against tuberculosis and smallpox, and availability of antibiotics used in treating infections and respiratory diseases (Preston 1979, Arriaga and Davis 1969, Palloni 1983, Gwatkin 1978, Meegama 1978).

In support of this view is the argument that mortality rates have fallen in virtually all parts of the developing world; even in areas which have not experienced extensive economic development, especially in Africa and some parts of Asia (Eblen, 1981; Willie, 1959; Hansluwka, 1975; Who, 1981; Butz et al, 1982). Arriaga and Davis (1969), for example, and more recently Behm (1979) and Palloni (1981), have shown that through the 19th century up

to the 1930s the rate of improvement in national mortality levels in Latin America was closely linked to each nation's level of economic development. But after 1940 up to 1960, as Preston (1979) documents, the availability of effective antibiotics, e.g., sulfa drugs and insect acids used to attack the main vectors, helped to drastically bring down the mortality in most of these countries.

Similar confirmatory evidence for the Asian and African countries have also been given elsewhere (Azefar 1981, Sivamurthy 1981, Gwatkin 1980).

The general observation from these studies is that mortality decline in most of the developing countries has been too rapid to be accounted for by economic development alone, prompting the conclusion that medical technology has accounted for a large proportion of mortality reduction from exogenous factors, thereby causing a shift in the mortality curve.

However, evidence from other studies supports the view that economic and social factors have made an equally important contribution in the reduction of mortality rates in the developing countries, especially mortality from endogenous factors, thereby causing a shift along the curve (Preston 1981, Ratcliffe 1978, United Nations 1980, Gray 1978, Newman 1981, Nag 1981). Studies in Cuba, Sri Lanka, Taiwan and Mauritius, for

example, have shown that it was not only the importation of medical technology but also its equitable distribution and accessibility to the people that helped reduce mortality (Preston 1979, United Nations 1973). Along with medical technology were also measures such as development of efficient transport system to reach the rural areas, changes in land tenure systems, provision of sanitary services including clean drinking water and sewage systems, sufficient supply of food with improved agriculture, and increased literacy rates among the populations, especially women.

A better demonstration of this shift in mortality curve is given by the experience of Kerala State in India (Nag 1981, Ratcliffe 1978). Regarded as one of the poorest states in India with a per capita income of only $80, Kerala has achieved some of the lowest mortality rates in the country through socio-economic development. The changes, which included land reform tenure system, legislation of minimum wages, provision of accessible medical facilities, efficient transportation and, most important, mass participation in decision making at the local level, helped reduce infant mortality from 120 per thousand in 1952 to an estimated 55 in 1972, and the crude death rate from 20 to 7 over the same period, lower than that found in developed nations, i.e., 10.

The experience of Kerala and other countries provides further evidence that measures which affect the social environment are necessary to reduce mortality rates beyond levels achieved by affecting the physical environment (e.g., through eradication of malaria carrying mosquitos).

However, whatev er view one is willing to consider, there is no doubt that both medical technology and socio-economic development have and will continue to play important roles in the reduction of mortality in the developing countries. The validity of this conclusion stems from the emerging evidence of deceleration of mortality decline in these countries, which is still largely due to factors associated with underdevelopment, i.e., poor nutrition and housing, unsanitary living conditions, lack of access to medical care, as well as the persistence of diseases like malaria, tuberculosis, etc. (Preston, 1978; Gwatkin, 1980). The persistence of these diseases emphasizes the fact that it is not the availability of malaria and immunization programs in a given country that helps reduce mortality but rather how such programs can effectively reach the more than 80% rural population, a process which in itself depends on many other aspects of socio-economic development, e.g., efficient transport.

With this recognition, the United Nations and World Health Organization have recently stated that the inter-

pretation of the existing mortality differentials by socio-economic factors is not straightforward because most of the factors involved are highly interrelated. Furthermore, the report adds, there are numerous socio-political-cultural compounding factors which cannot be directly measured or observed, not to mention the definitional and measurement problems which further complicate the interpretation of the results UN, WHO, 1982).

It is in this context of the complexity of relationship between mortality and socio-economic development, which continues to engage most governments in the developing world amidst limited but unequally distributed resources, that this study addresses the problem as it relates to the Kenyan situation.

Justification of the Problem

It is generally agreed in the literature that infant mortality, its determinants and differentials, is considered the most important component of mortality in developing countries.

(i) Its contribution to the total loss of years of human life is substantial both because it occurs early in life and because its level is relatively high in developing countries.

(ii) Its causes tend to be largely distinct from those which operate at the older ages of childhood and at adult ages.

(iii) Its measurement provides a useful index of the status of health as well as the standard of living of the society.

(iv) Its prevention has been, and remains, a major preoccupation of the health authorities, both national and international and the degree of success of health programs could be ascertained on the basis of the observable decline in infant mortality. .

Such studies as have been done in most developing countries have emphasized the inverse relationships between various socioeconomic factors and mortality (Preston, 1980, Palloni 1983, Caldwell 1979, Rodgers 1970, Flegg, 1982, Cochrane 1980). Some of the variables studied have included income, education, class status, and age of the mother, as well as contextual factors such as use of piped water, amount of calorie intake, type of housing, etc.

Such studies have also been completed in Kenya where such relationships have also been emphasized (Anker and Knowles 1978, Mott 1980, Henin 1979, Eelens 1983, Ominde 1978, UNICEF 1981). While this being the case, the Kenyan situation nevertheless presents its own peculiarities for further examination of this relationship.

First, the present socio-economic structure is deeply entrenched in historical socio-economic political

administration of the country by the former colonial government which maintained separate and distinct development, not only for Africans but also among the various regions of the country. This imbalance has survived the post-independence era to the extent that structural evolution rather than revolution has increased the maldistribution of services and facilities, especially in the rural areas where more than 80% of the population live. This is especially so as regards such vital services as health, piped water, roads, schools, etc., most of which were concentrated in white-occupied areas. The government efforts to correct this imbalance has been slow and expensive, especially with a rapidly increasing population of which 52% is under age 15. Estimated at 4% per annum, Kenya is said to have the highest growth rate of population in the world.

A large part of this population increase has occurred in the former "African reserves" where most of the local population was concentrated with minimum services and facilities. This historical aspect of development in the country has been recognized but not adequately related to the observed mortality differentials. This study will attempt to address this issue.

Closely related to the above regional imbalances is the political decision-making and policy-implementation structures in the country. Politics has a major role to

play in the overall socio-ecomic development of any country. The decision to build more health centres rather than hospitals, improve the urban areas more than the rural areas or provide loans to the small farmers to improve the food production and therefore their health are all made by politicians who are in most cases unaware or are unwilling to acknowledge the fundamental problems affecting the masses at the grass roots level.

Kenya is divided into administrative units known as provinces which are broken down into districts, locations, and sublocations. All these units are headed by a politically-appointed administrator who is answerable to the President's Office through his immediate head. This is the administrative set-up devised and used by the colonial government, and it has been adhered to in the post-independence period.

Planning in the country is undertaken at all levels based on the outlined political units. But whatever decision that is reached must get the approval from the ministerial headquarters centralized in Nairobi. This has led to long bureaucratic delays in the implementation of the desired development programmes, especially in the rural areas which in turn means denial of such essential services to the larger share of the population.

These two aspects of planning in the country are

usually complicated by the occasional disagreements among the country's politicians who form the parliament. Each member bears the responsibility of promoting development in his area. But ministers are better placed to achieve this than ordinary members of parliament. This has led to many projects being abandoned in certain areas due to lack of government backing, a process which perpetuates unequal development and, in turn, differentials in mortality in the country.

The above theoretical justifications have been reinforced by empirical evidence from recent studies in the country showing the persistence of large mortality differentials both at micro and macro levels (CBS, 1979, 1983; Blacker, 1971; Eelens, 1981). Mortality estimates have been made for the country since 1943, the time of the first census. Before this period, mortality is believed to have been high due to crude medical care, widespread famines and malnutrition (van Luijk, 1969).

Though recent estimates show a steady but gradual decline in the infant mortality rate over the years, i.e., from an estimated rate of 184 per thousand in 1948 to 83 per thousand in 1980, enough evidence also exists to the effect that this decline has not been uniform (Mott, 1979; Anker and Knowles, 1978; CBS, 1983). For example, it has been shown that infant mortality

differs not only by region and place of residence but also by individual characteristics such as age of the mother, ethnic group, social class, education and income.

These mortality differences, while being consistent with results from other countries, have however not been adequately explained from the socio-cultural point of view in the country. Incidentally, the distribution of population by ethnic groups follows the administrative boundaries of the seven provinces. Within these provincial demarcations exists varying degrees of not only climate and physical features but also unique social cultural practices that tend to differentiate one region from the other.

For example, provinces known to have high mortality rates (Nyanza, Western and Coast) are also noted for their prevalence of malaria and other related diseases (Van Luijk, 1974; Ominde, 1978). This is attributed to a number of factors. First is their low-lying elevation which allows extensive flooding from the humid tropical rainy weather. Secondly, the numerous irrigation rice schemes, especially in Nyanza, provide fertile breeding places for mosquitoes which leads to high incidence of malaria.

On the other hand, nutritional and other socio-cultural studies in the country have provided evidence of

malnutrition resulting from food taboos observed and practiced by various ethnic groups, especially in the high mortality areas. Ojianbo (1968) has shown that, among the Luhyas of Western Kenya, widespread taboos prohibit pregnant women from using eggs, milk and chicken, all believed to cause infertility. Gerlich (1961) has also described the pattern of food consumption among the Digo (coast province) which he notes leads to high incidence of kwashiokor. Owen (1974) had also noted the many taboos surrounding food among the Luos of Nyanza province, which are observed from the sowing time till the consumption of food.

Weaning patterns also vary from one ethnic group to the other. Among the Kipsigis, for example, babies of only 10 days are given traditional gruel by forced feeding. This is also common among the nomadic groups. In contrast, the Kamba prolong the weaning period up to age 3.

The traditional patterns of feeding are believed to be changing rapidly but not necessarily for the better, especially in urban and cash crop districts. Traditional cheap protein foods are replaced by starchy foods or expensive high prestige shop baby foods, which in most cases are no better in promoting malnutrition. This has been observed in Machakos district, where some

of the highest protein calorie malnutrition rates (up to 50%) have been recorded. (See the report by the Medical Research Center in Machakos 1978).

Other social cultural aspects relate to the use of medical services. The idea of modern medical services has least penetrated the strong traditional beliefs and practices of the nomadic groups who roam the arid and semi-arid areas of the country, along with other groups in the most remote parts of the country. These people believe strongly in traditional herbs and roots in treating their sick. Even among the enlightened groups traditional medicine has always found its way to the hospital. High incidence of malnutrition and infant death rates have been recorded among these groups who rely on traditional medicine.

There are still those who believe in consulting the so-called wise men, believed to predict the future and therefore causes of deaths. And finally there are those who believe in nothing but prayers. Although the percentage of population involved in these traditional practices may be small, their contribution to the overall national mortality cannot be under estimated.

As already pointed out, most studies on mortality in the country have not adequately linked these socio-cultural aspects of food and health to mortality. There

is thus need to go beyond what is already known about the differentials associated with super-structure and examine the underlying mechanisms sustaining mortality, as this study will attempt to illustrate.

Finally, many models on the determinants of infant mortality in the developing world have mainly focused on factors related to the characteristics of the respondent, e.g., age, educational levels, social class, etc. Until recently few, if any, have in addition included the contextual variables, such as sanitary conditions, housing conditions, nutritional deficiences, and access to medical facilities (Flegg, 1982; Anker and Knowles, 1979; Butz, et al., 1982; Edmonston and Andes, 1983). From these later studies, it has been shown that not only are these variables major determinants of mortality but also they closely interact with individual characteristics in affecting the changes of death.

For example, malnutrition, which is a major killer of infants in the developing countries is known to be closely linked to education, income and the social status of the parents. These are, in turn, influenced by the region or place of residence of the individual which could, in turn, mean access to some of the eseential facilities like water, hospitals, etc.

As its main objective, therefore, this study will

test an explanatory model of infant mortality in Kenya where both individual and contextual variables are included, apart from re-emphasizing the already known facts about mortality in the country.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

In stating our problem in the last chapter, the complex nature of mortality and various socio-economic variables was stressed. It was pointed out that not only are the variables collinear but also present both measurement and interpretational problems. To further examine this question, a review of relevant literature which directly or indirectly bears on these relationships will be explored. Consistent with the stated problem, the review will distinguish the variables which relate to mortality at both the micro (individual and household) and macro (contextual) levels. However, note must be taken of the fact that collinearity as stated among the variables is possible and occurs across the two levels.

In an effort to conceptually comprehend the underlying relationships between the relevant variables and mortality, an attempt will be made to develop a theoretical framework which also considers both the macro as well as micro levels.

Finally, efforts will be made to develop a number of hypotheses the study will attempt to test based on the literature review and the theoretical model.

Literature Review

There is general agreement among scholars that the analysis of mortality in a given population is a complex issue since it relates to a great number of frequently interrelated biological, social, economic and cultural features of not only the individuals and the family but also the community in which they live (Behm, 1982; Ruzicka, 1983; Patton, 1983; Flegg, 1982; Butz, 1982; Azfor, 1982; Arriaga, 1982; Newland, 1980; Preston, 1979; WHO, 1981).

Newland, for example, argues that the effects of the physical environment on a child's chance of survival depends heavily on its parent's economic and personal resources such that their ability to cope with the challenges of seeing an infant through the first year is determined not only by their income but also by their knowledge of the resources available to them and their skills in using them.

Underlying the above argument is the fact that the solutions to the reduction of infant and child mortality in the developing world cannot be found in the singular approaches so far used in current research but rather in the multiple approach which considers not only the socio-economic factors but also cultural as well as environmental factors and their interrelationships as determinants of mortality in a given society.

The above line of reasoning, for example, was underscored at the Bucharest Conference by the World Health

Organization and more recently by the Conference on the Socio-Economic Determinants of Mortality in Mexico City (WHO, 1974; IUSSP, 1979).

In reaffirming the role of social and economic progress as a condition of the continuation of mortality decline, the World Health Organization observed that:

> The view that declining mortality in less developed countries can be attributed entirely to public health has proved to be an over-simplification of a rather complicated set of interrelated facts, and by no means a straight-forward cause-effect relationship. It appears plausable to assume that a certain take off into development is a prerequisite for entering into phase of rapidly falling mortality. Efficient government, progress in education, road communications and even rudimentary administrative infrastructure seem to play an important role in the initial stage. Once the decline is underway, public health measures supported and coordinated in many cases at an international level, become increasingly operative. Accessibility of an efficient health service infrastructure and a vigorous health policy, together with over-all progress in the socio-economic field then determine the extent and pace of further gains.

Indeed, while not underestimating the potential of public health measures in further mortality improvements, the WHO concludes that:

> ...actual progress will be determined by a multiplicity of problems whose solution is generally speaking not yet readily in sight. Mortality prospects cannot be assessed in a mechanical way isolated from prospective changes in the societal milieu nor can the experience of other countries be borrowed where their initial experience may have been radically different. A thorough review of the economic and social situation, both current and projected should be considered an indispensable prerequisite for a realistic assessment of future trends.

However, despite the possible adequacy of such an approach to the study of mortality in the developing world, the inadequacy of relevant data on mortality and the various factors that affect it has proved a persistent problem. Nevertheless, some headway has been made in utilizing the available data as we shall demonstrate in the following review.

Consistent with the foregoing arguments, recent research on the determinants of infant mortality, especially in the developing world, point to a number of factors, both demographic as well as socio-economic, that influence mortality at these vulnerable ages. Among others, available evidence shows the following to be important: maternal education, socio-economic class, income, place of residence, parity, age of mother, birth order, birth interval, and marital status. At the macro level, such factors as climate, transportation system, the administrative set-up, the availability and accessibility of health facilities, sanitation, sewage, and nutrition have been mentioned to play an equally vital role.

The association of infant mortality and maternal education has been widely discussed in the literature (UN, 1980; Caldwell, 1979; Preston, 1980; Arriaga, 1983; Behm, 1978). In a study covering eleven Central American countries, Hugo Behm and his group at CELADE found that maternal education showed the strongest correlation of any variable ovserved

to infant and child mortality. According to their study, the mortality rate of children whose mothers had ten or more years of schooling was only one third to one fifth the rate of children whose mothers were illiterate (Behm, et al., 1978).

Findings based on World Fertility Survey data for the Asian and African regions also provide substantial confirmatory evidence to the CELADE findings (Arriaga and Hobbs 1980, Caldwell 1979, Mott 1979).

Data for Pakistan for the period 1969-1974 revealed that unschooled women lost 142 infants for every thousand born whereas women with primary education and above lost only 100. For Indonesia, the range was 93 for illiterate women compared to 62 for those with primary school education. Such evidence also exists for Kenya (Mott 1979), Nigeria (Caldwell 1979) and Ghana (Gaisie 1982), among others.

Exactly how maternal education affects infant mortality is a subject of controversy among researchers. To some authors, maternal education is a proxy of the general level of living rather than a factor in its own. (Hugo et al. 1978). However, there is reason to believe that this assumption underestimates the direct role maternal education plays in the reduction of infant mortality. Caldwell (1979, 1983), for example, believes that in addition to being proxy, education also provides the woman

not only with the skills and knowledge to do the job, but most important, it changes the traditional balance of familiar relationships such that an educated mother has more weight in the decision-making process related to the care of her children.

What Caldwell and others are suggesting is that education increases the skills, knowledge and ability of the woman to deal with new ideas, especially those from outside her own culture. For example, better information on nutrition and hygiene will help in the direct prevention of such diseases as kwashokor, diarrhea, etc.

It is also argued that an educated mother is better able to judge the gravity of an illness, to understand the capabilities of modern medicine and, therefore, seek appropriate care for a sick child at the right time.

As one researcher has observed, an educated woman is more likely to intervene effectively when problems with a baby's health care arise and is more likely to prevent them from materializing in the first place (Newland 1980, Caldwell 1981, Cochrane 1980).

At another level, while relating education to wealth, Sawyer (1983) observes that in Brazil, in addition to knowledge, the education variable may reflect to a considerable degree levels of wealth and power among families, such that infants born to such families have higher probability of survival than those of less educated parents.

Two other variables thought to inversely relate to mortality but which correlate with education are income and occupation (Preston, 1976; Flegg, 1982; Rodgers, 1979; Weatherby, et al.)

Preston, for example, in his multivariate analysis of cross national data showed that countries with higher income had lower mortality. However, his was a very general approach to this relationship.

A more critical approach to this relationship is presented by newland (1981), who contends that it is not whether a country has a higher or lower income, but the way income is distributed within the subpopulations of a country that directly determines the chances of survival and, in turn, the level of mortality within it.

A comparison of the oil rich countries, where 90% of income is concentrated among the 10% Royal families, with other third world countries where income is spread out, revealed that Saudi Arabia, Libya and Qator had an estimated infant mortality rate of 146, 130 and 138 per thousand, respectively, compared to Sri Lanka (42 per thousand), Cuba (19 per thousand), Kerala State (India (45 per thousand), and Guyana (46 per thousand).

The point is that income interacts with every one of the common causes of infant mortality-education, housing, nutrition, etc. Thus, it is the poor families with low income that often cannot provide their children with food of sufficient quality and quantity, better housing, clean

water, better sanitation and medical help when they fall sick.

Occupation affects mortality in a similar manner as income. Although studies show lower mortality for the white collar workers, salesmen, etc. (Anker and Knowles 1979), other evidence exists to the effect that such advantage of better living conditions among these groups diminishes if one examines the categories within them. Thus a salesman for a corporation does not earn the same money as a rural shop salesman on whom the whole family depends, especially in developing countries (WHO 1980, UN 1973, Newland 1981).

Thus in addressing the socio-economic issues relating to mortality in third world countries, closer attention must be given these subcategories which tend to obscure important differences.

Infant mortality, as was suggested earlier, has also been shown to relate to various demographic factors such as age of mother, her parity, marital status and the birth weight, birth order, sex and space interval of the child.

Enough documentary evidence exists to show that the total number of children a woman bears in her lifetime and the timing and spacing of her pregnancies have major impact on each of her children's chances of survival (WHO 1980, Newland 1981, Butz et al 1982, Walfers and Scrimshaw 1975, Federic and Luciano 1982). For example, it has been

shown that women who start childbearing while in their teens or prolong it past their mid-thirties usually increase the chance that their children will die in infancy.

A demonstration to this effect was provided by P.A.H.O. Survey which showed that in California (USA) 26 of every 1000 babies born to teenage mothers died compared to only 15 per thousand to mothers between ages 25-29 and 18 per thousand for women over age 35. The same survey revealed that in El Salvador mothers aged 19 and less lost 120 babies for every thousand born compared to only 73 for those women aged 25-29 and 94 for women 35 and over.

Similar evidence has also been reported from Colombia (Somoza 1980), Kenya (Mott 1980) and Sri Lanka (Meegama 1980). In Kenya, Mott reported an infant mortality rate of 116 per thousand for women aged 15-19, 108 per thousand for those aged 20-29 and 124 per thousand for those aged 30 and over.

The association between infant mortality and age of the mother is said to relate to both physiological as well as environmental factors (Federici 1982, Solimano 1982). Physiologically the young woman has not matured well to sustain pregnancy in conditions of poor nutrition and usually little or no prenatal health care. Moreover, infants born to such women enter in an already polluted environment, plagued with disease-causing germs, especially

through poor housing, poor nutrition, etc. Thus, being economically handicapped such women may not be able to provide not only the desired nutritional ingredients (e.g., milk) but also the necessary medical care as this may be lacking or expensive and inaccessible if available.

Older women (35+), while caught up in similar poor economic and environmental conditions, are said basically to have a weakened body system that is less capable of withstanding the strains and stress associated with pregnancy. Thus, babies still face similar high chances of dying.

Equally important is the birth interval between the children. Available evidence suggests that closely spaced babies are subject to higher than average mortality. In India it has been shown that siblings born less than 2 years in between have a 50% greater death risk than those born with an interval of 3-4 years (UN 1973, Newland 1981). Evidence from the World Fertility Survey also provides similar confirmatory findings from other developing countries.

Closely associated with birth interval is the parity of the woman and birth order of the child. Recent research from developing countries suggests that a woman aged 25 years, for example, with four or more children, will face higher risks of death not only for the kids but also for herself. The contention here is that the woman does not allow herself time to adequately recover from the previous

pregnancy. With a weakened body system in the wake of malnutrition, not only for her but also the children who compete for her milk, the chances of higher mortality are unavoidable (Mosley 1983, WHO 1980, Meegama 1980, Debora 1981).

Thus women in the developing countries where completed fertility is quite high, e.g., Kenya 8.2, Ghana 7.8, and India 7.2 (World Fertility Survey Report 1980), and where the birth interval is small, in most cases less than 2 years, both mothers and infants face higher mortality rates.

The first born babies to a woman are also known to face elevated risk in the first month of life (UN 1973, WFS Report 1980, Population Bulletin 1983), not only in developing countries (DaVanzo, Habicht, and Butz 1981) but also for developed countries as well (Feldstein and Butler 1965). This has been attributed to the young age of the mother and the lower birth weight of the baby.

Two other factors which have been associated with infant mortality are marital status and type of marriage. Though there is no substantial empirical evidence of exactly how these relationships work, some researchers believe the inadequate care and resources given each family in the polygamous family and the little care given children by single, divorced or separated mothers, play a major part in contributing to overall more than average child mortality. In both cases, malnutrition has been pointed

out as a major factor (Mott, 1980; Caldwell, 1982; Gaisie, 1980, Sivamurthy 1981). And not to say the least, male babies are known to experience higher mortality than the females through the first year of life. This is attributed to biological factors beyond our control.

Thus far we have focused on the socio-economic and demographic factors as they influence mortality in infancy. However, as we have indicated elsewhere, these factors do not work in isolation. They interact with both the physical and environmental factors which further perpetuates mortality and mortality differentials in human populations.

Experience from the Western world shows that for a given population it is not just the presence of such vital facilities like clean water, sewage disposal, better housing, medical facilities, etc. but most important their accessibility to the people who need to use them (Preston and Van de Walle 1978, McKeown 1965). Such accessibility is facilitated by an efficient and well coordinated transport and communication system as well as a balanced and stable government with an efficient administrative set up.

Whereas the above conditions obtain in most of the now developed countries, the situation regarding the developing countries falls far short of expectations.

With few exceptions, the political instability in Africa and Central America, for example, throws in chaos whatever development projects the previous government had

put up. Each new government, while promising new directions and leadership usually becomes a victim of the same corruption and mismanagement as the previous one. Further complications are even introduced when a government is faced with choice of ideology - West or East. These national and international ties are important since they determine the extent to which projects like health services, rural education, and nutrition services can be funded for the benefit of the people.

The inequality of essential services between and within populations is well noted in the literature (UN 1973, Gwatkin 1980, Preston 1982). In any case, where such facilities exist, they are either inadequate, inaccessible or very expensive for most of the poor population to afford (Newland 1981, Sawyer 1983, Meegama 1980). It is usually the low income section of the population that is at a disadvantage as regards the access to such facilities.

The importance of adequate water supply and sewage disposal facilities as determinants of infant mortality is well researched. Both provide direct channels for disease-causing germs in the human body, which usually results in diseases such as diarrhea, dysentry, etc. and, in worst cases, death.

In Kenya, for example, although 85% of rural households are within two kilometres of a source of drinking

water of one kind or the other, only 15% have access to piped water (Economic Survey, 1979). A large percentage of population still depends on river,stream, pool and rain water which in most cases is usually contaminated one way or the other. This is because, due to lack of toilet facilities, most people use the surrounding bushes for both human and other refuse disposal. These are washed down the streams and rivers with the heavy rains. Since most families use unboiled water, high incidence of water borne diseases is not uncommon.

The same state of affairs has also been reported elsewhere. In India, Sivamurthy (1981) observes that,as of 1978, only 8.3% of the urban population had some provision for protected drinking water supply, while less than 10% of rural population had adequate drinking water supply of acceptable quality, hence the high frequency of water borne diseases. He also notes that only 30% of total urban population had only been partially sewered, leaving the rest of the urban population exposed to the dangers of open-gutter hazards.

In Nigeria, a report by a group of investigators on living conditions in slum areas noted that nearly all houses they visited had no water supply, no ventilation and in most cases the pail system was used to dispose of human and other refuse. These conditions provided the best breeding grounds for disease-causing germs, hence the

high rate of infant mortality reported (Ransome-Kuti, et al., 1972).

Efforts to improve these conditions by many governments in the developing countries are defeated by the high rate of migration to urban areas, especially the slum areas, and by the high growth rate of rural populations. The politicians who own most of these slum houses have also proved an obstacle to changing their conditions.

It is true that medical services, supplies, and personnel are concentrated in the cities of rich and poor countries alike but the disparity is particularly acute in most of the poor countries. Veron et al (1979) reported that Zaire in 1977 had one doctor for every 4,045 people in Capital City Kinshasa compared to 1 for 52,434 people in Kasai province. In India, population per doctor has been estimated to be 4,000 for the urban areas but ten times as much for the rural areas.

In Kenya, more than 75% of medical facilities are concentrated in the two main cities of Nairobi and Mombasa. The government, while expressing the need for promotive and preventive programs, nevertheless spends three quarters of the health budget on the importation of sophisticated and expensive technology which rarely finds its way to the rural population. The rural areas are characterized by an unsatisfactory level of service due to insufficient service delivery points, inadequate resources

and organization.

It is estimated that more than 80% of rural population has to travel more than 3 miles to obtain medical facilities, and drinking water. Most of the rural health centers are far spaced, under-staffed and inadequately equipped to handle even some of the minor cases (Medical Reports 1979). Most of them lack piped water, have no electricity and use very crude ways of sewage disposal.

In Brazil, Sawyer (1983) has shown that high infant mortality exists in the Northeast due to lack of some of the essential services. For example, whereas there were 467 persons for each hospital bed in the northeast and 3 doctors per 10,000 inhabitants, in the South (which is more urbanized) the ratios were 189 and 11/10,000. Meegama (1980) also provides an account of how the inadequacy of health facilities in rural Sri Lanka area(estates) has contributed to higher mortality compared to the urban areas.

These are but a few of the numerous examples of how lack of adequate health facilities and their unequal distribution within countries has contributed to and perpetuated high mortality conditions in these countries. Some countries, however, have made admirable progress in mortality reduction through equitable distribution of services.

Sri Lanka and Kerala State in India provide good testimony to this effect. In Kerala, for example, food

is distributed to everyone by the State, medical supplies are equally and efficiently distributed freely to the whole population and most important the literacy rates among the population, especially the women, is twice that of the national level. All these factors have reduced infant mortality from an estimated rate of 120 per thousand in 1952 to 55 per thousand in 1973.

Many researchers share the view that good nutrition is essential for both the mother and newborn alike (Cochrane 1980, Plank and Milanesi 1973, Habicht, et al.,1981, UN 1973, Gartmaker 1979). The effects of malnutrition and undernutrition on infant mortality are well noted in the developing world (Gwatkin 1980, Mosley 1983). They are linked not only to lack of enough income for the majority of population to purchase the necessary food but most important to the social cultural customs and feeding habits that characterize most rural population.

Severe maternal malnutrition has been reported for majority of the women in India, Pakistan and Bangladash where customs give preference to males over females (Chen and D'Souza 1979). In Guatemala, the infants who were born to malnourished women suffered three times higher infant mortality than those born to well-fed women. In Kenya, as we stated earlier, pregnant women in some areas are forbidden from using eggs and meat, which are thought to be harmful to the unborn.

The major cause of malnutrition and undernutrition especially is the lack of adequate food for the young infants. Due to low income, most infants are fed on traditional foods which are either deficient or unhygienic. In India, for example, the highest rates of malnutrition have been recorded among the 80% poor for whom the general price rise over the years has handicapped their purchasing power.

It is generally agreed that maternal milk has much more nutritional value than the baby formulae now so common in developing world. There is mounting evidence that breastfeeding provides the best diet to infants expecially during their first 6 months of life (Knodel 1977). Maternal milk offers the infant increased resistance to infection as it is known to contain antibodies. Exclusive breastfeeding also protects the infant from malnutrition which so commonly operates in partnership with diarrhea to undermine the health.

A study carried out in Papua- New Guinea by PAHO - Pan American Health Organization reported that 69% of artifically-fed infants were completely malnourished compared to 26% of the breast fed. A group of Chilean mothers surveyed in 1969 and 1970 reported three times as many infant deaths among babies given bottles before the age of three months than among those who were solely breast fed. In the Philippines, an 85% increase in breastfeed-

ing resulted in a 40 percent mortality reduction over two years. Similar studies have also reported similar results from the developed countries . (Newland, 1981). For example, in upstate New York, it was reported that bottle fed infants were hospitalized three times more than breast fed.

Equally important in the study of infant mortality is the quality and quantity of housing. According to the UN (1979), more than 70 % of the world's poor live in poor-quality housing. This is especially so in the developing countries where the slum areas of major cities are the focus of attention.

There is evidence that better housing conditions with related sanitary and public health measures in the now developed nations contributed to the present low levels of mortality (McKeown 1973, UN 1973) as obtains in these countries.

A large percentage of population in the Third World cannot afford to build or buy permanent houses. Most of them opt for grass-thatched and mud-walled and floored houses. But with lack of sanitary facilities like water, sewage and ventilation, the houses provide no better protection but a source of infection. This is especially dangerous for the crawling infants who go around and pick and eat any contaminated stuff due to lack of differentiation. The conditions are even worse where a single room is usually

shared by more than 6 to 8 members of one family. For example, studies in Tanzania in 1976 showed that 33% of all Tanzanians were living in households with seven or more members and about 29% of these households had only one or two rooms (Henin 1980).

In Kenya, a seasonal peak of diseases has been shown to coincide with the occasional floods which usually sweep through the western part of the country. Most of the houses are washed away. The homeless people are left victims of such diseases as cholera, as has been reported in recent years (Ministry of Health Bulletin 1978).

At another level, more emphasis has been put on the association between mortality and the region of residence (UN 1978, Henin 1978, Arriaga 1969). The legacy of colonial rule in most of what are now the less developed countries is the inequality in socio-economic development as designed, pursued and maintained by the colonial governments in the respective countries, and in some cases perpetuated by local post-independence political struggles. This in itself implies that some regions in a given country have access to such facilities as schools, health care, better nutrition, water, transportation, food supplies, etc., all which directly or indirectly impinge on mortality.

Further complications in regional differences are usually increased by variation in such factors as climatic and local weather conditions which attract disease-causing

vectors in some regions as opposed to others. In Kenya, for example, the humid tropical regions, i.e., the western and coastal areas, are noted for their high incidence of malaria, hence the high rates of mortality reported for these areas (Vogel et al 1983).

Also the unequal distribution of agricultural land, its ownership and accessibility, has a major role in explaining mortality differences within countries. This is because more than 80% of rural population in the developing world depend to a large extent on subsistence agriculture.

Malnutrition and undernutrition, as seen in most developing countries, are closely associated with land ownership and, therefore, agricultural production. In Central American countries where the feudal system denies the majority of the population ownership and accessibility to land, more than average mortality has been reported since the high prices of the essential foods set by the governments are beyond the purchasing capacity of these poor farmers (Palloni1980, Arriaga 1982). The same mortality conditions have also persisted in India where the feudal system, in terms of land ownership, is at its best (UN 1980). In some countries poor storage facilities and transportation systems also contribute to increased mortality especially in times of emergencies. A good example is the Sahelian countries where due to lack of

transport and poor communication facilities, many people cannot be reached during the devastating famines that usually sweep across these countries leaving trails of human remains and in certain cases helpless malnourished people who either die off or may be saved with relief aids (UN 1983).

Another factor considered crucial in mortality is the problem of refugees, especially in Africa and Asian regions. Due to political instability in the horn of Africa, for example, Kenya has been unable to cope with the thousands of refugees from neighboring countries, in terms of providing the essential services - medicine, food, shelter, etc. This is because the facilities are not only expensive to transport to these people but they are not even enough for the Kenyan population itself. The same situation has also been reported in southeast Asia where the mortality from refugees has become an international issue.

All the factors reviewed above, plus others which bear on mortality, should be taken note of in any mortality analysis especially for the so-called Third World countries.

Although we have tried to place a distinction between the micro and macro variables, their interdependence must however be emphasized. For example, while it is true that income is closely related to education, sanitation, housing, health services, etc., which in turn play a major role in

determining mortality, it is equally true that the success of these factors in mortality reduction requires a stable political system, an efficient transport and communication system for transportation of food and other essential goods, and an environment free of disease-causing vectors.

However, we cannot lose sight of the fact that some factors such as weather, floods, famines, etc. are beyond our manipulation, especially with the technological level existing in the present developing world.

The fact is that an understanding of the determinants of infant mortality requires an examination of the total superstructure, its individual factors and their combined interactive effects as will be shown in this study.

Conceptual Framework

In both the last and the present sections, we have emphasized the complex nature of the determinants of mortality. For example, we have suggested that mortality in a given population is determined by frequently interrelated biological, social, economic, environmental and cultural factors. We have also demonstrated in the foregoing literature review how some of these variables interact in influencing mortality.

However, in an effort to comprehensively conceptualize the linkages between mortality and the various factors, attempts will be made here to develop a conceptual model

or framework to be applied to this study.

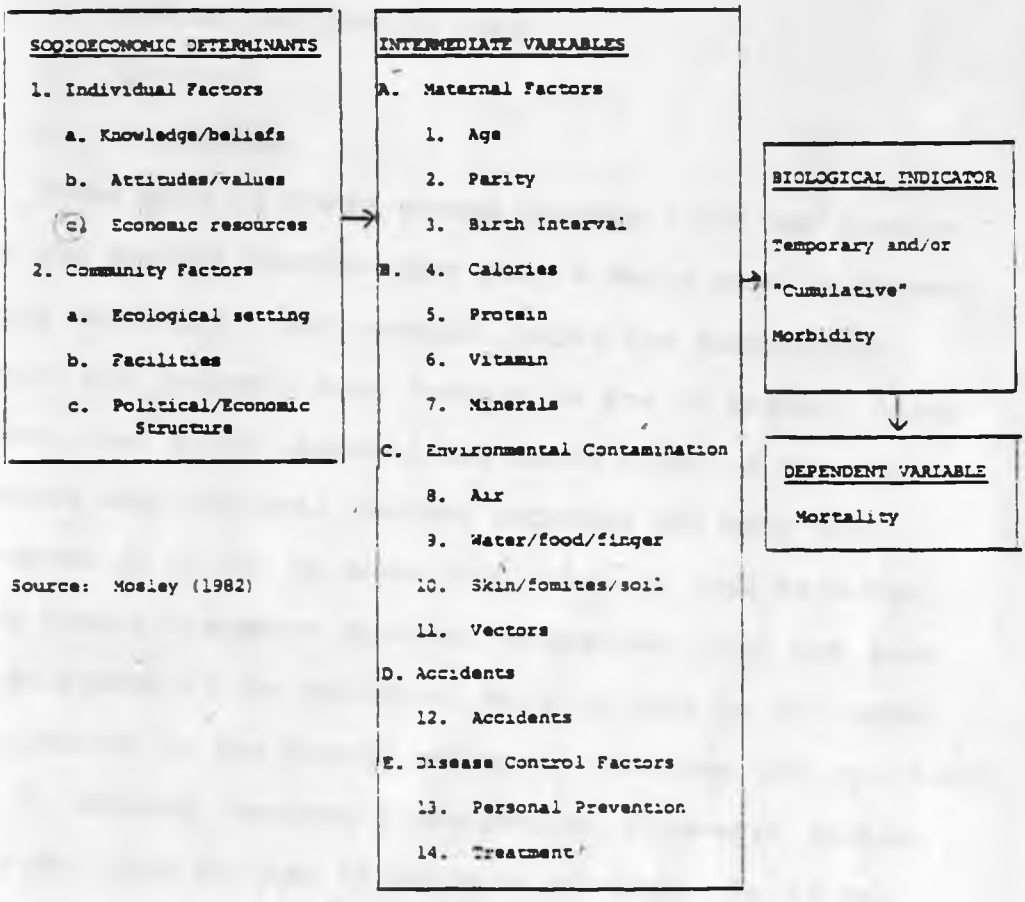
As Behm (1983) has appropriately observed, "efforts to elaborate on a comprehensive theoretical framework involving mortality and socio-economic - environmental factors have been very limited until recently." Recent research, nevertheless provides empirical evidence of increasing breakthroughs (Meegama 1980, Mosley 1980, 1983, Pallom 1983). In most cases, past research has assumed the specification of the model in the statistical techniques used as in the multivariate analysis.

The model developed by Mosley recognizes the fact that the socio-economic determinants operate through some biological mechanism (intermediate variables) to produce the levels and patterns of mortality observed in given populations (Mosley 1980). He stresses that while most demographic research relating mortality and socio-economic variables has ignored the mechanisms through which the variables operate, biomedical research on the other hand has focused on the causes of death ignoring the social and economic intervention measures. Thus, in an effort to bridge the two areas, Mosley suggests the framework of variables for the study of infant and child mortality in Figure A.

Meegama (1980), using Sri Lanka Fertility Survey data for 1976, suggests a broader conceptual model for the

Figure A

A FRAMEWORK ON VARIABLES FOR THE STUDY OF FACTORS INFLUENCING CHILD SURVIVAL



Source: Mosley (1982)

study of factors affecting neonatal mortality in developing countries. He divides these factors into six broad groups as follows:

1) Demographic
2) Economic and Political
3) Environmental
4) Medical and Health Care
5) Cultural
6) Geographic

Under each of these groups Meegama lists and justifies the various factors that play a major part in determining mortality. For example, under the demographic section are included such factors as age of mother, birth weight, sex, birth interval and birth order of the child. Economic and political factors includes not only the resources to invest in such facilities as road networks, cheap public transport systems, education, etc. but also the existence of the political will to help in the equal distribution of the scarce resources (Meegama 1980,pp.17-18).

In general, Meegama's theoretical framework follows the same lines as that of Mosley's although the latter differentiates between background variables (socio-economic), and the intermediate factors (maternal dietary intake, environmental, etc.). Meegama, however, illustrates this relationship in his analysis of the various factors, their interrelationships and how they combine to

directly or indirectly affect mortality.

Meegama justifies such a detailed model on the grounds that it will not only provide broader understanding of mortality but will also help in the collection and analysis of specific data on these factors which will be tested for their relevance to mortality.

Meegama's argument picks up support from Palloni's recent work on the determinants of infant mortality in Latin America (Palloni, 1983). Working within the same framework as the other two, Palloni observes that it is not only the lack of health facilities that perpetuates mortality at these vulnerable ages but a whole series of events and processes that can be traced to the individuals psysiological well-being as well as the socio-economic environmental conditions.

Palloni sees social development and what he calls non-vertical interventions working through individual households and community conditions to reduce mortality in infancy. For him, social development includes education campaigns and socialized medicine: non-vertical interventions include nutrition programs, maternal care, sanitation and disease prevention; individual conditions include biological factors, child care as well as maternal care. Under household conditions are crowding and family structure while community conditions includes sanitation, access to services and ecology.

Intricate as they appear, the above theoretical frameworks only goes so far to support the recent observations by the United Nations and the World Health Organization on the complex nature of infant mortality which is multi-dimensional rather than unidimentional (UN, 1982).

Within the framework of the above theoretical models and drawing on our literature review as already discussed, we shall propose a conceptual model with the following classification of variables:

1) Background variables
   - Age of mother
   - Marital status
   - Region of residence
   - Place of residence
   - Religion
   - Ethnicity
   - Sex of child
2) Intermediate variables
   - Mother's level of education
   - Age at marriage
   - Age at death (of the infant in months)
   - Parity of woman
   - Birth order
   - Polygamy
   - Access to health services

- Housing type
- Months breastfed
- No. of fertile pregnancies

3) Infant mortality

1 = birth died before 1 year

0 = birth survived first year

The background variables (which in a model are conveniently called exogeneous variables) are expected to have direct as well as indirect influence on infant mortality. The indirect effect is mediated through the intermediate variables (called endogeneous variables in the model).

However, for the purpose of this study, a distinction between individual and contextual variables must be emphasized within the two broad groups (i.e., Endogenous and Exogenous). Variables such as housing, health services and water supply will thus be treated as contextual in the sense that certain portions of the population in given regions have access to them. Their effects on mortality will thus be seen as additional to those of the individual factors.

For example, we would expect the poor survival chances of an improperly fed infant to increase if the housing conditions are poor in the region.

Age of mother is and has been shown to be an important factor in determining mortality. It does not only

determine the level of education of the woman but also her entry into marriage as well as her parity. But from the literature, we have shown that mother's education will influence the infant's survival chances in many ways (Caldwell, 1981). For example, an educated mother, we have argued, will be better off financially and will be able to provide not only better housing and clean water but also adequate health care to the woman.

The part played by region of residence, as well as place of residence, in influencing mortality is well documented in the literature as already discussed (Meegama, 1980; Mott, 1980. In the Kenyan context, for example, we have shown that the country shows distinct differentials in terms of socio-economic development, demographic distribution, and ethnicity; and physical features, especially in terms of climatic conditions.

These differentials in themselves mean different sections of the population will have different access to some of the facilities like health, housing, water, etc. which in themselves have direct effect on the survival of the infant. We have also shown how different regions are conducive to malaria in terms of climatic conditions, a factor which further perpetuates mortality differentials.

Although the ethnic distribution of the population in the country follows the geographic boundaries, the

socio-cultural characteristics, such as religion, feeding habits, etc, have also been found to be geographically bound. Thus, such factors as age at marriage, level of education and the average number of children are greatly influenced by ethnic affiliation but as we have already seen these factors themselves have their own effect on infant mortality.

The above discussion of the interrelationships between the various factors and how they impinge on infant mortality implies a number of relationships which have nevertheless been supported by literature elsewhere. We shall, therefore, attempt to test the following hypotheses as they apply to this study.

HYPOTHESES

The following hypotheses will be based on individual variables:

Hypothesis 1: The age of the woman will have a negative effect on infant mortality.

Hypothesis 2: Male infants will have a higher infant mortality than the female.

Hypothesis 3: Maternal education will have a negative effect on infant mortality. The same is also true of father's education on mortality.

Hypothesis 4: Married women will be associated with

lower mortality compared to single, divorced or separated women.

Hypothesis 5: Higher parity will have a positive effect on infant mortality. Also associated here are birth orders and birth interval. Higher mortality is closely associated with first order babies and closely spaced children.

Hypothesis 6: People residing in the urban areas will show lower infant mortality compared to those in the rural areas.

Hypothesis 7: People residing in Nyanza, Western and Coast provinces will have higher infant mortality than those living elsewhere in the country with the exception of North Eastern province.

Hypothesis 8: Polygamous families will be associated with higher infant mortality compared to once married families.

The following hypotheses will be based on contextual variables:

Hypothesis 9: Regions with high prevalence of malaria will have higher infant mortality.

Hypothesis 10: Areas with a high percentage of population having access to clean piped water and

other sanitary facilities (toilets) will have lower infant mortality.

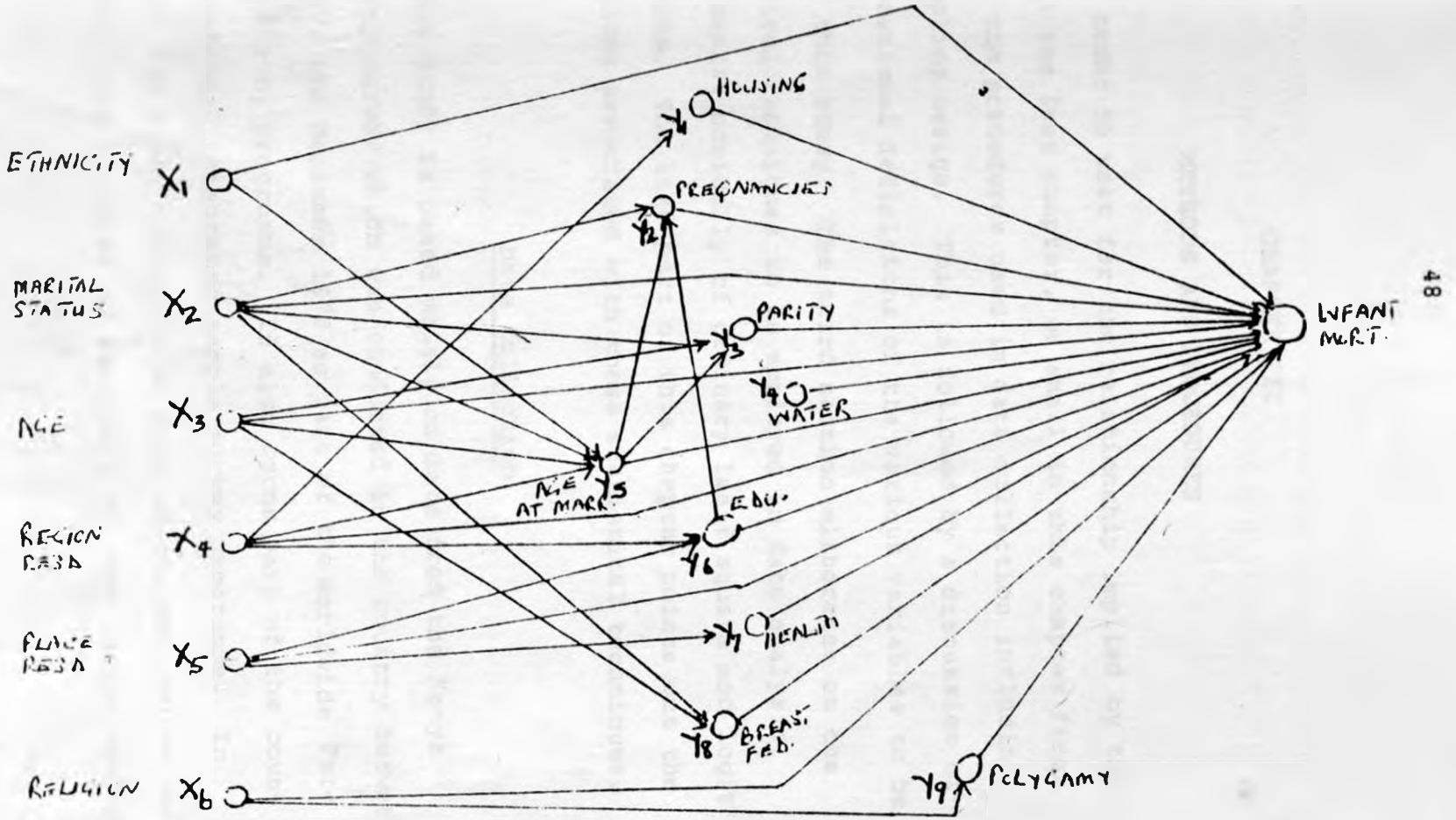
Hypothesis 11: Low quality housing (e.g., earth floor and mud walls with grass roofs) will be associated with high infant mortality.

Hypothesis 12: Low quantity and quality of health services will be associated with higher infant mortality.

The foregoing list of hypothesis does not exhaust all the number of relationships that will be tested in this study. Any others that might be relevant will be tested in the course of the analysis. On the other hand, the lack of data on some variables does not allow their inclusion though they will be mentioned at one stage or the other. These include nutrition, food production and land holding.

However, based on the above relationships, the theoretical model in Figure B will be tested for this study.

Figure B. Hypothetical Model for Determinants of Infant Mortality in Kenya



CHAPTER III

METHODS AND PROCEDURES

In order to test for the relationship implied by the model in the last chapter, we shall in this chapter first present the procedures used in data collection including the sampling design. This is followed by a discussion of the operational definitions of the various variables to be used in this study. The third section elaborates on the statistical techniques to be employed in data analysis. These consist basically of ordinary least square and logit regression. The last part of this chapter points out the limitations associated with these statistical techniques.

Data Collection

This study is based mainly on data from the Kenya Fertility Survey which was conducted in the country between July 1976 and December 1978 as part of the worldwide Fertility Survey programme. It also forms part of the country's national integrated sample survey programme. In addition the study incorporated data on various contextual variables from a number of secondary sources in the country,

mainly from the Central Bureau of Statistics and Ministry of Health. These include data on housing conditions, water and sanitary conditions, distribution and accessibility to health facilities, etc.

While focusing mainly on the collection of fertility related data, the Kenya Fertility Survey, which covered 8100 women aged 15 to 49, also gathered information on the respondent's socio-economic and cultural background in addition to other demographic characteristics. These data have direct relevance to this study and will therefore be used.

Specifically, the following data will be utilized:

1) Respondent socio-economic and ethnic background.
2) Respondent demographic characteristics, for example, age, marital status, age at marriage, etc.
3) Respondent maternal history which includes one's history of recorded births, deaths to these births and number of pregnancies experienced over the years.

Sample Design

The Survey was a multi-stage sample covering both the urban and rural areas separately. This design was purposely used in an effort to minimize both sampling and non-sampling errors through such measures as accurate mapping of the

sampling units and use of qualitative supervision and enumeration (Kenya Fertility Survey Report 1977-78).

Rural Sample

For the rural sample design, the entire country was divided into strata on the basis of ecological zones from which one administrative district was selected forming the primary sampling unit. Two clusters were selected from each of the sampling units giving a total of 64 rural PSUs and 128 rural clusters. They covered an estimated population of 200,000 people.

Due to the expense of covering a whole district as a PSU, it was divided into chunks which were small manageable units. Ten chunks were created out of every sampling unit, out of which two chunks were finally selected using probability, proportional to the estimated chunks' population size expressed in terms of expected number of clusters.

Each cluster was expected to have approximately 1000 people or 200 households. One cluster was selected from each chunk using simple random sampling and this yielded two clusters per sampling unit (PSU). The rural sample was derived so as to be self-weighting with all clusters having an equal probability of selection.

Urban Sample

The total sample was designed to carry a 2% urban sample. A total of 80 urban clusters was selected. The

urban centers were also stratified according to ecological zones and household income levels. The strata were further divided into chunks on the basis of the 1969 population Census. Two chunks were selected from each stratum, with probability proportionate to size. From each selected chunk, a single cluster was selected with equal probability to size.

The Sample of Households and Respondents

Based on the above sampling procedures, a total of 120 rural clusters was finally picked out for which a complete listing of the households was carried out. Since the ratio of eligible women to households was slightly over 1, a sampling fraction of 1/3 was applied to select the sample of households. This fraction was applied in the selection of all households.

For both urban and rural areas, a total sample of 10,763 households was selected out of which 1187 were found vacant. Out of the remaining 9576 households, 8891 (92.8%) were successfully enumerated.

A total of 8452 women aged 15 to 50 years who had slept in the household the previous night were identified in the 8,891 enumerated households, giving a ratio of .95 eligible women per household, out of which 8100, i.e., 95.8% were finally interviewed.

A 93.9% response rate in the rural areas and 92.5% in the urban areas were obtained.

Operational Definitions

Infant Mortality

Generally, infant mortality refers to the number of deaths occurring to infants below 12 months of age. For purposes of analysis, this mortality is frequently divided into neonatal mortality which occurs in the first month after birth and post-neonatal mortality which occurs during the rest of the year.

Infant mortality is measured in various ways depending on the kind of data and methodology to be applied to a particular problem. In the analysis of levels, trends and differentials, for example, the measurement most commonly used is the infant mortality rate which can directly be calculated by dividing the number of deaths occurring in children under the age of one year by the total number of live births in the same period. Life table functions and indirect methods have also been used (Bragg 1978) in the calculation of infant mortality.

However, when data is analyzed on the individual level, and such is the case for our purposes, infant mortality is frequently measured by obtaining the proportion of infants deaths from the total number of live births corresponding to each woman. This measure is not inadequate but neither is it satisfactory. For example, a woman who has only one child who dies would have the same infant

mortality measure as another woman whose five live born children all later died.

Moreover, such a mortality ratio compounds the effects of some of the independent variables which presents problems in interpretation. This is especailly so when the variables are both entered as continuous as well as discrete variables.

In an effort to minimize the above problems, infant mortality in this study will focus on each individual live birth. It will be measured as a binary variable with the categories of whether the child died or survived the first twelve months of life. But the use of live births as observations implies more than one observation per mother. This creates the possibility that influences on different infants born to the same mother may be correlated. We partially control for this by including variables specific to the infant and variables specific to the mother or household. However, the unmeasured mother-specific influences may remain.

Age

Age refers to the number of years lived by the mother since birth. It is measured as a continuous variable. Though one of the important variables in demographic analysis, it is usually plagued by numerous problems including age misstatement, heaping and shifting,

most of which result from memory lapse, socio-cultural customs, etc. In this study, however, the question on date of birth was used to cross check the accuracy of the reported age.

Age at First Marriage

This variable refers to the age of the woman, in number of years, at the time of her first marriage. It is measured as a dummy variable in the model, with four categories. Most research shows that young age at first birth is correlated with high mortality.

Marital Status

Each respondent was questioned about her first and current marital status. Four categories were identified - single, currently married, separated, divorced or widowed. This variable will be measured as a dummy variable with these categories. It refers to the first marriage of the respondent.

Type of Marriage

This variable refers to whether the respondent's marriage was a polygamous or monogamous one. It is entered as a dummy variable with two categories.

Parity

Parity refers to the birth order of the ith child born

alive to each woman. It is measured as a dummy variable with several categories as will be indicated in the model. It is widely believed that higher infant mortality is associated with higher parity.

Sex

This variable refers to the sex of the ith child at birth and is measured as a dummy variable, i.e., either male or female.

Birth Interval

This variable is used in this study to refer to the time elapsed in months between two consecutive pregnancies. It is also measured as a dummy variable with several categories.

Maternal Education

This variable refers to the number of years the respondent had spent in an educational institution receiving formal education. It is measured as a dummy variable with three categories.

Region of Residence

This refers to the usual region of residence of the respondent. Everybody was asked to state this clearly. In this study, however, this variable is measured as a categorical variable with four dummy

categories. This categorization is based on both the geographic and physical continuity as well as demographic characteristics of the regions. The categories in this case will be Coast Region, Central and Eastern Regions, Rift Valley Region, and Western and Nyanza Regions.

Place of Residence

Place of residence in this study will be used to refer to the respondent's place of residence at the time of the survey, either urban or rural. Hence it is measured as a dummy variable with two categories.

Ethnicity

Ethnicity is used in this study to refer to the ethnic group of the respondents. It is measured as a dummy variable with a number of categories as will be indicated. Actually there are many small ethnic groups in Kenya. But the major four or five groups happen to follow the provincial political demarcations, thus emphasizing the consolidation of socio-cultural factors which play a major part in determining infant mortality in Kenya.

Religion

Religion in this study refers to the denomination to which each of the respondents belongs. It is measured as a categorical variable with four dummy cate-

gories of Catholics, Protestant and other Christians, Muslim, and no religion.

Father's Education

This variable refers to the number of years the respondent's husband has spent in a learning institution. It is measured as is the maternal education, i.e., a dummy categorical variable with several categories.

The following contextual variables will also be used in this study.

Type of Water and Sanitation

Data relating to the percentage of population using a kind of source of water for each of the seven provinces was collected for this study. This variable is measured in this study as a dummy with three categories, i.e., piped, streams and rivers, and others. Sanitation is also measured as a dummy variable but with two categories, i.e. with or without sanitation facilities.

Accessibility to Health Services

This variable refers to the percentage of population for each region having access to some kind of health facilities. It is measured as a dummy variable with several categories in reference to either health centers, hospitals or others.

Housing Conditions

This variable refers to the percentage of population in each region depending on type of housing, ie., permanent, semi-permanent, mud house or other. Thus the variable is measured as a dummy with several categories

Malaria Prevalance

As already pointed out, three major regions in Kenya are known to have high prevalence of malaria which compounds with other factors in perpetuation of high mortality. This does not, however, leave other regions free of this deadly disease. Data relating to the incidence of this desease for each region was collected and this variable will be measured as a dummy depending on whether the region had a low or high prevalence of malaria.

As already stated, there are numerous other factors relevant in the study of mortality which have not been defined here, for example, calorie intake, prenatal care, birth weight, etc. While lack of adequate data on these variables justifies their exclusion from the model, the objective nevertheless was not to handle all factors relating to mortality but only those which were thought more relevant theoretically and empirically, provided information on them was available to us. Those not in the model will be discussed in the interpretations of data. A summary of all the variables and their names

used in this study is given in Table 1.

Possible Biases in the Data

Before we discuss the statistical techniques to be used in this study, it is appropriate here to point out some of the problems and biases associated with the data and sampling frame as presented above.

As in any survey data, no sampling design can assure complete accuracy. This, although the adoption of a multi-stage design was to minimize sampling errors, some shortcomings were nevertheless revealed during the survey.

Some discrepancies were discovered, for example, between the listed and the expected population in the cluster. The listed population in the cluster was, in cases, below that expected in these clusters. This was corrected by the addition of more clusters in an effort to maintain the balance.

The problem of undercoverage was also detected in the survey. The listed and expected population showed that the drawn sample fell short by 20%. This was attributed to poor implementation design and a recheck was carried out to assure some accuracy.

There were also enumeration errors, especially relaing to over and under estimation of both the adults as well as births. For example, there was under estimation of children aged less than 5 years and more than 9 years.

Table 1. Names and Variables Used in the Analysis

VARIABLES	NAMES
A. Demographic	
Var 010	Age of Respondent
Var 107	Marital Status
Var 109	Age at First Marriage
Varh 1	Birth Order
Varh 2	Date of Birth of Child (months)
Varh 3	Sex of Child
Varh 5	Age at Death (1-12 months)
Var 207	Number of Fertile Pregnancies
Var 208	Children Everborn to a Woman
B. Socio-Cultural-Economic	
Var 231	Birth Interval
Var 305	Number of Months Infant was Breastfed
Var 701	Region of Residence
Var 702	Place of Residence
Var 704	Education - Number of Years Completed
Var 706	Ethnicity of Respondent
Var 707	Religion of Respondent
C. Contextual Variables	
No San	No Sanitation
Pit Lat	Pit Latrine
HsePam	Permanent House Floor
Hseeth	Earth House Floor
Hosp	Hospital
Hce	Health Center
Pipwat	Piped Water
Rivwat	River Water
Other	Other Sources of Drinking Water

NOTE: Some variables were dropped at various levels either because they were insignificant in the models or they were perfectly correlated with each other.

This, in fact, implies an under-estimation of the children ever born and those who died in childhood.

Generally a live birth is more likely to be reported than a dead one. Moreover, most women may not be able to remember all those children who died in infancy. This factor will reflect lower mortality in the population. Further distortion may result from responses to the question of still births who may be included in both deaths and births.

Another related bias relates to age misstatement and preference by the women. This results in shifting of women in the younger age groups to the older ages and vice versa. Mortality will be biased in either direction depending on the direction of the bias. Thus, caution needs to be exercised in the use and interpretation of the dependent variable and that relating to age as used in this study.

Equally important is the fact that there are dangers inherent in drawing inferences from cross-sectional data results regarding the likely changes over time in the infant mortality conditions of a given country or countries. For example, as already suggested, the reporting women may represent a biased sample of the population and bias the dependent variable.

Moreover, since our data was collected as part of the Kenya Fertility Survey, information on some of the relevant

variables which directly relate to mortality was not collected. Thus, the proxies that will be used to represent some of the variables may not provide a true picture of the underlying relationship between mortality and these variables. However, as we have already suggested, our choice of variables was guided by both theoretical and empirical evaluations of the variables.

Further, it must be noted that data on most background variables relating to socio-economic and environmental factors refer to conditions prevailing at the time of the survey while mortality data covers the experience over a much longer period in the past. To overcome this problem, we collected the contextual data relating to the same period as the survey was carried out, i.e., 1976 to 1978. And for the rest of the socio-economic variables, we selected those relevant variables based on the state of knowledge about their relevance to mortality, in addition to carrying out significance tests through simple correlations. These procedures have been applied elsewhere with significant success (Meegama 1980).

Statistical Analysis

As stated earlier, we shall apply two statistical techniques in this study, that is the ordinary least squares (OLS) regression and the logit analysis which falls under the log linear probability models. These two techniques,

their assumptions, applications, as well as their limitations, are discussed below.

Whereas the application of the ordinary least squares regression could have been applied to the data in its original form, that is, as regards the dependent variable which could have been either an infant mortality rate or any other conventional rate, the use of logit analysis required reformating of the data in order to create the categorical dependent variable which focused on whether the baby survived beyond the first year of life. Thus, the Kenya Fertility Survey data was reformated from the original form of pregnancy histories for each of the sample of women to a file of live births where each becomes the unit of observation.

The above was followed by identifying all the socio-economic and demographic factors relating to each of the births to which was also added the environmental attributes.

The application of the ordinary least square regression as will be applied in this study is given in the literature (Duncan, 1975; Blalock, 1964; Land, 1969). In general it takes the following form:

$$Y = B_0 + B_1X_1 + B_2X_2 \ldots\ldots\ldots B_nX_n + E_i$$

where Y is the dependent variable (in our case infant mortality), X_1 to X_n are independent variables representing social, economic, demographic and environmental factors

affecting or influencing infants' survival, the Bs are the regression coefficients and E_i is the residual term.

Since the focus is on whether the baby survived or died in infancy, the dependent variable will be binary. Furthermore, most of the variables under study are categorical, a factor which calls for due care in the interpretation of the results especially in relation to the case of the suppressed categories.

The use of both regression (OLS) and logit analysis to the same data has recently been applied with the results showing very little difference (Butz, et al., 1982; Preston and Trussell, 1981).

Ordinary least square models are based on a number of assumptions (Gujarati, 1976; Blalock, 1969). As regards the error term, it is assumed that the mean is zero, it is homoscedastic, i.e., it has a constant variance for different values of the X variables, no correlation exists between any two error terms, and finally the error term in any one equation is uncorrelated with the independent variables. As has been shown elsewhere the violation of the above assumptions results in unbiased, consistent but inefficient estimators.

One other major assumption in regression analysis concerns the independence of the individual variables such that there is no multicollinearity. The presence of

multicollinearity affects the regression coefficients by raising the standard error of the estimates (Blalock 1963, Asher 1976).

Asher, for example, argues that multicollinearity is likely to be a problem in studies using aggregate data, since through data aggregation the random measurement error is suppressed, whereas in individual studies this error is always present. The use of a large sample size is said to minimize the effect of collinearity.

This study uses data from the individual survey and, with a sample of 8100 respondents, the problem of collinearity is expected to be minimal but not completely absent. Thus, its presence will be examined through simple correlations tests.

In addition to the above assumptions, the assumption that the entire model is specified without error and that all the important variables are in the model will be examined through stepwise regression, i.e., excluding given variables and examining the effect on the model. The above assumption, i.e, the absence of specification error in the model is very critical in any data analysis. Basically it asserts that the theoretical model embodied in the equation is correct, i.e., the functional form of the relationship is actually a straightline and no variables have been improperly excluded or included as causes.

However, this perfection can hardly be achieved in social research. For example, in our case, due to lack of relevant data on certain variables, they have been left out. This is not surprising, especially in the light of the fact that mortality is affected by numerous factors, as we have already elaborated. The problem of the inclustion of irrelevant variables is easily tested by simple correlation tests.

As already stated, we shall also examine the hypothesized relationships between the independent variable and infant mortality through logit analysis, as is explained below. The need for the use of logit regression is prompted by a number of factors.

First, some of the mortality determinants in our model are related to general public health conditions that affect mortality risk of most infants subjected to these influences. Logit analysis is appropriate for these factors because it is a multivariate method for estimating relative risk. The logit coefficients are the natural logarithms of the relative odds by which the determinants of mortality are different for the risk of dying.

Moreover, the use of a dichotomous dependent variable refocuses the analysis from examining the determinants of infant mortality in general to the examination of the determinants of infant survival versus death.

Furthermore, the combination of both individual as well as contextual variables in a simple ordinary regression model raises some doubts as regards the interaction effects of these factors on infant mortality in our first suggested application. This is because these variables are measured in different units, i.e., some are continuous like age, others are categorical like education and others are at aggregate level, like percent population using a given facility. The compounding interaction effect between these variables and infant survival is well picked up through logit analysis which allows the transformation of the underlying nonlinearity among the variables.

Basically logit analysis is an extension of the linear probability regression models which expresses the dichotomous Y_i as a linear function of the explanatory variables X_i. The models assume that the conditional expectation of the given X_i can be interpreted as the conditional probability that an infant will survive or die given the variables in our model.

However, in logit analysis the dependent variable is defined by the log odds also known as the logit transformation of $P_{(x)}$. The model takes the following form .

$$\text{Ln}\left[\frac{P_{(x)}}{1 - P_{(x)}}\right] = \alpha + \beta_x$$

where

$\alpha + \beta$ is the logit transformation of $P_{(x)}$ commonly denoted by the (P). The logit here is the odds whose variation is to be explained. An odds is the ratio of the frequency of being in one category to the frequency of not being in that category and is interpreted as the chance that an individual randomly selected will be observed to fall into the category of interest (Hanushek and Jackson, 1977).

The odds ratio here is a marginal odds applying to the total frequencies in the margin of the table while holding the effect of other variables constant. In logit analysis, the odds ratio is used to measure the effect of the independent variables on the dependent variable. The model transforms the dependent variable to range from $-\infty$ to $+\infty$, thereby eliminating the problem that $\alpha + B_x$ will be outside the unit range (Hall 1980).

Logit analysis is based on the same assumptions as the general log linear probability models. For example, it is assumed that the population under study has a multinomial distribution structure and that the sample under study is large enough, drawn randomly and independently from

the population. As we have already indicated our data for this study satisfies these conditions. This, however, does not rule out both enumeration and coverage errors which could in a way affect the pattern of results.

Given the above assumptions, a selected model based on some theoretical understanding of the underlying interrelationships among the variables in the population can be accepted or rejected based on the goodness of fit of the chi square, a statistic which measures how closely the expected relationship among the variables estimated by the model fits the relationships among the variables in the observed data (Hanushek and Jackson 1977, Goodman 1972). In the case of logit analysis, the selected model reflects the effect of the independent variables on the dependent variable.

The parameters in the logit model may be interpreted as ordinary regression coefficients. Positive values indicate that the independent variables or their interactions raise the log odds of the dependent variable, while negative betas show lower log odds (Pindyck and Rubinfeld, 1976).

For example, in a regression that controls for other mortality correlates the logit coefficient on living in a house with a toilet is -.425. This means, the presence

of a toilet reduces the logarithm of the odds by 42 percent. and that a baby living in a house with a toilet is about 2/3 (antilog -.425 = .65) as likely to die in infancy as is one living in a house without a toilet, other things being the same.

To test whether the hypothesized model fits the data, we first estimate the expected frequencies under the hypothesized model and compare them to the observed frequencies using the chi square goodness of fit test statistic or the chi square based on the maximum likelihood ratio statistic.

The maximum likehood (ML) criterion is frequently used in statistics because it is known usually to be an asymptotically efficient estimator, but it is also an intuitively appealing criterion. Basically the criterion addresses the question, " What underlying parameters would be most likely to have produced the observed data ?" The mathematics of maximizing the likehood function is given elsewhere (Hanushek and Johnson 1977).

The chi square value obtained from the above process can be assessed by comparing its numerical value to the tabulated chi square distribution for appropriate degrees of freedom. The statistical significance of any parameter in the model may also be tested through the changes in the chi square without the parameter in question in the model.

Although some programs for logit analysis make it necessary that all variables be coded in discrete categories (e.g., ECTA Goodman 1972), other computational software allows for the use of both categorical as well as continuous independent variables. These include QUAIL (Berkman and Brownstone 1979), BMDP (Dickson 1983) and MLOGIT (Hall 1980).

Limitations of Log-Linear Analysis

As noted earlier, the major assumption underlying the logit analysis is that of a sufficient sample size. This is important because the test statistic used in the selection of the model depends on and is affected by the sample size. For example, the magnitude of the chi square is proportionally related to the sample size, which in turn implies that significant effects will always be found in moderate to large size samples. But large sample size may sometime magnify what was to be the minor differences thereby leading to erroneous conclusions.

This question becomes even more important when viewed in terms of categorical sample size. Most researchers usually collapse categories of given variables in an effort to maximize the utility of time and cost. But in so doing, important information unique to particular categories is usually lost and the conclusions drawn about the relation-

ships may be inconsistent with those in the underlying population. This problem is minimized in this study by utilizing as many categories as data could allow.

Indeed, as has been argued elsewhere (Hasushek and Jackson, 1976), the best solution to small sample size is to categorize the data such that you increase the number of observations in each category. As the size of each of the categories increases, the observed frequency becomes a better estimate of the true probability.

Finally, the log-linear approach assumes that all the observed frequencies for cells of the cross-classification are greater than zero, otherwise estimation is impossible. To overcome this problem, it has been suggested replacing each sample zero by 1/R where R is the total number of cells in the table or adding 1/2 to each elementary cell before analyzing the model with zero cells (Goodman, 1972). However none of these suggestions has proved to be perfect solutions.

All these factors, however, will be taken into consideration in the analysis and interpretation of our data in the next chapter.

CHAPTER IV

DATA ANALYSIS AND RESULTS

In the first three chapters, we presented and elaborated on the nature and kind of problem under study, in the context of the existing theoretical as well as empirical literature. We also outlined and discussed some relationships in terms of hypotheses. In this chapter, attempts will be made to examine and test those relationships.

The first section examines the effect of all the independent variables on mortality considered in this analysis on mortality. A more focused analysis of the variables, especially the endogenous variables which are thought to have a direct bearing on infant mortality, is considered in the next section. The effect of the contextual variables on mortality is also examined at the same time. Still using most of the variables considered in the model, the last section focuses on regional analysis with emphasis on the determinants of mortality differentials. A summary of the analysis is given at the end of the chapter.

As was stated in the last chapter, both ordinary least squares (OLS) and logistic regression models will be applied in this analysis. However, due to the small samples of mortality events at certain levels, combined with relatively large numbers of variables and categories of some of the variables, the application of the logistic model will be limited to the total sample and not regional levels. In fact, a large sample size is a prerequisite for the application of the logistic model otherwise small sample size will bias the coefficients (Dickson, 1983).

The sample size of 30,382 cases and more than 10 categorical variables required some adjustment to the data before the application of the logistic model. The point is that the numerous variable categories creates too many covariate patterns in the data for a single model to handle. Thus, in order to apply the model, we selected a random sample size of 10,000 cases but used the same variables as in the OLS with the exception of the contextual variables which could not be analyzed by the model due to the nature in which the data was collected. (See Table G in the appendix which shows the frequency distribution for the two samples.)

The choice of the sample size is consistent with other recent studies which successfully applied the model to the World Fertility Survey with sample size limited

to between 5000-8700 (Koening et al., 1984; Davanzo et al., 1982, 1984; Lewis 1984). Throughout the analysis, indication will be made where the logistic model is not used.

The General Model

This model is based on the hypothesized theoretical general model shown in figure A. Table 2 presents the coefficients of all the variables in the model for both the OLS and the logistic models.

Apart from age, which was treated as a continuous variable, all the others were treated as dummy categorical variables. The emphasis on categories is based on the theoretical, as well as empirical relationships of these variables to mortality as shown by evidence from recent research findings (Da Vanzo,1984; Meegama,1980; Koening et al.,1984; Chase,1973; Behm,1979). For example, it is no longer useful to focus on breastfeeding as such but on the number of months an infant is breastfed, for it has been shown that a longer period of breastfeeding (i.e., more than 1 year) is associated with higher mortality (Eelens,1983; Lewis,1984; Da Vanzo 1984; Lesthaeghe and Page 1981). The same is true of such factors as age at marriage and education, which show negative relationship to mortality in the higher categories.

According to the results in Table 2, nearly all the

variables in the model are not only significant but also consistent with the hypothesized relationships. There are, however, a few exceptions based on logistic coefficients which, while still indicating the expected causal direction, are nevertheless not significant.

Age of the woman is shown to be negatively related to mortality, i.e., higher age of woman is associated with lower infant mortality. This, however, is not true of the OLS results which though still significant are nevertheless positively related to mortality. This may be due to the linearity assumption inherent in the OLS model but which is probably handled by the logistic model. (See figure 1 in the appendix which shows the distribution of death rates by age.)

The negative relationship may also be due to the fact that age effects of the woman are probably mediated by behavioral factors, perhaps associated with mother's increasing experience with infant care.

Closely related to age is age at first marriage. Based on the cross-tabulations from these data, 94.7% of all the women were married by age 22 with an average of 16.3. Thus the categories were formed to reflect this early pattern of marriage. The results show that, compared to those marrying earlier than age 16, those who marry

Table 2. OLS/Logistic Regression Coefficients for Significant Variables Control Model

VARIABLE/CATEGORY	OLS COEFFICIENTS Coefficient	t-Value	LOGISTIC Coefficient	t-Value
Age	.034	4.492***	-.032	-5.820***
Birth Interval	-.017	-2.926***	-.061	1.660*
Age at Marriage (years)				
16-20	-.010	-1.798**	-.219	-1.99**
21-25	-.022	-3.891***	-.217	-2.74***
26+	-.008	-1.354*	-.095	-1.73*
Marital Status				
Widow	.022	4.274***	.102	.393
Divorced/Separated	.011	3.260***	.351	.223
No. of Fertile Pregnancies				
4-8	.030	3.516***	.354	5.33***
9-15	.063	6.645***	.088	1.30*
Period Breastfed (months)				
6-12	-.103	-13.383***	-.899	-8.10***
13-24	-.122	-14.894***	-.317	-4.35***
25+	.28	4.043***	.427	6.32***
Age at death (months)				
4-6	.375	36.733***	1.30	4.210***
7-12	.318	25.262***	2.90	5.273***
Sex (Male birth)	.027	5.610***	.072	1.790*
Polygamy	.021	4.093***	.175	2.940***
Urban residence	-.015	-2.671***	-.171	-2.732***
Education				
Primary	-.032	-5.829***	-1.21	-3.070***
Secondary	-.011	-1.976**	-.366	-1.79*
Region of Residence				
Nyanza/Western	.016	3.053***	.831	2.370**
Coast	.007	1.106*	1.690	2.070**
Rift/Eastern	-.036	-5.411***	-2.470	-3.650***
Ethnicity				
Kikuyu	-.015	1.110	-2.190	-2.370**
Luo/Luhya	.036	2.289	1.640	1.580*
Kamba/Kisii	-.021	-1.521	-.511	-.486
Hospital Use	.016	2.137**	-	-
Earth floor house	.002	1.155*	-	-
Malaria presence	.047	7.816***	-	-
χ^2	-		559.609	
R^2	.287		-	
N	30820		10,000	

*** - significant at -.01 level.
** - significant at -.05 level.
* - significant at -.10 level.

later are associated with lower infant mortality. The results are consistent for both the OLS and logistic models. This finding is consistent with our hypothesis and falls in line with findings elsewhere (Meegama 1980, DaVanzo,1982, Newland 1981). The importance of age and age at first marriage in influencing infant mortality must be emphasized as they together in turn determine other factors such as birth interval which,in turn, directly affects mortality.

Equally important is the effect of marital status on infant mortality. Though significant in the OLS and not with the logistic coefficients, both models still attest to the fact that infants born to divorced, separated as well as widowed parents experience more than average mortality compared to those born to married couples. The lack of significance on the part of the logistic coefficients may be attributed in part to the small sample size of the mortality events as marital categories listed are rare occurances in the population under study, i.e. divorces and separations.

Two other important variables which bore consistent results in terms of significance as well as causal direction are the number of fertile pregnancies a woman has had and the number of months the infant is breastfed. The importance of these factors in determining infant mortality

has been underscored in recent research where it has been shown that higher number of pregnancies increases the probability of infant mortality, for this implies shorter birth intervals and therefore less care to each child and, most important, less time for recovery for the mother.

The hypothesis that infants who are breastfed for more than six months experience lower mortality, compared to those breastfed less than this period, is supported by these data by both OLS and logistic models. Interestingly enough, there is also evidence to the effect that longer breastfeeding is associated with higher mortality. This finding which has been supported elsewhere (Belens 1983; Holland 1983; Montgomery 1983; Habicht et al., 1981), is explained by the fact that mother's milk after a certain period doesn't provide the required nutrients for the infant who at the same time becomes vulnerable to the infected food and contaminated water and environment in general. This may reinforce the fact that the probability of dying at ages 4-6 months is higher compared to the other periods as shown by this set of data. This observation is widely recognized in the literature (United Nations, 1973, 1980; World Health Organization, 1982; Behm, 1979; Palloni, 1983; Mosley, 1980; Newland, 1981).

Also consistent with the hypothesized relationships as well as findings from elsewhere, both the OLS and logistic coefficients support the view that male infants are subject to higher mortality compared to the females. The same is true for infants born to polygamous families. These findings have been confirmed in the country (Mott 1980; Anker and Knowles 1978).

Other results from the two models relate to the effect of place of residence, region of residence, and education on infant mortality. According to both the OLS and the logistic coefficients, urban residence is associated with lower mortality, presumably due to the availability of such facilities as health services, maternal child care programs, etc. The results further suggest that residence in Nyanza, Western and Coast regions is also associated with higher mortality. This is an expected finding due to the low levels of socio-economic development which are reinforced by the high prevalence and incidence of malaria compared to other regions in the country.

Also, education is both significant and in the expected causal direction. The evidence suggests that infants born to women with primary and secondary education are subject to lower mortality compared to those born to women with no

education. This finding has also been confirmed for the country in earlier studies (Mott 1980, Ominde 1980, Anker & Knowles 1979).

An important factor which has some socio-cultural aspects to it is ethnicity. Our results suggest that being born in Kikuyu, Kamba and Kissi tribes implies lower probabilities of dying. Indeed, this particular finding reinforces the conclusion reached earlier about regional residence, because the Kikyuus and Kambas reside in Central and Eastern regions respectively, areas considered more developed in terms of socio-economic amenities. In contrast, the Luos and Lunyas reside in Nyanza and Western regions, areas considered less appealing in terms of socio-economic development, a perpetuation of colonial development patterns. These findings are also true in the logistic model. In addition, the continued reliance on certain socio-cultural values which denies both the females as well as infants in these two regions certain foods, has partly contributed to the higher mortality.

Of all the contextual variables included in the model (OLS), only the presence of malaria showed a strong effect (b = .047). For other variables, hospital use and mud floor houses, their effects were small though significant (that is b - .016 and b - .002, respectively). The remaining variables were either perfectly correlated

or were left out due to the insufficient level of statistical tolerance. While the malaria presence and mud floor house coefficients are in the expected direction, the positive direction of hospital use needs some elaboration.

In Kenya, a large percent of rural population travels long distances to hospitals avoiding along the way the ill-equipped, less-staffed health centers. Moreover, more births occur in hospitals rather than health centers. Thus, the pressure on hospitals, where many infants brought in poor health die, may reflect this positive effect. Alternatively, the hospitals may be overused because they happen to be where populations are concentrated.

Efforts were also made to examine the effect of the variables in the model on neonatal and post neonatal deaths separately. But as Table H (appendix) shows, there was not much change from the results based on all the deaths.

The Reduced Model

The foregoing analysis of various effects on mortality provides a broad framework in which to focus on the major factors which directly or indirectly impinge on infant mortality. Recently the role of

indirect influences on mortality has been on the increase, in particular the contextual factors which have long been assumed in most research.

Keeping, therefore, in line with this gap in mortality research, we shall thus attempt in this section a diagnosis of the various endogenous factors in the model as well as an examination of the contribution of the contextual variables, such as type of water, type of housing, sanitation, etc.

The OLS coefficients for the individual and contextual variables is summarized in Table 3 and figure C. The table also provides separate coefficients for these two sets of variables, column 4 through column 7. The logistic coefficients for the endogenous variables were left out because they exhibited the same pattern of significance as well as direction as in the general model. Furthermore, the logistic model could not be applied to the contextual variables due to the nature of the raw data on these variables.

The results in Table 3 show that all the variables included in the model exhibit patterns of effects consistent with those of the general model, direction and significance. In fact, apart from Secondary Education which is still significant at the .05 percent level, and age at marriage (26 and over) which is not significant but with the correct causal direction, all the other

Table 3. Regression Coefficients of Individual and Contextual Variables

VARIABLES/CATEGORY	With Contex. Vari. Coeff.	t-Value	Without Contex. Vari. Coeff.	t-Value	Contex. Vari. Only Coeff.	-Value
Individual Variables						
Polygamy	.018	3.577***	.031	6.242***		
Age	.036	3.262***	.053	4.273***		
Age at Death (months)						
4-6	.376	76.868***	.379	77.387***		
7-12	.318	65.334***	.321	65.716***		
Age at first marriage						
16-20	-.006	-1.095**	-.012	-2.250**		
21-25	-.016	-2.950***	-.023	-4.232***		
26+	-.004	-.753	-.013	-2.161**		
Months Breastfed						
3-6	-.106	-13.730***	-.110	-14.247***		
7-12	-.123	-14.991***	-.120	-14.673***		
13+	.025	3.615***	.032	4.585***		
No. of Pregnancies						
4-8	.043	5.715***	.043	5.732***		
9+	.082	10.737***	.084	11.010***		
Sex (Male births)	.020	5.610***	.022	3.477***		
Birth Interval						
24-35	-.022	-3.922***	-.021	-3.854***		
Education						
Primary	-.037	-6.915***	-.041	-7.694***		
Secondary	-.013	-2.306**	-.012	-2.142**		
Contextual Level Variables						
Malaria Presence	.049	3.242***	-	-	.155***	13.080
Hospital Use	.044	3.679***	-	-	.127***	6.905
Perm. Floor House	-.118	-6.728***	-	-	-	-
Earth Floor House	.015	2.573***	-	-	-.019**	-.359
Pit Latrine	.086	5.573***	-	-	.136***	8.532
Piped Water	-.042	5.080***	-	-	-.162***	-9.766
Other Source of Water	-	-	-	-	-.031***	-4.126
R^2	.295		.271		.082	
F	525.81		598.51		79.26	

*** significant at .01 level
** significant at .05 level
* significant at .10 level

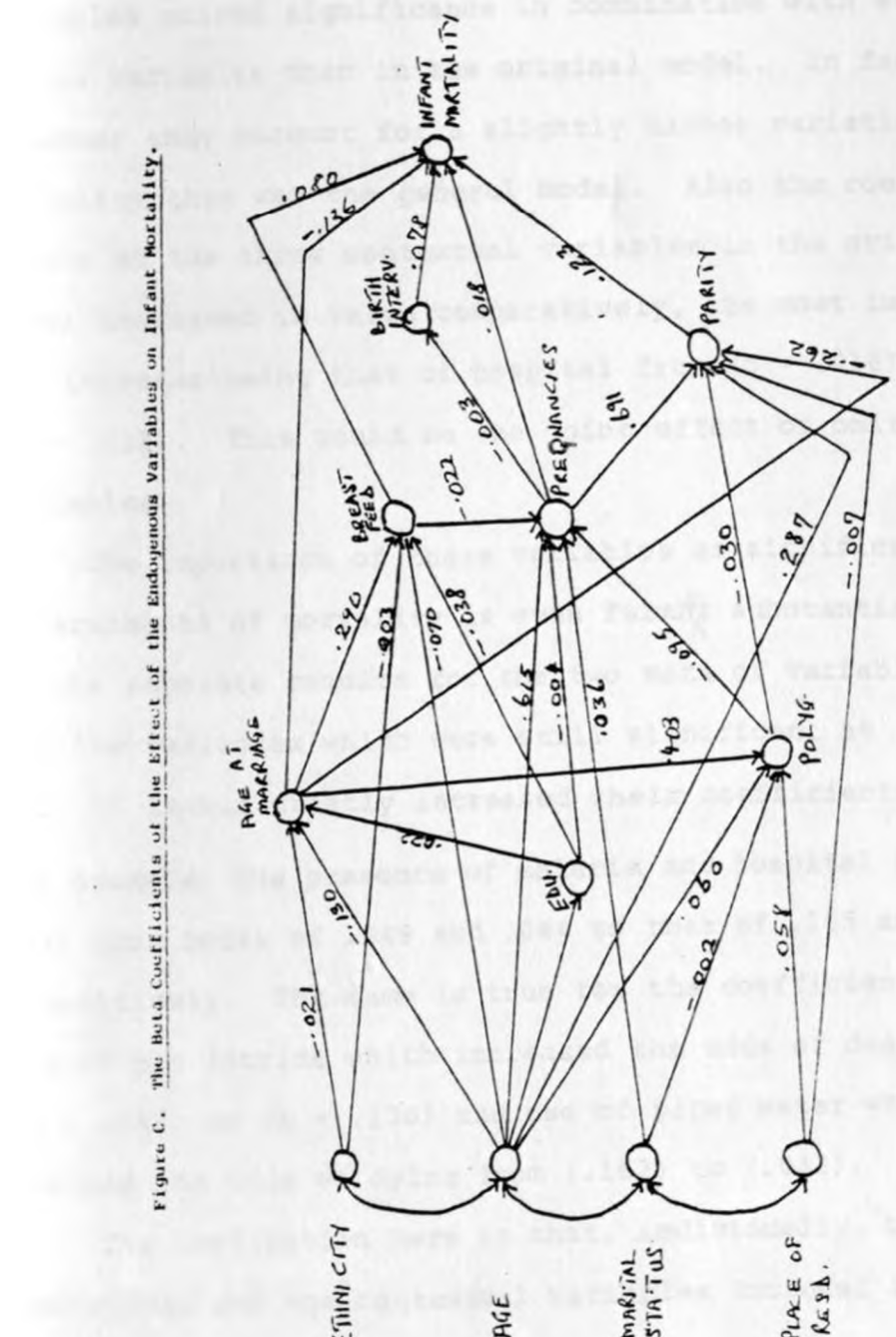


Figure C. The Beta Coefficients of the Effect of the Endogenous Variables on Infant Mortality.

variables are significant at the .01 level, as in the original model.

On the other hand, it seems that more contextual variables gained significance in combination with endogenous variables than in the original model. In fact, together they account for a slightly higher variation in mortality than was the general model. Also the coefficients of the three contextual variables in the original model increased in value comparatively, the most important increase being that of hospital from (b - .016) to (b = .015). This could be the joint effect of omitted variables.

The importance of these variables as significant determinants of mortality is even further substantiated by the separate results for the two sets of variables. All the variables which were still significant at .01 and .05 levels greatly increased their coefficients. For example, the presence of malaria and hospital use rose from betas of .049 and .044 to that of .155 and .127, respectively. The same is true for the coefficients of use of pit latrine which increased the odds of death from (b - .086) to (b - .136) and use of piped water which reduced the odds of dying from (.162) to (.042).

The implication here is that, individually, both the individual and the contextual variables included in these

models can be said to be significant determinants of mortality but even in combination they are still stronger predictors of infant mortality in the country, based on this set of data.

Thus from the general model, which focuses on the broad general framework of determinants of mortality, it is possible to isolate and focus on particular variables which significantly relate to mortality as we have attempted to illustrate above.

It is essential however to point out that the above synthesis has specific implications for both long and short term planning at different levels where they can be tapped and manipulated as will be shown later.

To further appreciate the multidimensional effect of the various significant variables from our models, we decomposed the model variables into their direct and indirect effects. The decomposition is necessary because, while some variables may show significant association with mortality, still their overall effect in determining it can be better grasped through such separate analysis. This, in a way, is an added advantage in terms of policy formation as specific areas can be isolated for specific action.

The decomposition effects of the various factors

are shown in Table 4. Generally for most variables, the indirect effects seem to make very little contribution, though they still indicate the expected causal direction. For example, in the model relating infant mortality to all predetermined variables, with the exception of the number of pregnancies and months breastfed, the indirect effects of most, if not all, variables are far less than those of direct effects.

In some cases, for example polygamy, the direction of the effects in fact changes from positive to negative. For this particular case, however, it may be because of the negative correlation of polygamy to both the number of pregnancies and parity, which in turn are positively correlated with infant mortality. The rest of the variables still attain the expected causal direction of the indirect effects.

The seemingly large indirect effects of some variables in this model calls for some elaboration. These include, as already suggested, the number of pregnancies, the period of breastfeeding and to some extent age at marriage.

The significance of their effects point to the fact that the contribution of these variables in the understanding of mortality can be greatly enhanced if the other factors associated with them can be emphasized.

Table 4. Decomposition of Effects on Endogenous Variables

DEPENDENT VARIABLE	PREDETERMINED VARIABLE	TOTAL EFFECTS	INDIRECT EFFECTS	DIRECT EFFECTS
Infant Mortality	Age	.068	.024	.044
	Marital Status	.089	-.003	.092
	Place of Residence	-.023	.001	-.024
	Ethnicity	-.019	-.002	-.017
	Age at Marriage	-.168	-.032	-.136
	Primary School / Secondary School	-.015	-.006	-.009
	Polygamy	.010	-.012	.022
	Parity	.123	-	.123
	No. of Pregnancies	.067	.085	-.018
	Months Breastfed	.143	.063	.080
	Birth Order	.078	-	.079
Age at Marriage	Age	-.1301	-.0001	-.130
	Education	.022	-	.022
	Ethnicity	-.021	-	-.021
Polygamy	Age	.008	-.052	.060
	Marital Status	-	-	-
	Place of Residence	.058	-	.058
	Age at Marriage	.403	-	.403
Parity	Age at Marriage	-.278	-.016	-.262
	Polygamy	-.096	-.066	-.030
	Age	.162	-.125	.287
	Pregnancies	.691	-	.691
	Place of Residence	-.013	-.006	-.007
Months Breastfed	Ethnicity	-.009	-.006	-.003
	Age at Marriage	.290	-	.290
	Age	-.149	-.079	-.070
	Education	-.032	.006	-.038
No. of Pregnancies	Breastfed	-.022	-	-.022
	Education	-.003	.001	-.004
	Polygamy	-.106	-.011	-.095
	Marital Status	-.036	-	-.036
	Age	-.619	-.004	-.615
Birth Order	No. of Pregnancies	-.003	-	-.003

For example, higher education will not only postpone the age at marriage but also provide the prospective mother with better understanding of breastfeeding the child, spacing of her children, as well as general understanding in caring for infants, factors which all contribute to lower mortality.

Another notable result concerns the indirect effects of age on most other variables in the rest of the models. For example, higher age seems to significantly contribute to lower parity (b = -.123) as well as the number of months breastfed (b = -.079).

Age has an equally depressing indirect effect on polygamy (b = -.052). These findings support not only our earlier observations but also bear evidence to conclusions reached elsewhere. Of particular importance here is the need for more attention be given young mothers who are not only incapable of enduring spontaneous marriages and pregnancies with their associated pressures but also who may not be well equipped economically to support the infants in terms of nutrition, medicare, etc.

The rest of the results bear the same interpretation with the understanding that the need for an integrated approach in the reduction of mortality is inevitable.

Analysis of Births by Period

As an added aspect to the data analysis, we also examined the relationships under study from a historical perspective based on the birth interval period. The number of births were divided into those born before 1960, between 1960-1970 and after 1970. Each of these periods is marked by its own shortcomings or successes. The pre-1960 period was dominated by the Colonial struggles, the 1960-70 period meant socio-economic adjustment to freedom and the post 1970 period could be viewed as a stable period excepting, of course, the national and international economic disorders that continue to intimidate the world.

Table 5 summarizes the OLS regression coefficients of variables for the different periods. The logistic coefficients are given in Table 6. Note that some of the variables could not be captured by the logistic model due to the high probability inclusion level which is determined by the covariate patterns of all the variables in the model.

The coefficients from the two models show that age at death of the infant (first twelve months) is significantly associated with infant mortality now as well as in the past. Similarly the higher number of pregnancies a woman

Table 5. OLS Regression Coefficients for Birth by Periods

	Births 12-120 months		Births 1960-1970		Births Pre-Indep.	
VARIABLE	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
Age	-.010	-.833	-.033	-3.264***	-.020	-1.411*
Age at Death						
4-6 months	.223	29.002***	.227	26.106***	.202	14.786***
7-12 months						
Sex (male birth)	.013	1.651*	.036	4.080***	.034	2.523**
Marital Status						
Widow	.004	.549	.012	1.366*	.054	3.755***
Divorce/Separated	.024	3.082***	.019	2.180**	.010	.676
No.of Fertile Pregnancies						
4-8	.081	7.426***	.023	1.103*	-.076	-2.140**
9+	.084	6.505***	.056	2.633***	-.009	-.242
Months Breastfed						
3-6	-.170	-13.234***	-.072	-5.227***	-.035	-1.820*
7-12	-.211	-15.400***	-.090	-6.143***	-.015	-.706
13	.074	6.419***	.037	3.313***	.036	1.900*
Polygamy	.028	3.377***	.009	.937	.064	4.292***
Urban Residence	-.012	-2.394**	-.037	-3.568***	-.004	-.279
Education						
Primary	.101	1.252*	.077	.706	.036	-.377
Secondary	.013	.317	-.004	-.128	.034	-1.611*
Region of Residence						
Western/Nyanza	.035	2.132**	.011	1.566*	.040	1.175*
Central/Eastern	-.024	-2.394**	-.042	-3.757***	-.033	-1.858*
Ethnicity						
Kikuyu	-.006	-1.489*	-.019	-1.325*	.054	2.495***
Luo/Lunya	.052	3.389***	.065	3.411***	.063	1.971**
Kamba	.007	.287	-.015	-1.077*	.025	1.097*
Religion						
Protestant	-.004	-.246	-.076	-3.881***	-.022	-.757
Catholic	.002	.068	-.049	-2.542**	-.002	-.444
Muslims	.016	1.543*	-.007	-.623	-.014	-.70
F	112.49		68.64		27.89	
R2	17.19		13.44		12.87	
R2 (adj.)	17.03		13.25		12.41	

***significant at .01 level
**significant at .05 level
*significant at .10 level

Table 6. Logistic Coefficients for Births by Periods

VARIABLES	Births 12 to 120 months		Births 1960-1970		Births per 1960	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
Age at First Marriage						
16-20	.824	3.74***	-.627	-3.77***	-.219	-1.99**
20-25	-.155	-1.12*	.322	2.65***	.217	2.74***
26+	-.343	-3.38***	.226	2.69***	.095	1.73*
No. of Months Breastfed						
6-12	-.727	-6.64***	-.693	-5.20***	-.547	-2.80**
13-24	.383	3.99***	.148	1.76*	.240	1.80*
25+	.512	5.82***	.388	4.82***	.311	2.79***
No. of Pregnancies						
4-8	-.385	-2.16**	-.765	-2.64	.518	3.71***
9-15	.502	2.41**	.443	2.02**	.314	2.81***
Sex (Male birth)	.822	1.70*	.828	1.74*	.149	2.15***
Polygamy	.290	3.25***	.724	1.43*	.418	4.46***
Education						
Primary	-1.23	-2.04**	1.12	2.30**	1.06	1.56*
Secondary	-1.52	-2.38**	-.280	-1.10*	-.349	-1.01
Region of Residence						
Nyanza/Western	.831	2.37***	1.07	1.33*	.450	2.33**
Central/Eastern	-2.47	-3.65***	-1.95	-2.93***	.375	2.02**
Ethnicity+	-	-	-	-	-	-
Religion+	-	-	-	-	-	-

*** - significant at .01 level.
** - significant at .05 level.
* - significant at .10 level.
+ - not used due to high categorical probability value of removal and entry

had, the longer an infant was breastfed and infants born to polygamous marriages were all associated with higher probabilities of dying during the three periods.

On the other hand, urban residence seems to be significantly related to mortality in the post-1960 periods but its effect dwindles as we go further back in the past. This particular finding is consistent with the expected results since areas labeled urban were no more than rural villages before 1960. There is also evidence from the tables that residence in Nyanza, Western and Coast regions is associated with higher mortality now as well as in the past, a finding we have already encountered and which other studies have supported (Mott 1980; Anker and Knowles 1979).

A more persistent and consistent variable from both the logistic as well as the OLS models is sex of the child. It seems that male infants were subject to higher mortality throughout the three periods.

The erratic nature of the results (OLS) relating to religion and ethnicity may be attributed to statistical anomalies in the data which may not be significant in specific categories. Nevertheless, the results seem to suggest that being born a Kikuyu is associated with lower mortality compared to being a Luo/Luhya. The same observation is true for religion where it is shown that

Protestant and Catholic religions are associated with lower mortality compared to other religions.

Regional Analysis

As we have already shown, due to its historical colonial development patterns, which emphasized separate development for regions and populations, considerable differentials in mortality exists in the country between the various regions as well as within regions among different socio-economic strata. Available evidence attests to the fact that these differentials are reinforced by the climatic as well as physical conditions (Ominde 1979, Central Bureau of Statistics 1980, Mott 1980).

To the extent that the above is true, we will attempt in this section to illustrate how the perpetuation of differential socio-economic development in the post-independence era has, in turn, sustained high mortality differentials in the country.

The regional variation in terms of births and deaths based on the sample is given in Table 7. Generally the tabulation points to the fact that a higher percentage of deaths of all the children born occur in Nyanza, Coast and Western provinces, a finding which still conforms to our earlier statistics based on our hypothesized relationships.

Table 7. Percent Distribution of Births and Deaths by Region - Kenya Fertility Survey 1978

	Nairobi	Central	Coast	Nyanza	Rift Valley	Western	Eastern	Total
Birth Survived	87.8	88.1	80.9	77.1	88.5	80.0	85.3	83.7
12 months	(1674)	(4289)	(1765)	(5035)	(5004)	(3204)	(4426)	(25397)
Birth Died	12.2	11.9	19.1	22.9	11.5	20.0	14.7	16.3
12 months	(232)	(577)	(418)	(1499)	(648)	(803)	(763)	(4940)
Total Births	6.3	16.0	7.2	21.5	18.6	13.2	17.1	100.0
	(1906)	(4866)	(2183)	(6534)	(5652)	(4007)	(5189)	(30,337)

For example, of the total deaths in the sample, Nyanza and Western provinces claimed 30.3% and 16.3% respectively compared to 11.7% and 13.1% for Central and Rift Valley provinces. Even within provinces, Nyanza and Western areas registered higher percentages of Deaths compared to other provinces, i.e., 22.9 and 20.0 percent, respectively.

Perhaps these statistics are reinforced by Tables 8 and 9 which show the percent distribution of children by duration of sickness and type of sickness for each province. Table 8 shows that the three provinces of Nyanza, Western and Coast still have a higher percentage of children with duration of 4-7 days of sickness. It is also evident from Table 9 that the prevalence of such diseases as fever and diarrhea are highest in these same regions. For example, Coast has a percentage of 25.1, Nyanza 26.7 and Western 41.0 of children suffering from fever, compared to 16.3% for Eastern and 19.2% for Rift Valley provinces.

The magnitude of these differentials can better be comprehended when viewed in a broader context of the factors associated with child survival, where emphasis is on accessibility and the distance covered to tap these vital resourses.

Table 8. Percentage Distribution of Children, By Duration of Sickness, By Province

DURATION OF SICKNESS	RURAL Coast	Eastern	Central	Rift	Nyanza	Western	URBAN Coast	Nairobi	Other	RURAL KENYA	URBAN KENYA
1 day	3.6	3.1	4.0	3.7	7.8	8.2	3.4	7.4	4.3	5.2	5.0
2 - 3	19.2	10.6	7.2	7.1	11.5	13.9	13.2	13.1	15.2	10.6	13.9
4 - 7	10.6	7.0	8.6	9.8	11.9	19.2	10.8	10.2	15.2	11.0	12.2
More than 1 week	12.0	12.3	12.1	12.7	17.7	21.7	10.4	8.4	15.7	14.3	11.6
Not sick	54.6	67.1	68.1	66.7	54.1	37.0	62.2	60.9	49.7	58.8	57.4
Total = 100%	100.0										

Source: Integrated Rural Survey Report No. 2

Table 9. Percentage Distribution of Children, By Type of Sickness, By Province

TYPE OF SICKNESS	RURAL Coast	Eastern	Central	Rift	Nyanza	Western	URBAN Coast	Nairobi	Other	RURAL KENYA	URBAN KENYA
Fever	25.1	16.3	21.8	19.2	26.7	41.0	22.8	22.1	27.2	24.6	24.1
Diarrhoea	7.3	5.3	3.2	5.8	5.2	8.1	0.3	2.0	7.1	5.5	3.2
Fever and Diarrhoea	9.0	2.4	2.1	2.8	7.6	8.3	3.3	3.6	4.4	4.9	3.8
Other	4.0	9.0	4.8	5.5	6.4	5.6	11.4	11.3	11.7	6.2	11.5
Not sick	54.6	67.1	68.1	66.7	54.1	37.0	62.2	60.9	49.7	58.8	57.4
Total + 100%	100.00										

Source: Integrated Rural Survey Report No. 2

Tables 10 and 11 show the percent of households in each region having access to given facilities and the distances covered to these facilities, respectively. The great disparity between these regions is clear from the tables. It is evident that whereas one region may be better off in one aspect, it may be lacking in another, a factor which suggests that the observed mortality differentials are not accidental.

Overall, it seems that Central and Western provinces have fairly localized amenities in contrast to Coast province where the facilities are more dispersed. For example, whereas over 95% of households in Coast province must cover more than 2 kilometers to get to a health centre, in Western the percentage is only 79%. This figure may, however, be deceptive for some health centres are ill-equipped to handle even the simplest cases due to lack of supplies which must be ordered from the capital city, and take months to arrive. And as we already observed many people would prefer hospitals to health centres.

Another aspect relates to the distance to a source of water. While over 97% of households in both Western and Nyanza are within 2 km of water, only 71% are so placed in Coast province. Again these figures require caution for most sources of water are rivers and streams which are in most cases contaminated.

Table 10. Percent Distribution of Households by Access to Indicated Facilities by Province

FACILITIES	PROVINCES					
	Central	Coast	Nyanza	Rift	Western	Eastern
Hospital	21.7	19.9	19.8	32.7	7.2	28.3
Health Centers	54.2	45.5	52.8	35.0	65.3	37.7
Piped Water	21.1	42.1	13.4	15.0	2.1	8.3
River Water	59.7	31.2	32.5	42.2	28.3	43.8
Other Source of Water (springs, wells, tanks, etc.)	2.8	17.1	14.2	11.6	57.2	17.6
Pit Latrine	89.0	22.5	71.5	32.5	65.9	56.4
No Sanitation	9.0	75.0	27.5	64.6	33.0	43.2
Permanent House	11.9	7.7	7.2	9.8	6.2	10.5
Earth (mud) House	87.0	92.3	92.8	89.5	93.5	89.4
Visits to Hospital by 0-4 year olds	26.7	28.2	27.6	31.8	32.4	23.6
Presence of Malaria	5.6	14.3	28.8	10.7	21.9	0.84

Source: Kenya Integrated Rural Survey 2. Central Bureau of Statistics Nairobi. 1978

Table 11 helps clarify the foregoing observations. For example, in Western province, only 2% of households have access to piped water compared to 21% for Central, and 42% for Coast. But again the Coast region figure may be reflecting the influence of Mombasa metropolitan area.

Still another factor of importance relates to households having access to sanitation. Coast is shown to have 75% of its households with no sanitation but it should be noted that the regions seemingly having more households with pit latrines are no better off. This is because most of the pit latrines are usually located a mere 10 yards from the main house, and,more often than not, if not well cared for, i.e. covered, flies from these places find their way to living quarters where they pose potential danger through food contamination.

We have already pointed out the importance of malaria as a major determinant of mortality in Nyanza, Western and Coast provinces. Certain features specific to these regions help explain why they are chronically infested by this deadly disease.

Physically they are all low-lying lake or ocean-based regions with low elevation, less than 300 feet above sea level. This encourages flooding which, in turn, provides large standing pools for the breeding of mosquitoes. Worse still, these regions experience some of the heaviest

Table 10 Percentage Distribution of Households, by Distance to Social Amenities, by Province.

	COAST	EASTERN	CENTRAL	R/VALLEY	NYANZA	WESTERN	NATIONAL TOTAL
PRIMARY SCHOOL							
up to 2 km	50.9	77.7	81.7	58.9	76.0	82.9	73.2
over 2 km	49.1	22.3	18.3	41.1	24.0	17.1	26.8
GOVERNMENT SEC. SCH.							
up to 2 km	5.8	13.5	9.3	9.1	7.2	8.4	9.2
over 2 km	94.2	86.5	90.7	90.9	92.8	91.6	90.8
HARAMBEE SEC. SCH.							
up to 2 km	9.7	19.6	30.6	8.7	21.0	19.2	19.1
over 2 km	90.3	80.4	69.4	91.3	79.0	80.8	80.9
HEALTH CENTRE							
up to 2 km	4.7	11.9	14.1	16.4	18.1	21.1	15.5
over 2 km	95.3	88.1	85.9	83.6	81.9	78.9	84.5
LOCAL MARKET							
up to 2 km	17.7	29.2	31.9	24.4	54.5	67.4	38.9
over 2 km	82.3	70.8	68.1	75.6	45.5	32.6	61.1
DUKA							
up to 2 km	40.1	69.0	79.4	50.2	63.0	79.9	63.7
over 2 km	59.9	31.0	29.6	49.8	37.0	20.1	36.3
CO-OP STORE							
up to 2 km	10.9	22.0	27.5	7.3	22.3	13.6	18.2
over 2 km	89.1	88.0	72.5	92.7	77.7	86.4	81.8
BUS ROUTE							
up to 2 km	31.5	42.7	50.1	44.7	45.3	52.5	45.8
over 2 km	68.5	57.3	49.9	55.3	54.7	47.5	54.2
MATATU ROUTE							
up to 2 km	27.1	59.4	77.8	59.2	57.3	68.3	61.6
over 2 km	72.9	40.6	22.2	40.8	42.8	31.7	38.4
WATER SOURCE							
up to 2 km	71.0	80.2	98.5	86.8	88.1	97.5	88.1
over 2 km	29.0	19.8	1.5	13.3	11.9	2.5	11.0

Source: Integrated Rural Survey 2 1978

Table 12. Percentage Distribution of Those Household Members who Received Non-Institutional Treatment, by Sex and Province (IRS-2)

	COAST			EASTERN			CENTRAL			RIFT VALLEY		
	M	R	T	M	F	T	M	F	T	M	F	T
Shop	78.7	71.3	74.7	70.6	63.8	67.0	25.3	44.6	35.7	46.2	45.9	46.0
Self Medication	1.0	3.6	2.4	18.4	21.6	20.1	66.0	54.8	60.0	45.4	40.3	42.5
Witch Doctor	1.1	1.9	1.6	8.6	10.8	9.8	2.7	0.0	1.2	2.0	3.9	3.1
Traditional Doctor	18.6	22.4	20.7	1.0	2.5	1.8	0.0	0.0	0.0	5.3	8.5	7.2
Other	0.6	0.8	0.6	1.4	1.3	1.3	6.0	0.6	3.1	1.0	1.4	1.2

continued

Table 12. continued

	NYANZA			WESTERN			NATIONAL TOTAL		
	M	F	T	M	F	T	M	F	T
Shop	57.2	55.6	56.3	59.1	56.2	57.6	57.8	56.3	57.6
Self Medication	20.7	18.9	19.8	20.8	23.0	21.9	25.2	25.9	25.6
Witch Doctor	3.7	3.5	3.4	7.2	3.2	5.1	4.6	4.0	4.3
Traditional Doctor	10.7	14.3	13.3	8.6	14.7	11.8	8.6	10.9	9.6
Other	7.7	7.7	7.2	4.3	2.9	3.6	3.8	2.9	2.9
Total = 100.0	100.0								

NOTE: The table shows the distribution of people seeking treatment at places other than the official licensed health institutions, by source of treatment. Of these people, 83% received treatment direct from shops or by self-medication: these sources may be resorted to in the rural areas because of the long distances to official centres, and the congestion at many government health institutions.

About 17% of non-institutional treatment (2.6 million cases) was acknowledged to be from Witch Doctors, Traditional Doctors, or 'other': this is likely to be an underestimate as there was unwillingness to admit to seeking treatment of these kind. 'Traditional' doctors may or may not be medically qualified.

rains in the country due to their geographical location. During the subsequent floods, many houses usually built of mud and grass-thatched are swept away with large numbers of people left homeless. The most vulnerable areas are Western and Nyanza provinces.

The trail of damage left behind by such floods is characterized by high human loss apart from the helpless exposed population which becomes susceptible to other diseases through contamination. This line of reasoning falls in place with the observation already made about the high prevalence of fever and diahrreal diseases in these regions (See Tables 8 and 9).

A closely related aspect is how most people treat these diseases, apart from seeking institutional treatment. As Table 12 illustrates, while many people are able to administer self medication, still others, in fact a larger percentage,find it easier to buy prescription drugs from the nearby shops. But as we have already noted, in some areas, large numbers of households are constrained by the long distance to the shops (Dukas) or bus route (See Table 10). The Table also tells us that a reasonable number of patients still maintain links with the witch and traditional doctors. In some cases the new borns are initiated in the society through traditional ceremonies, a process sometimes not very reassuring to its survival.

Thus, we see that in Coast, Nyanza and Western provinces the role of the traditional doctor has withstood the test of time. Not that the contribution of the traditional doctors to the survival of the society can be underestimated but the conditions under which they administer their treatment has sometimes cast a shadow of doubt on their effectiveness.

One important implication of treatment of diseases is the fact that many people are able to comprehend the symptoms of certain diseases, such as fever, and actually buy the right drugs from a nearby shop. This suggests that infant mortality, especially in the rural areas, can be reduced significantly through simple education programs which teach the mothers, especially young mothers, how to deal with these simple cases on recognizing the signs. This point reinforces our earlier observation about the importance of education as an indirect influence of mortality.

Whereas the foregoing consideration of the determinants of mortality at regional levels reflects the gradual changing socio-economic superstructure of the country, the conclusions based on the above discussion will be more meaningful with the incorporation of the other factors already included in the regression

models for this study.

This is especially useful in addressing such socio-demographic questions which relate to age, age at marriage, breastfeeding, and the number of pregnancies to a woman. Also related are issues pertaining to education, residence (urban/rural), and type of marriage Indeed these factors differ from region to region when viewed in the framework of the contextual factors already discussed. The regional pattern of their effect on mortality is further reinforced by other factors such as ethnicity and religion which as we have already observed are regional-specific.

The underlying logic here is that each region has its own level of education, urbanization and even polygamy, and events such as breastfeeding and age at marriage are determined partly by the socio-cultural values specific to these sub-populations.

Table 13 provides a summary of the OLS coefficients of the variables for the six regions in the country. As can be seen from the table, all the variables were already included in the analysis at the general level. Consistent with the earlier findings, with the exception of a few isolated sub-categories, the results still reflect and conform to our earlier observations. For example, longer breastfeeding (more than twelve months), higher number of pregnancies to a woman, and young age

Table 13. OLS Coefficients for Various Regions

VARIABLE/CATEGORY	CENTRAL Coeff. (t-Value)	COAST Coeff. (t-Value)
Age	.027	.089
	(.779)	(4.128)***
Age at death (months)		
4-6	.374	.348
	(35.879)***	(18.421)***
7-12	.302	.250
	(28.970)***	(13.251)***
Sex (male birth)	.019	.052
	(1.815)**	(2.470)**
No. of Pregnancies		
4-8	.013	.056
	(.765)	(2.320)**
9+	.045	.103
	(2.798)***	(4.334)***
Months Breastfed		
3-6	-.103	-.172
	(-6.318)***	(-6.747)***
7-12	-.115	-.186
	(-6.770)***	(-6.837)***
13-24	.043	.007
	(2.973)***	(.278)
Polygamy	.043	.030
	(3.933)***	(1.498)*

NYANZA Coeff. (t-Value)	R/VALLEY Coeff. (t-Value)	WESTERN Coeff. (t-Value)	EASTERN Coeff. (t-Value)
.101	.069	.018	.018
(8.041)***	(5.096)***	(1.249)*	(1.096)*
.386	.358	.361	.362
(36.918)***	(31.097)***	(30.627)***	(30.201)***
.341	.326	.338	.337
(32.767)***	(28.205)***	(23.347)***	(28.281)***
.037	.014	.026	
(2.978)***	(1.063)*	(1.249)*	
.051	.060	.060	.014
(2.950)***	(3.504)***	(2.607)***	(.644)
.096	.122	.073	.054
(5.562)***	(6.877)***	(2.651)***	(2.339)**
-.098	-.125	-.063	-.088
(-5.661)***	(-6.029)***	(-3.146)***	(-4.759)***
-.136	-.148	-.079	-.094
(-7.013)***	(-6.840)***	(-3.572)***	(-4.796)***
.008	.002	.040	.032
(.475)	(.128)	(2.175)**	(1.929)**
.016	-.005	.018	.018
(1.533)*	(-.040)	(1.249)*	(1.445)*

continued.....

Table 13. continued

VARIABLE/CATEGORY	CENTRAL Coeff. (t-Value)	COAST Coeff. (t-Value)	NYANZA Coeff. (t-Value)	R/VALLEY Coeff. (t-Value)	WESTERN Coeff. (t-Value)	EASTERN Coeff. (t-Value)
Urban Residence	-0.009	-.105	-.053	.003	-.021	.003
	(-.740)	(-4.931)***	(-4.229)***	(.242)	(-1.521)*	(.025)
Education						
Primary	-.023	.007	-.029	-.010	-.058	.045
	(-1.896)**	(.319)	(-2.569)***	(-.807)	(-4.068)***	(3.356)***
Secondary	-.005	-.006	-.007	-.009	-.005	-.045
	(-.433)	(-.301)	(-.677)	(-.698)	(-.357)	(-.165)
Marital Status						
Widow	.032	.034	.030	.015	.030	-.019
	(2.943)***	(1.598)*	(2.473)**	(1.107)*	(2.192)**	(-1.496)*
Divorced/Separated	.013	.024	.030	.009	.002	.022
	(1.256)*	(1.142)*	(2.455)**	(-.678)	(.152)	(1.853)*
Age at Marriage						
16-20	-.024	.003	.009	-.022	-.020	.004
	(-1.804)*	(.147)	(.794)	(-1.683)*	(-1.346)*	(.283)
21-25	-.013	-.036	.002	-.014	-.009	-.025
	(-3.003)***	(-1.811)**	(.162)	(-1.081)*	(-.620)	(-1.655)*
26+	-.022	.003	.010	-.005	.017	-.026
	(-1.659)*	(.116)	(.781)	(-.287)	(1.101)*	(-1.667)*
R^2	27.22	23.90	29.88	25.67	29.33	26.83
R_2 (Adj.)	26.92	23.20	29.68	25.43	28.97	26.54
F	90.06	33.96	154.24	108.05	82.71	94.73
N	4866	2183	6534	5652	4007	5189

*** significant at .01 level ** significant at .05 level * significant at .10 level

of women all seem to be associated with higher infant mortality in all the regions. The same is true for male births as well as children born to polygamous families. However, note must be taken of the differentials in the coefficients for various regions. For example, the probability of dying in the first twelve months for infants born to polygamous families is higher in Central and Coast provinces (b = .043 and .030) compared to those in Nyanza, Rift Valley and Western regions respectively (b = .016, b = .005 and b - .018).

Equally important, the table shows that the probability of dying for infants between seven and twelve months is lower in Central province (b = .302) compared to Western and Eastern (b= .338. Nyanza is shown to have the highest probabilities of dying at these age groups. This differential in age at death reflects the influence of environmental, as well as social, factors which, as has been shown elsewhere, have their strongest effect after age six months (WHO, 1980; Goldbert et al., 1984; Lee et al., 1984; Palloni, 1983).

In terms of breastfeeding, the results show that for infants breastfed for seven to twelve months in Central province the probabilities are high (b = .115) compared to Western and Eastern provinces where they reduce to b - .079 and b=-.094 respectively.

The underlying implication of the above discussion is that, for each of these regions, there are other forces at play which counter the effect of breastfeeding (thought to be most important factor in the early stages) on the survival of the infant.

In the Nyanza and Coast regions, one such factor may be young age at marriage which at 16-20 still is positively correlated with infant mortality. In Nyanza in particular, the positive correlation of age at marriage in all categories may be suggestive of social cultural forces adhered to in married life, especially those relating to feeding and care of the infants. As the marital status data would suggest, infants born to widowed and divorced parents have a higher probability of dying in Nyanza and Coast than the other regions, a factor reflective of not only the prevalence of that type of marriage in the area but also of its indirect effect on infant mortality.

On the understanding that the foregoing analysis actually reflects the empirical interpretation of our data, one must not lose sight of the statistical shortcomings inherent in it. For example, the inequality in the distribution of events in certain categories of some regions may be a contributing factor for lack of statistical significance of some variables. Moreover, the overall regional distribution of infant deaths (Table 7) is so

varied that we may be picking biased numbers of events bearing in mind the chronic nature of misreporting associated with infants who died at birth or during the first twelve months.

Despite all these, the above conclusions can be viewed as indicative of the expected theoretical understanding of the relationships hypothesized as based on this set of data.

As a final dimension to this analysis, the regression framework is extended to the regions, as before on an historical birth interval basis. This again is an attempt to illustrate how significant some of these variables have remained over time. The summary of the coefficients of such an application for each region is given in Tables B-F in the Appendix, where they are based on births before 1960, between 1960-1970 and after 1970.

The erratic nature of the signficance of some of the coefficients may be attributed to a number of factors. First, as already stated, the categorical sample size for many of the variables may be small both in terms of the population size as well as the reported number of mortality events, a factor complicated by the misreporting and underreporting of both the ages as well as the events.

More importantly however, as one goes back in time, so does the number of events scale down both in terms of

quality and quantity. Thus the lack of significance for certain expected categories should be viewed in this context. On the other hand, the differences may be due to factors specific to the region and therefore reflecting the reality of the situation.

In essence,the above limitation makes comparison across regions problematic unlike in the former case where comparison was across three periods for the whole country. Nevertheless, there are interesting confirmatory patterns both across and within regions that deserve mention.

Across regions, it is evident that age at death of the infant, number of months breastfed, as well as the number of pregnancies to a woman played major roles as determinants of mortality in all the regions over all three periods. This confirms the significance of the earlier findings and points to the importance that should be given to child/ maternal health care programs not only at the regional level but also the national level, if history is anything to go by.

Another general observation across regions is that most of the variables gain significance during the post 1970 period. For example, whereas in Western region breastfeeding was not significant until 1970s, the same holds true for infants born to young women in Central region. These two factors are related to education and it would seem to suggest that as education expanded in

the post-independence era, the indirect effects of various factors become widespread.

Education as such seems to have had little impact overall. But this might be expected for, as late as the 1980s, only 40% of the country's population was literate.

The impact of religion, though mostly indirect, is also evident on a regional basis for the three periods. Portestant and Catholic religion seems to have played a major role in Western, Nyanza and Rift Valley provinces. This is especially significant given the fact that many Catholic and Protestant missionaries settled in these areas and have since helped to raise people's living standards (though minimally) through such activities as schooling, health services, etc. For example, their overall contribution to the existing health system fills a vital niche in the country.

Conclusion

The foregoing analysis of the relationship between mortality and the various socio-economic-contextual variables has shown a number of findings:

First, it was shown that whereas both the exogenous factors (such as age, residence, ethnicity) and the endogenous factors (such as education, age at marriage, parity, etc.) are all significant determinants of infant mortality, the need for more emphasis on those factors

which directly impinge on mortality, for example breast-feeding, birth interval, and number of pregnancies, is unaboidable. The above seems even more pertinent when viewed from the perspective that most of these factors have been persistently significant determinants over time, not only at the regional level but also for the country as a whole.

Secondly, the analysis underscores the vital role played by the contextual variables such as sanitation, good quality drinking water, access to health and other amenities, etc. The urgency for the integration of these vital factors in the understanding of mortality in the country stems from their unequal distribution which undermines the well intentioned efforts of reducing mortality for the total population.

While some variables showed inconsistencies in terms of causal direction and statistical significance, their theoretical inclusion underscores their role in the overall understanding of mortality.

Finally, whereas it was possible to test several models with different variables, the persistent significance of most of these variables calls for more understanding of their theoretical relationship to other unrelated variables in the overall understanding of

mortality determinants. The inevitable conclusion is that an integrated approach to mortality determinants has still to be emphasized.

CHAPTER V

SUMMARY AND CONCLUSIONS

The importance of the study of human loss,especially in the first few years of life,is well documented in the literature. Such studies have focused not only on the total numbers that die but more importantly on how these numbers die differently within and between populations. This in turn implies the study of the mechanisms with which these differentials are maintained across the populations.

However, as the United Nations has appropriately observed, mortality in general and infant mortality in particular is a multidimensional complex process that cannot be understood and overcome from one perspective for it occurs within and is affected by a complexity of factors, themselves interrelated. Thus, knowledge relating to specific factors is vital in the understanding and reduction of mortality. This study attempted to address this issue with regard to infant fortality in Kenya.

In this chapter, a summary of the major findings is given, followed by their implications for policy and research. Finally, some basic weaknesses and needed research are suggested.

Summary

The broad objective of this study was to examine the effects of various factors on infant mortality in Kenya. These factors have been grouped into two general categories - variables associated with mothers of the babies and variables associated with the social and environmental settings within which these mothers live and their babies are born and nurtured. The first set of variables has been identified as "individual variables" and the second set as "contextual variables." Most studies of factors affecting infant mortality have focused on the effects of "individual variables," such as the mother's age, education and socio-economic status. Some studies concerned with infant mortality have emphasized the effects of "contexual variables," such as available health facilities, water supply and sanitation. A unique aspect of this study is that we are dealing simultaneously with both types of variables. We were anxious to determine the combined effects of the two types of factors. An important aspect of this approach is that it differentiates between those factors which are peculiar to the individual and those which are experienced by groups of mothers and their babies in geographic areas (such as cummunities or provinces). Thus is is possible to look at the effect of longer breastfeeding of an infant given that it was born in a region infested

with malaria. In this case its chances of dying will be higher.

To accomplish the above objectives, we applied two models based on ordinary least squares and logistic analysis.

Based on the existing theoretical and empirical evidence, we applied a more general model which included all the variables under study. A more focused model included those variables which not only directly impinge on mortality but also through which other factors mediate their effects on mortality. The impact of both direct and indirect effects of the above variables on mortality was also assessed. The last part of the analysis focused on the effect of all the above variables on mortality with emphasis on the contextual factors as they are unequally distributed in the country. The results of the above analysis are summarized below.

Age of the woman was shown to be negatively related to mortality. As we pointed out earlier, the negative relationship may be due to the mother's increasing experience with infant care. The results also showed that being born male and the product of a polygamous family was associated with higher mortality. Also

supported by this data was the hypothesis that infants born to divorced, separated and widowed parents experienced higher mortality.

Two other hypothesis which were consistently supported by these data throughout the analysis related to the period of breastfeeding and the number of pregnancies a woman has had. Whereas breastfeeding of the infant increases the survival chances, as evidence from this study showed, it was also shown that longer periods of breastfeeding (more than two years) was correlated with higher probability of dying. The reason, as we have already suggested, is said to relate to lack of nutrients in mother's milk after a certain period. This particular finding has been supported elsewhere (Da Vanzo 1984, Lewis 1984, Chase 1973, Eelens 1983).

As for the effect of pregnancies on infant mortality, a number of explanations have been given to account for its positive relationship. There is evidence that a higher number of pregnancies is associated with short birth intervals and when this is related to the fact that most of the women are young mothers (97% marry by age 22), the total indirect effect of higher number of pregnancies is bound to be higher. There is also the possibility that most of these young women have less access to prenatal

and post natal health care, a crucial factor in their ability to go through pregnancy process and recover in time for the next pregnancy.

Whereas the direct effect of education on infant mortality still raises unanswered questions among researchers, its negative, indirect effects has widely been discussed in the literature (Caldwell, 1980; Palloni, 1983; Preston and Trussell, 1981; and Behm, 1979). The results from this analysis also support this observation.

It is possible that higher education will delay marriage, thereby raising age at first marriage and first birth, which in turn will indirectly affect the birth spacing of the children. There are other dimensions to the indirect effect of education. Perhaps the most important is the fact that educated women will not only have high income but also better jobs which will ensure better standards of living, for themselves as well as their children.

The findings based on these data also supported the hypothesized relationships between mortality and the contextual variables. For example, the analysis showed that the use of pit latrine and earth floor house were all associated with high infant mortality. It was also shown that the presence of malaria was significantly correlated with high mortality. Also as hypothesized, the results

showed that a permanent house and use of piped water were associated with lower mortality.

Most of these contextual factors act directly or indirectly to promote mortality. For example, the use of contaminated water and food helps to transmit disease - causing germs which eventually ends in death. The type of housing (usually mud floors and walls and grass thatched) also poses great dangers to the crawling infants who may unknowningly swallow deadly objects or may be affected by the contaminated floor.

The effect of lack of sanitation on mortality is well documented (Da Vanzo 1983, Wolanya 1984, Meegama 1980). Many people lack sanitation facilities, instead preferring the use of bushes close to the houses or on slopes, and with the persistent heavy rains, all is washed down the rivers, thereby contaminating the water used for both drinking and bathing. Since most people do not boil their water before drinking, they can hardly avoid infection.

The hypothesis that high prevalence of malaria is positively related to mortality is also supported by these data. While malaria has a direct fatal effect on infants, it is the mosquitoes who are the principle carriers of the disease that require more attention. We have shown that the presence of floods, pools and other forms of standing water around houses form rich breeding grounds for these

insects. Thus, the significance of malaria in promoting mortality must be viewed from this broad perspective of both the individual as well as contextual factors.

The regional analysis was done with several aims. Most important was to show some of the variation in relationships between variables in different settings within the same country or region. As we suggested earlier, there is no single most important variable to explain mortality wherever it may occur. Rather the effects of each variable on mortality depends on the economic and social surroundings in which they occur. Kenya, as we indicated from the start, shows considerable geographical variation socially and economically.

The results from the regional analysis showed that whereas most of the variables were still significantly related to mortality, there was distinct variation for the six regions included in the study.

This was well illustrated by ethnicity which is linked to geography. For example, whereas being born in Kikuyu and Kamba implied lower mortality, the Luo and Luhyas were associated consistently with high mortality. These findings have also been observed in the country by other studies (Anker and Knowles, 1979; Mott, 1980; Henin, 1983). While the other factors remained significant, the implication here is that such social-cultural practices

like breastfeeding, polygamy and age at marriage are sustained within certain ethnic groups where they promote or reduce mortality depending on how they are practiced.

Moreover, the unequal distribution of socio-economic facilities in the country helps promote mortality, not only between regions but also within regions (especially urban and rural areas within regions). Whereas, some regions, like Central and Rift Valley,can claim higher percentages of such facilities like schools, hospitals, better housing, etc., many parts to the West of the country where half of the country's population reside suffer from shortages of these vital resources as they are located far from the supply centers where most of the important decisions are also made.

As we stated earlier, the last part of the analysis focused on the significance of the variables by birth period. At the general level, the results were consistent and significant for most variables including age, age at marriage, age at death, period breast fed, number of pregnancies, polygamy and sex of the child.

Although the regional results were not consistent for all the regions for the three periods (probably due to the small sample size for each period), the point was clear that breastfeeding, age at death, and polygamy played major roles as determinants of mortality now as well as in the past.

One conclusion to be reached about the findings of this study is that many variables influence infant mortality in Kenya, and one must consider all of them in terms of their combined impact. Equally important is the fact that both individual and contextual factors are related to infant mortality and further reductions in the latter can be achieved only by a concerted effort to deal with ameliorating conditions at both the individual and contextual levels.

Policy Implications

With a population of an estimated 16 million people and a growth rate of 4% per annum, Kenya is said to have one of the fastest-growing populations in the world. And with more than half of its population under age 15, it has been suggested that the potential for further growth is even greater. This becomes even more real considering the fact that the potential for further mortality declines are there.

However, as will be shown below, from a policy point of view, the factors responsible for the deceleration in mortality reduction are of equal concern to the government as are those responsible for the potential rise in population.

According to recent estimates, Kenya has an estimated infant mortality rate of 83 per thousand. Compared to

the developed nations, this rate is still significantly high. While remarkable gains in mortality declines have been made over the years,reducing mortality from an estimated 160 per thousand in 1948 to the present level, further declines in mortality will require a more integrated approach to raise the standard of living of the individual and his environment.

Our study has shown that the young women who marry at early ages significantly increases infant mortality. This is because most of these young women are either too young to withstand the strains of pregnancy, or they are too poor to support the infant once it comes into the world. Sometime the fathers of such kids are hardly identifiable - dodging the responsibility of caring for the child.

In nearly every aspect of the socio-economic system in Kenya, women are misrepresented. Most who drop out from school look to marriage as a solution for their problems. It would be worthwhile if the government provided equal opportunities to women, especially in training colleges and other schools. It will also help if the female labor force was increased to allow them more opportunities away from home.

As relates to education in particular enrollments at every level will help sustain a sizeable number at

higher levels of learning. This in a way will help postpone the age at marriage and possibly help prepare those who go on with higher learning to become better mothers.

Although the intended increase of the years for primary education will help keep these teenagers off the streets for a while, it is possible to argue that that will only be postponing the problem, as most of them, even if they pass exams, will find no places in higher institutions of learning.

The emphasis on education here is crucial because it directly or indirectly influences most other aspects that concern the mother and the infant. As most researchers have observed, educated women will be able to provide not only better health care to the infants but also adequate and better food and clothing. The point here is that education increases the awareness of women to the extent that she is capable of caring for the child in the first few years of its life, assuming, of course, she generates enough income.

As our analysis indicated, the longer an infant is breastfed the more it becomes vulnerable to malnutrition and, therefore, higher chances of dying in the first year. This is more so for infants who are born weak due to

closer spacing. But as we have indicated above, some secondary education will make a woman aware of these dangers not only to herself but also to the child. Thus, the inevitable emphasis on education.

While still focusing on the effect of education, a more manageable solution would be for the government to introduce population education in both teacher's colleges and schools in general. This would cover such areas as sex education and family planning and at least help increase awareness of the dangers of teenage pregnancies.

While the government cannot teach every woman better health care in formal schools, it is still its responsibility to strive to reach as many as possible. This is important as regards the rural women, especially those who do not attend school.

Although this service has been provided through rural clinics and health centers, the major obstacle is that most of them are under-staffed and ill-equipped for any practical demonstration. The training of the particular nurses and the nutritionists has been slow and expensive. Thus, most rural women prefer to stay home through the pregnancy and only rush to hospitals during labor times. Such pregnancies have, in most cases, resulted in fetal deaths or high infant mortality. The lack of both peri-natal and post-natal care calls for the government to

re-examine its training strategies as well as the planning and distribution of its health facilities.

We have also emphasized in this study the effect of ethnicity on mortality in the country. Whereas it is not possible to isolate the ethnic specifics that help perpetuate mortality in some groups and not others, there is evidence that some light can be shed on this aspect from this study. As we stated in the presentation of our problem, some ethnic groups in the country, e.g., the Luhya Luo, discourage pregnant women from eating eggs, beef, etc. But we know this food is important in providing the necessary energy for growth of child and mother. In other groups emphasis is put on traditional feeding habits where a none-month infant is given hard local food, not necessarily recommended. Still in other groups like the Kamba, breastfeeding lasts up to three years. All these factors which are ethnic-specific could be said to be partly contributing to the observed mortality differentials.

While educating the public about the need for change from more traditional ways will help create the needed awareness, much more needs to be done in terms of research, especially at the micro level.

For example, study is needed to show how widespread such practices are in the particular groups, and also to what extent these people are receptive of the looming changes in their socio-cultural structures. Findings from

such research will help plan for better changes in these populations.

On the other hand, local institutions such as the family,and especially,the church form an important part of most people, especially in the rural areas. Such institutions should be used to accommodate the dissolusioned families which cannot hold together after death, separation or divorce. It is also possible for the government to support those programs which bring together the orphans, the abandoned and the like. Although this exists at local levels, its significance would be more meaningful with more government participation.

While focusing on the individual factors, this study also laid emphasis on the contextual variables which directly impinge on mortality. These factors include type of housing, medical facilities, type of water used and the absence or presence of malaria in given regions.

In Kenya, the impact of these factors is felt at particular regional levels as there are distinct differentials in terms of their use and distribution.

We have stressed throughout this study how the historical pattern of development has perpetuated the maldistribution of these facilities in the post-independence era. Thus the question to address here is what alterna-

tives will be adopted to remedy this inequality for the benefit of all.

The failure of the government efforts to provide adequate health facilities, good drinking water, and better housing has partly been blamed on the pressure of the rapidly growing population and partly on the international economic-political turnovers. However, one would adequately argue that the solutions to some of this dilemma still rests within the system.

Our analysis showed that for many regions a large percentage of population has to travel more than two kilometres to get to a water source, bus route or health facility. This question is even more critical in the rural areas of most regions and especially for the expectant mothers who either have to walk due to the high cost of transport or lack of a bus route in the area of residence.

While the government is limited in what it can do with the available resources, the need to equip and staff the existing health facilities quickly is crucial and within the government's capability. Most of the existing facilities are usually far spaced, ill-equipped and under-staffed to handle simple cases. Thus most people are willing to cover long distances to hospitals.

The inadequacy of the existing health system to provide adequate services to the people was recently

underscored by the Vice President of Kenya who stated that,

> "In the provision of health services, the government policy is to control, to prevent and ultimately eliminate communicable diseases, health deficiency conditions, environmental hazards and problems associated with child birth and child-rearing.

but was quick to add that

> ...the health provision and delivery system is still characterized by a shortage of both medical personnel and service delivery points and disparities in the service provision due to financial limitations.
> (Vice President Kibaki, July 1984)

If the above speech is anything to go by, it seems that the much needed service delivery points will have a long way to becoming a reality.

One possible solution could be change in policy where stress will be placed on preventive rather than curative medicine. According to the government, only 8% of the health budget is spent on preventive medicine. As already pointed out, the government training of low level, cost-effective nurses and nutritionists should be given priority.

Whereas the housing problem is felt more in the urban areas, due to influx of migrants, the rural areas are no better off. More than 60,000 units of houses are built every year in the rural areas according to government estimates (Development Plan 1984-1989). However, the quality of these houses leaves a lot to be desired. Most are earth floors, mud walls and grass-thatched.

But with consistent heavy rains, most of these houses are swept away or start leaking, thereby providing breeding places for disease causing germs. While the government encourages people to own better houses, it would do better if it provided subsidies by lowering the price of such items as iron sheets which are vital in the housing industry.

Nevertheless, the recent spirit of people pulling together resources to erect houses for individuals in the rural areas seems to be gaining momentum and could lead to many people owning semi-permanent houses than anticipated.

The government's effort to provide adequate and better drinking water for the whole population continues to have partial success through centrally placed pipes where people can freely draw clean water. However, more than 70% of the population has to travel long distance fetch water which probably will be contaminated.

While the government cannot presently provide water for everyone in the countryside, it could however encourage the population to boil the water before drinking or bathing. This could, for example, be done effectively through inspection by local authorities. This practice has worked before in the country and could prove effective if reinstated.

Finally, whereas most researchers in the country agree on the high prevalence and incidence of malaria in

certain regions, especially Nyanza, Western and Coast, it has not been possible to isolate and agree on the contribution of this disease to mortality in these regions.

However, as we stressed elsewhere in this study, the evidence that it may be contributing a significant proportion exists in terms of the amount of mosquitoes found in these regions. While the government is committed to eliminating the disease, its slow action in spraying (first stage not complete since independence) leaves a lot to be desired.

The best solution here is stress on personal hygiene. The public should be educated on the dangers of standing waters and children playing in pools and mud and of the need for proper wiring to prevent the penetration of mosquitoes from reaching its victims.

While it is not possible to provide a summary of all possible factors relating to mortality, it is nevertheless important to point out that the individual and contextual factors alone will not significantly reduce mortality. As the experience from the West would have us believe, it is rather the combination of all other factors, for example strong political will and commitment on part of government to carry out decisions, that will in the long run lead to at least easing of infant mortality in the country. In any case, just as the Kenyan government may be taking

positive steps in achieving some of the above goals, the cost, administration and implementation of most of these programs seem to present insurmountable problems which are likely to stay for some time to come.

Limitations of the Study

Although this study attempted to address the broad question of the effects of the various soci-economic factors on infant mortality in Kenya, there were some weaknesses that deserve mention.

First, since the data on the two sets of variables came from two different sources required some reformating. However, in the process, some of the variables, especially the contextual, become highly correlated and could not be picked well by both the models due to their high level of tolerance. While we might have wanted all the original variables in the two models, the few that could not be tolerated did not drastically change the expected results. Furthermore the application of the logistic model required taking a sample of 10,000 cases of the original sample. But the frequency distribution for variables used in the two samples showed minimal differences.

Thus one of the major future recommendations in carrying out such a study should be the need for all relevant data from one survey. This will be aleast avoid the problem of integrating the data.

Even more important is the fact that our analysis was based mostly on fertility survey data. Despite all its advantages, the World Fertility Survey, as noted elsewhere, did not provide certain detailed information on mortality. For example, information on causes of deaths, weaning, utilization of health services, etc. vital in the analysis and interpretation of mortality was not available. It thus would be useful if future research would focus on such a set of data allowing for its availability.

It has also been argued that, for the developing nations, high fertility is justified to offset the prevailing high infant mortality. This seemingly important area has least been explored and it would be a timely added contribution if future research could focus further on the merit of this argument.

Finally, from a social research point of view, this study remains open for challenge and should be regarded as an additional contribution to the existing literature on this very important topic.

APPENDIX

Table A. Percentage Distribution and Ranking of Smallholders by Amenity and Service Indicators, and Province, (1976).

	Central[1]	Coast	Eastern	Nyanza	Rift Valley	Western	National Average % (ROW)
Household Amenities							
% with pit latrine	89 (1)	23 (6)	56 (4)	72 (2)	33 (5)	66 (3)	68
% without sanitation	9 (1)	70 (6)	43 (4)	28 (2)	65 (5)	33 (3)	38
% piped water (wet)[2]	23 (2)	35 (1)	8 (5)	13 (4)	17 (3)	1 (6)	15
% piped water (dry)	21 (2)	42 (10	8 (5)	13 (4)	15 (3)	2 (6)	15
% 2 km. to water[3] supply (dry)	98 (1.5)	71 (6)	80 (5)	88 (3)	87 (4)	98 (1.5)	89
% 1 km. to water (dry)	88 (1.5)	41 (6)	65 (2)	68 (4)	77 (3)	88 (1.5)	74
% with concrete floor	12 (1)	8 (4)	11 (2)	7 (5)	10 (3)	6 (6)	9
% thatched roof	32 (1)	92 (6)	63 (2)	82 (4)	76 (3)	85 (5)	69
% corrugated iron roof	57 (1)	3 (6)	35 (2)	18 (3)	18 (4)	14 (5)	27
Access to Services							
primary school 2 km.	82 (2)	51 (6)	78 (3)	76 (4)	59 (5)	83 (1)	73
govt. secondary school 8 km.	74 (1)	35 (6)	59 (2)	57 (3)	36 (5)	56 (4)	54
harambee secondary school 8 km.	70 (2)	34 (6)	64 (4)	81 (1)	50 (5)	67 (3)	64
health center 2 km.	14 (4)	5 (6)	12 (5)	18 (2)	16 (3)	21 (1)	11
local market 2 km.	32 (3)	18 (6)	29 (4)	54 (2)	24 (5)	67 (1)	39
duka (shop) 2 km.	70 (2)	40 (6)	69 (3)	63 (4)	50 (5)	80 (1)	64
co-operative store 2 km.	27 (1)	11 (5)	22 (2.5)	22 (2.5)	7 (6)	14 (4)	18
bus routs 2 km.	50 (2)	31 (6)	43 (5)	45 (3.5)	45 (3.5)	52 (1)	46

Source: Preliminary tabulations, IRS-2

[1] First column is percentage of households in the category; second column in parentheses is the rank of Province, compared to other provinces on the same indicator. Rank of 1 - best rating.

[2] "Wet" means in wet season.

[3] Km. means kilometre; "dry" means in dry season.

Table B . The Regression Results of Various Factors on Infant Mortality by Birth Interval for Various Regions in Kenya

CENTRAL REGION

VARIABLE	Post 1970 Coeff.	t-Value	1960-1970 Coeff.	t-Value	Pre-1960 Coeff.	t-Value
Age	-.001	-.023	-.035	-.851	-.028	-.336
Age at Death (months)						
4-6	.267	8.909***	.287	8.314***	.195	2.869***
7-12	.140	4.641***	.245	7.026***	.224	3.615***
Sex (male birth)	.018	.590	.017	.496	.080	1.308*
Polygamy	-.011	-.332	.110	2.977***	.070	.936
No. of months Breastfed						
3-6	-.132	-2.833***	-.074	-1.411*	-.172	-1.796*
7-12	-.169	-3.541***	-.0347	-.634	-.132	-1.516*
13-14	.049	1.138*	.1413	3.202***	-.067	-.860
25+						
No. of Pregnancies						
4-8	.087	2.199**	.129	2.109**	.094	.495
9+	.031	.754	.190	3.040***	.072	1.386*
Marital Status						
Widow	-.015	-.462	.037	.977	.015	.228
Divorced/Separated	.046	1.485*	.045	1.173**	.185	2.419**
Education						
No Education	.158	1.204*	.126	.437	-.119	-.632
Primary	.045	.408	.035	.216	-.103	-1.082*
Ethnicity						
Lui/Lubya	-.048	-.219	.045	.441	.186	1.232*
Kikuyu	-.055	-.819	.051	.475	.194	1.142*
Kamba	-.0001	-.002	-.086	-1.074*	.162	1.215*
Religion						
Protestant	.030	.211	.135	.839	-.341	-1.668*
Catholic	.061	.437	.094	.589	-.279	-1.415*
Muslim	-.026	-.630	-.037	-.688	-.161	-1.772*
R2	.153		.246		.206	
N	988		672		246	

Table C. COAST REGION

VARIABLE	Post 1970 Coeff.	t-Value	1960-1970 Coeff.	t-Value	Pre-1960 Coeff.	t-Value
Age	.027	1.344*	.035	2.048**	.040	1.594
Age at death (months)						
4-6	.218	15.701***	.223	15.022***	.211	8.718***
7-12	.229	16.366***	.205	13.729***	.220	9.080***
Sex (male birth)	.020	1.420	.018	1.222*	.034	1.427*
Polygamy	.026	1.777*	.022	1.399*	.035	1.317*
No. of months Breastfed						
3-6	-.158	-6.735***	-.052	-2.268**	-.020	-.590
7-12	-.191	-7.669***	-.047	-2.016**	-.003	-.074
13-24	.059	2.825***	.061	3.491***	.038	1.343*
No. of Pregnancies						
4-8	.055	2.628***	-.005	-.127	-.113	-1.733*
9+	.083	3.519***	.018	.442	-.034	-.513
Marital Status						
Widow	-.008	-.579	.014	.909	.029	1.074*
Divorced/Separated	.017	1.233*	.040	2.642***	.051	2.087**
Education						
No Education	.119	.677	.116	.747	.026	.180
Primary	.023	.307	.029	.828	-.022	-.592
Ethnicity						
Luo/Luoya	.049	3.171***	.066	4.057***	.013	.521
Kikuyu	-.010	-.252	-.027	-.521	.108	1.303*
Kamba	.014	.344	-.004	-.090	.073	.875
Religion						
Protestant	-.002	-.048	-.099	-2.628***	-.087	-1.789*
Catholic	-.003	-.002	-.053	-1.402*	-.005	-1.206*
Muslim	-.004	-.271	.005	.325	-.013	-.530
Other Sources of Water					.0005	.0004
Housing (Earth floor)					.0007	.0004
Health Center					-.0005	-.0006
Malaria	.012	1.891*				
R^2	.148		.123		.128	
N	1069		783		331	

Table D. WESTERN REGION

VARIABLE	Post 1970 births		1960-1970 births		Pre 1960 births	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
Age	.014	.554	.060	2.468***	-.027	-.727
Age at death (months)						
4-6	.247	14.223***	.242	11.613***	.081	2.269**
7-12	.235	13.523***	.249	11.989***	.226	6.342***
Sex (male birth)	.0009	.005	.025	1.248*	.005	.139
Polygamy	-.001	-.062	.012	.517	.051	1.091*
Months Breastfed						
3-6	-.109	-3.453***	-.098	-2.482**	-.079	-1.384*
7-12	-.143	-4.336***	-.071	-1.733*	-.091	-1.551*
13-24	.091	3.410***	-.010	-.350	.047	1.090*
No. of Pregnancies						
4-8	.090	3.707***	.036	.714	.102	1.091*
9+	.051	1.707*	.091	1.746*	.204	2.152**
Marital Status						
Widow	-.018	-1.028*	-.009	-.356	.077	1.995**
Divorced/Separated	.025	1.434*	-.015	-.688	-.056	1.474*
Education						
No Education	.031	1.621*	.006	.282	-.058	-1.478*
Primary	-.026	-1.361*	-.019	-.385	-	-
Ethnicity						
Luo	.053	2.795***	-.006	-.247	.069	1.736*
Kikuyu	.024	1.226*	.026	1.245*	.074	1.823*
Kambo	.001	.573	-.021	-1.008*	.072	1.987**
Religion						
Protestant	.009	.267	-.069	-1.907**	.090	1.505*
Catholic	-.015	-.489	-.058	-1.662*	.041	.710
Muslim	-.014	-.759	-.005	-.244	.053	1.438*
River water	.0001	.0004	.0005	.0006	.005	.004
Malaria	.004	.0005	.007	.0042	-	-
Pit Latrine	-	-	-	-	.00057	.0057
R^2	.159		.113		.117	
N	2864		2047		741	

Table E. NYANZA REGION - REGRESSION COEFFICIENTS

VARIABLE	Post 1970		1960-1970		Pre 1960	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
Age	.011	.267	.005	.129	-.051	-.893
Age at death (months)						
4-6	.142	6.852**	.201	5.921***	.134	2.482***
7-12.	.196	4.978***	.180	5.285***	.192	3.598***
Sex (male birth)	.016	.554	.052	1.539**	.077	1.415*
Polygamy	.073	2.329***	-.058	-1.583*	.097	1.602*
Months Breastfed						
3-6	-.239	-3.716***	-.076	-1.643*	-.032	-.483
7-12	-.216	-4.841***	-.177	-3.523***	-120	-1.637*
13-24	.074	-1.826**	.013	.310	.036	.561
No. of Pregnancies						
4-8	.084	2.287***	.012	.216	-.135	-1.482*
9+	.112	2.745***	.048	.853	-.23	-.249
Marital Status						
Widow	.031	1.050*	.051	1.434*	.084	1.247**
Divorced/Separated	.025	.832	-.015	.414	.087	1.481**
Education						
No Education	.321	.796	.041	-1.043*	-.153	-2.514**
Primary	.191	.864	-.044	-1.215*	-	-
Ethnicity						
Luo/Luhya	.042	1.179*	.011	.272	.044	-.739
Kikuyu	.025	.775	-.029	-.723	.063	.938
Kamba	.003	.069	.020	.045	-.034	-.453
Religion						
Protestant	-.012	-.270	-.020	-3.85	.034	.474
Catholic	.010	.225	-.054	-1.083*	.044	.539
Muslim	.045	1.223*	-.009	-.201	-.061	-.834
Urban Residence	-.036	-1.070*	-.154	-3.640***	-.0001	-.024
Piped Water	-	-	-	-	-.0001	-.0002
Malaria	-	-	-	-	.0004	.0004
Dispensary Use	-.003	-.004	.0001	.0005		
Earth Floor House	-.0001	-.0003				
R^2	.171		.121		.155	
N	3079		1906		1549	

Table [illegible] RIFT VALLEY REGION - REGRESSION COEFFICIENTS

VARIABLE	Post 1970 Coeff.	Post 1970 t-Value	1960-1970 Coeff.	1960-1970 t-Value	Pre-1960 Coeff.	Pre-1960 t-Value
Age	.003	.134	.026	1.489*	.011	.504
Age at death (months)						
4-6	.221	16.583***	.222	14.900***	.226	10.391***
7-12	.217	16.279***	.207	13.890***	.247	11.375***
Sex (male births)	.010	.739	.056	3.767***	.032	1.500*
Polygamy	.027	1.997**	-.004	-.255	.078	3.327***
Months breastfed						
3-6	-.190	-8.557***	-.053	-2.237**	.021	.668
7-12	-.263	-10.597***	-.1005	-3.787***	.073	2.105**
13-24	.058	2.752	.016	.744	.063	2.101**
No. of Pregnancies						
4-8	.077	3.981***	.006	.145	-.058	-.863
9+	.084	3.491***	.043	1.070*	-.012	-.179
Marital Status						
Widow	.017	1.237*	.008	.510	.075	3.331***
Divorced/Separated	.018	1.312*	.030	1.970**	.004	.159
Education						
No Education	.037	.251	-.044	-.223	-.046	-2.031**
Primary	-.024	-.356	-.051	-.882	-.040	-1.841*
Ethnicity						
Luo	.035	1.214*	.087	2.749***	.085	1.934**
Kikuyu	.003	.207	-.015	.971	-.012	-.534
Kamba	-.017	-1.172	-.014	.903	.016	.687
Religion						
Protestant	.026	.574	-.033	-.667	-.096	-1.128*
Catholic	.041	.913	.002	.052	.146	1.759*
Muslim	.021	1.018*	-.013	-.574	.018	.482
River Water	-	-	-	-	.005	.0004
Other Sourses (water)	.0005	.0004	-	-	.0001	.0005
Permanent Housing	-	-	-	-	.0006	.0001
Malaria	.0004	.0004	.005	.004	-	-
No Sanitation	-	-	.004	.004	-	-
R^2	.183		.129		.136	

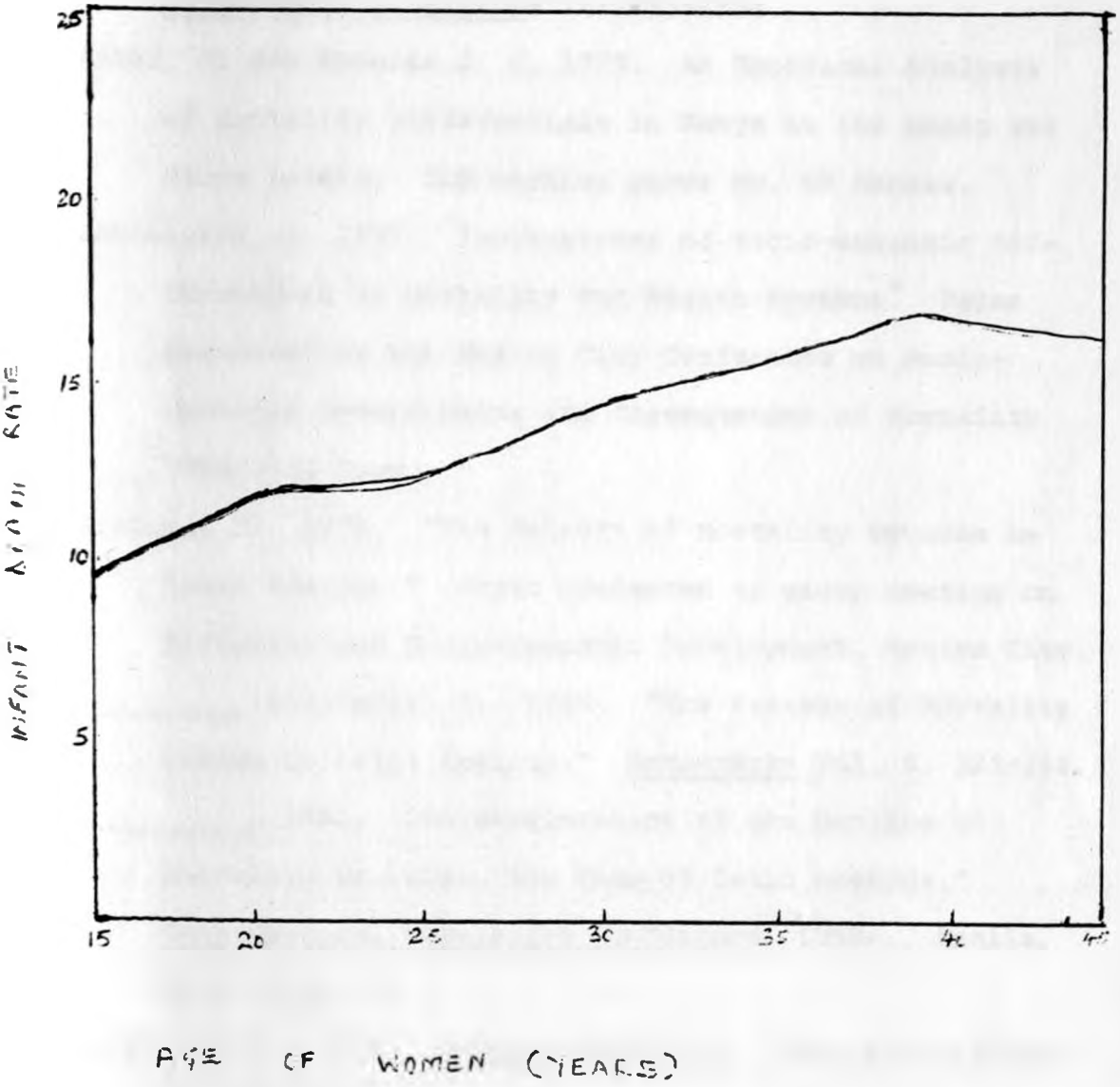
Table G: Frequency Distribution of the Two Samples

VARIABLES	TOTAL SAMPLE (30382)	SUB-SAMPLE (10000)
Age at Marriage		
15-19	56.0	55.0
20-25	18.0	17.0
26+	3.1	3.0
Marital Status		
Widow	4.5	4.3
Divorced/Separated	3.8	3.9
No. of Fertile Pregnancies		
4-8	55.8	56.4
9-15	29.7	29.6
Period Brestfed (months		
6-12	23.6	23.0
13-24	55.6	56.7
25+	10.4	10.1
Age of Death (months)		
4-6	14.3	14.2
7-12	16.3	16.1
Sex (Male)	49.4	49.8
Polygamy	26.9	26.8
Urban Residence	8.8	5.8
Education		
Primary	39.1	38.7
Secondary	3.8	3.9
Region of Residence		
Nyanza/Western	33.1	33.0
Coast	7.2	6.9
Rift/Eastern	34.7	34.4

Table H: OLS Regression Coefficients for Neonatal and Post Neonatal Deaths

	NEONATAL		POST NATAL	
	beta	t-value	beta	t-value
Age	.023	3.009***	.19	2.546***
Birth Interval	-.021	3.110***	-.025	-3.025***
Age at Marriage				
16-20	.010	.573	.072	4.319***
20-25	.006	.321	.047	2.748***
26+	-.013	-1.077*	.025	2.133**
Marital Status				
Widow	.020	3.441***	.020	3.329***
Divorced/Separated	.010	1.910**	.022	3.663***
No. of Fertile Pregnancies				
4-8	.032	3.387***	.035	3.733***
9-15	.064	6.008***	.054	4.973***
Period Breastfed				
6-12	-.120	-13.391***	.015	-1.702*
13-24	-.138	-14.421***	.028	-2.932***
25+	.003	.429	.104	12.989***
Sex (Male birth)	.032	5.562***	.015	1.814**
Polygamy	.023	3.823***	.018	3.025***
Urban Residence	-.022	-3.524***	.004	-.651
Education				
Primary	.022	.374	.069	1.180*
Secondary	-.010	-.389	-.006	-.841
Region of Residence				
Nyanza	.041	6.409***	.004	.599
Coast	.042	6.540***	.066	10.172***
Central	-.011	-1.768*	-.013	-2.046***
Western	.027	4.317***	.041	6.584***
Ethnicity	-.011	-1.957**	-.021	-3.562***
R^2	.1388		.1261	

Figure 1. Infant Mortality Curve by Age of Women



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