AN EVALUATION OF THE PRECEDING BIRTH TECHNIQUE USING THE 1998 KDHS DATA

BY
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DECLARATION

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

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This thesis has been submitted for examination with our approval as university supervisors

Signed M^r.. . . . . M ? ,
DR. A.T.A. OTIENO **DATE**

Signed
DR. B.O. K'OYUGI **DATE**

DEDICATION

To my children Martina and Nelly, you have been a source of my inspiration.

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ABSTRACT

The purpose of this study is to evaluate the preceding birth technique and to see whether the results obtained can be compared to those derived using the Coale-Trussell and the direct life table method to give reliable childhood mortality estimates.

The research question that arises is to what extend do estimates of childhood mortality derived using the preceding birth technique compare with those derived using direct and stable population models. The most important source to obtain reasonable estimates of childhood mortality in developing countries has been the use of retrospective questions in censuses and surveys. The best results so far obtained have been from questions about the total number of children ever born and the number surviving to women along their reproductive period. This has been faced with the limitations; namely lack of a current indicator of infant mortality that may be relevant enough for an evaluation of a health programme especially those aimed at reducing the incidence of infant mortality.

The second research question is; in the absence of facility based data, can stable estimates of childhood mortality be obtained from the preceding birth technique using household data. Procedures such as those based on the survival of the preceding child provide more recent estimates of childhood mortality and are less dependent on model patterns of mortality. Because of its simplicity, it can easily be used by other practitioners not trained in demographic techniques as a useful reliable indicator for monitoring programme activities.

The estimation is based on a recent five-year reference period preceding the survey interviews of the 1998 Kenya Demographic and Health Survey. These estimates are worked out using different socio-economic characteristics such as maternal age, type of residence, maternal education and current working status of the mother for comparisons between preceding birth technique (n) and Coale-Trussell. Other socio-economic characteristics such as birth order, sex, ethnicity and religion are added for comparisons between n and the direct life table method. The estimates are also obtained for the eight provinces of Kenya. Once the difference between n and Coale-

Trussell and the direct life table method are obtained, percentages are also calculated for the same for further ease in comparison.

As the study results indicate, general trends expected in childhood mortality are realized in all calculation, with children born to mothers with no education experiencing higher mortality than their counterparts. Those born in Nyanza, birth order seven and above and the male gender also show higher mortalities in their categories. However calculations using the Coale-Trussell method were quite unstable possibly because of the sample sizes but estimate comparisons with the preceding birth technique (PBT) show that the two techniques are fairly comparable. This is attributed to the fact that they are both indirect methods and are based on the stable population theory.

Comparisons between n and the direct life table method showed a tendency of the n estimates to consistently exceed the life table estimates of probability of dying at 24 months of age. There is no comparability in results obtained using PBT and the direct method. This could be attributed to the use of incomplete birth histories in PBT and complete use of birth history data in the life table method.

As a recommendation for further research, since the PBT method was thought primarily as a method for estimating mortality using clinic records for a small region, it would be ideal to evaluate it in multiple clinic settings and compare its computations of n with life table estimates of child mortality by 24 months of age obtained from reliable census, vital registration or survey data for the areas covered by the clinics. Another challenge for researchers would be to examine the underlying assumption that II approximates probability of dying at 24 months of age; an assumption that has already been challenged by several studies in Latin America and South Asia. To policy makers, the PBT method may prove useful for public health administrators as an easy to compute indicator of mortality index.

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

Death is a principal vital event for which vital statistics are collected and compiled. The United Nations (UN) and World Health Organisation (WHO), define death as 'the permanent disappearance of all evidence of life at any time after a birth has taken place'. A death can occur only after a live birth has occurred. It excludes all foetal loss, which embraces stillbirths, miscarriages and abortions.

Infant mortality rates and post neonatal infant mortality are among the best indicators of socio-economic development. It reflects not simply per capita stocks of food, clean water, but the actual availability of such amenities to all segments of a population. However, in many developing countries especially those of Sub Saharan Africa, 50 percent or more childhood deaths occur after infancy.

The World Population Conference in Cairo (1994) estimated that overall infant mortality for the whole world was about 62 infant deaths per a thousand live births and for developing countries averaged 69 infant deaths per a thousand live births.

Analysis of available data indicated a steady decline in infant and under-five mortality up to mid 1980s and thereafter rapid increases from early to mid 1990s. According to Kenya Demographic and Health Survey data (1993), in 1948, infant mortality stood at 194 deaths per a thousand live births while under-five mortality stood at 262 deaths per a thousand live births. By the year 1979, infant mortality had declined to 84 deaths per a thousand live births while infant mortality had declined to 105 deaths per a thousand live births.

The lowest level of infant mortality was witnessed in the period between 1979 and 1983 when it stood at 58 deaths per a thousand live births. Thereafter, it begun to rise steadily to 72 deaths per a thousand live births in the period between 1994 and 1998. Under-five mortality was lowest in the period between 1984 and 1988, when it stood at 89.2 deaths per a thousand live births. In the period between 1994 and 1998, it had risen to 111.5 deaths per a thousand live births. The upward trend has been attributed to HIV/AIDS, increased poverty levels and the collapse of the public health sector in Kenya.

All child health programmes aim to prevent the deaths of young children. Despite this, accurate and reliable measures of childhood deaths in developing countries are rarely available. The preceding birth technique (PBT) is a simple and inexpensive method for obtaining regular information on childhood mortality and monitoring changes in mortality over time. Just like estimates obtained from the crude death rate (CDR) and the age specific death rate (ASDR) methods, it can be used to compare mortality indices by non-technical demographers.

The PBT asks mothers about the survival of their preceding born child at the time of a visit to a health facility for a subsequent delivery. Mothers are asked three key questions:

1) Have you ever been pregnant before this last pregnancy or delivery?
2) If yes, what was the outcome of the pregnancy? (Live birth, still birth or abortion)
3) If a live birth, is the child alive today?

An early childhood mortality index is then calculated and this has been demonstrated to be an accurate and reliable measure of under-two mortality in most developing populations. The information obtained by asking the above three questions to respondents in a health facility are the same when compared with those obtained from birth histories in household surveys. The research questions that arise are;

1) To what extend do estimates of childhood mortality derived using the PBT method compare with those derived using the direct and stable population models?
2) In the absence of facility based data, can stable estimates of childhood mortality be obtained from the PBT method using household survey data?

1.2 Problem Statement

The most important source to obtain reasonable estimates of childhood mortality in developing countries has been the technique of using retrospective questions in censuses and surveys. The best results have been obtained from questions about the total number of children ever born and the number of surviving children to women along their reproductive period (UN 1983). However, there are limitations namely regarding the estimates based on the proportion of dead children along women's reproductive period.

As noted by Chackiel and Gough (1988), the limitations include lack of a current indicator of infant mortality, since the estimates obtained especially from women of younger ages correspond to a period of time several years removed from the census or survey.

Another limitations as Chackiel and Gough quote Guzman (1985), is the fact that infant mortality estimates at two, three, five, ten, fifteen and twenty years of age that are obtained through model patterns of mortality by age has not proved to be a totally reliable procedure to determine the probability of dying.

These limitations constitute a serious problem as far as the technique does not meet the demand for recent indicators of childhood mortality that prove to be relevant enough for an evaluation of health programmes, in particular those aimed at reducing the incidence of childhood mortality. Planners need to know more about the current health conditions in order to compare them with the situation after implementing their programmes.

Procedures such as those based on the survival of the preceding child provide more recent estimates of childhood mortality and are less dependent on model schedules. The purpose of this study is to evaluate this technique and compare the results got from it with those got from the Coale-Trussell and the direct life table method. An evaluation of the PBT method will also allow a check on its usefulness and reliability as a method of estimating under two mortality. Because of the simplicity of computing this technique, it can easily be computed by non-technical health workers and used to monitor their programmes.

1.3 Objectives

1.3.1 General Objective

The general objective is to apply the preceding birth technique to 1998 Kenya Demographic and Health Survey (KDHS) data to estimate childhood mortality.

1.3.2 Specific Objectives

1. To estimate childhood mortality from 1998 KDHS data using the PBT, Coale-Trussell and direct life table methods
2. To compare the results obtained from PBT and Coale-Trussell methods.
3. To compare the results obtained from PBT and direct life table methods.
4. Assess the suitability of PBT in estimation of childhood mortality in Kenya using 1998 KDHS data

1.4 Study Justification

The world summit for children held in 1990 adopted a set of goals for children and development up to the year 2000, including a reduction in infant and child mortality rates by one third. These goals were based on the accomplishments of child survival programmes during the 1980's, which were based on effective low-cost technologies made widely available.

In many countries child mortality rates have declined in the last decade due to improvements attributed in part to child survival interventions and the use of primary health care services.

The children ever born or Brass method derives estimates of q(x), that is the probability of dying between birth and exact age x, from the proportions of children dead among those ever born to women in different age groups by allowing for the duration of exposure to the risk of dying. This method can reliably establish the trends in childhood mortality over the past fifteen years or so but does not provide a very robust estimate of very recent mortality rates as the estimates derived from the two youngest age groups (15-19 and 20-24years) are often misrepresentative.

The PBT in its original form allows the gathering of quite recent estimates of childhood mortality through the simple procedure of asking a few questions to female patients of maternities and health centres. By including these questions in an on-going record keeping system, it also allows for the monitoring of changes in mortality rates over time, generating useful information to evaluate the impact of health programmes in specific areas.

1.5 Scope and Limitation

The study focuses on women in their reproductive ages, that is, 15 to 49 years, who have had a birth in the preceding five years before the survey. These women should at least have had a preceding live birth since n calculates the proportion dead of next to last births to women reporting a last birth, in this case, in the reference period.

Serious limitation to the study is incomplete reporting of births and deaths. If early neonatal deaths are selectively under reported, the results would be low values of n. It is also important to note that the experience of last born and only children is never reflected in the estimation of childhood mortality using PBT.

Another limitation is the reliance on mother's reporting, within this rest the assumption that adult female mortality is not very high, or if it is high, then there is little or no correlation between the mortality risks of mothers and their children. This assumption blots the real situation on the ground since between 1989 and 1998; which is within the study period, maternal mortality rate stood at 590 deaths per 100,000 live births.

The 1998 KDHS is national in scope. It excludes all the three districts in North Eastern province and four other northern districts, that is, Samburu and Turkana districts in Rift Valley province, Isiolo and Marsabit in Eastern province. In total, the excluded area accounts for less than four percent of Kenya's population (KDHS 1998).

1.6 Organisation of the study

This thesis is presented in five chapters. Chapter one covers the introduction of the study, problem statement, the general and specific objectives of the study, study justification and finally the scope and limitations of the study.

Chapter two covers the literature review, which includes the general review of both the direct and indirect methods of childhood mortality estimation, relevant studies of childhood mortality estimation in Kenya, the PBT; its analytical method and biases, and studies that have been carried out using this method.

Chapter three covers the source of data, methods of data collection, which include the sample design and questionnaire, the quality of data and finally the techniques for data analysis.

Chapter four covers the presentation of the results. It is in this chapter that comparisons of estimates of mortality at 24 months of age are made using the PBT, Coale-Trussell and the direct life table method.

Chapter five covers the summary, conclusions and recommendations for researchers and policy makers.

CHAPTER TWO

LITERATURE REVIEW

2.1 Childhood mortality estimation studies in Kenya

There have been a number of new procedures that have been used to gather and analyse data on demographic variables, reasons being the shortcomings inherent in the vital statistics especially of developing countries. Indirect methods of estimation published by United Nations (UN 1983) have been used in Kenya so as to come up with unbiased estimates of the level of childhood mortality.

Anker Knowles (1977) and Kibet (1982) used the Brass technique to estimate e(0), q(2) and total fertility rate. Anker used 1969 census while Kibet used the 1979 census. With e(0) or q(2) as a dependent variable, each one made a regression model to find out which factors were significantly correlated to child mortality.

Ronoh (1982) evaluated different techniques for studying childhood mortality. He applied logit life table system to female adult mortality levels in each of the provinces of Kenya. He then patched the adult mortality level with the child mortality level and constructed abridged life tables for females.

K'oyugi (1982) also applied this technique to both the male and female adult mortality for Siaya district. He then patched the estimates with those of child mortality in the district and constructed abridged life tables. Using the Brass Growth Balance technique, K'oyugi estimated the degree of completeness of death registration in Siaya district.

Ottieno (1985) used the 1979 census data on deaths by age and sex to construct a life table. In a paper he presented on mortality levels, trends and differentials in Nyanza and Western provinces of Kenya, he used the 1979 census to calculate estimates of infant and child mortality using the Trussell technique along with Coale-Demeny life tables.

Mudaki (1986) studied adult mortality in Kenya using the information on child and adult mortality with the help of Coale-Demeny life tables. To adjust for possible mortality change between 1969 and 1979, Mudaki used the multiplicative model of synthetic approach and the age specific growth rate technique. These adjustment techniques were used only at the national level.

Kichamu (1986) used the Trussell multipliers for north model to estimate infant and child mortality. The parameters used were q(2), e(0) and infant mortality rate, which are given at the national, provincial and district levels for possible differentials.

Munala (1988) estimated the mortality of children at age two for all divisions in Kakamega district by differentials of marital status, education and residence. He used Trussell technique and found that infant and child mortality differs by geographical and ecological regions represented by the divisions.

2.2 Methods of estimating childhood mortality

2.2.1 Direct sources of childhood mortality data

Almost all data on childhood mortality comes from censuses, surveys or from vital registration systems and less commonly from population registers.

Information about vital events, that is, births, marriages and deaths are usually collected by means of the compulsory registration of such events within a short time after their occurrence. This vital registration system or method is defined as the continuous and permanent, compulsory recording of the occurrence and the characteristics of vital events primarily for their value as legal documents as provided by the law and secondary for their usefulness as a source of statistics.

Death statistics usually records the name, age, sex, marital status, occupation and place of birth, date and cause of death of the deceased. The birth registration form usually includes characteristics of the event or child such as date of occurrence, date of registration, name, sex, type of birth (live or still birth, single or multiple birth) and place of occurrence. The form also includes characteristics of the parents including information on names and ages of the previous children born to the mother.

Vital registration systems have been established in most developed countries, however, in many developing countries, the systems are often non-functioning or seriously incomplete rendering the measurement of childhood mortality difficult.

An alternative source of mortality statistics is the sample survey. Sample surveys, as the name suggests, collects information from only a part of the population selected and assumed to be representative of the whole. They are used to collect supplementary demographic information and also used to test the accuracy of traditional data sources such as the census. The quality of statistics from the source depends heavily on the sample; the design of the sample and the way the survey is carried out.

Another alternative source of death statistics is the census. The modern population census is defined as the process of collecting, compiling, evaluating, analysing and publishing demographic, social and economic data about the entire population of a well defined territory at a specified time. Conducting a census is usually carried out by the government to ensure completeness of coverage. It is usually taken at regular intervals of say five to ten years.

Census data are known to suffer from coverage and in some instances double counting, content and response errors brought about by the inability or unwillingness of the respondents to give accurate information about themselves or the people they are talking about, information regarding number of children ever born or children dead. Cultural considerations may also lead to the unwillingness to give accurate information. Despite these shortcomings, in developing countries, estimated death rates are increasingly available from sample surveys or from analysis of census returns.

In developed countries where there is a complete registration system, a separate card for each individual from the time of birth to death or emigration is kept and continually updated. A regular census then provides an accurate check of the data as it's matched against the population register.

The advantages of the system include the completeness of coverage, accuracy and contact with individuals if required. Its disadvantages are the high cost needed to set it up and to maintain it. It also needs a high cultural and educational level and its regarded by many as an invasion in to their civil rights.

2.2.2 Indirect estimation of childhood mortality

Demographers generally agree that patterns of mortality of human populations as depicted in life tables can be distinguished in terms of level of mortality, that is, the overall rate at which people die and also the distribution of deaths between various age groups.

A life table is a history of a cohort or a hypothetical group of people as it is diminished gradually by death. It provides a summary of the effects of age specific mortality rates upon the birth cohort.

Identification of mortality patterns is closely linked to the evaluation of model life table. Its use will depend on the data available and the reliability of such data. When death by age and sex are available, the models can be used to smooth the data or to adjust for perceived errors. New model patterns can be generated based on an average age pattern of mortality for a country or a region. They are an important tool in the indirect estimation of infant and child mortality. In fact, it is said that model life tables systems have a special place in the development of modern demographic analysis. Without life tables, stable population theory cannot be used to estimate fertility or mortality.

Due to the inadequacies or shortcomings of direct data on childhood mortality, several indirect methods of estimating childhood mortality have been developed and described in United Nations Manual X (UN 1983). However, these indirect estimates cannot be considered as substitutes for the mortality measures obtained from complete and accurate vital registration system. In the absence of such data, they provide reasonable basis for demographic analysis and other purposes.

The basic principal underlying estimation is that good judgement should be exercised in applying the methods and accepting the estimates. The main limitation of indirect estimation is that at one stage or another, subjective judgement is involved.

Proportions of children ever born who have died are indications of child mortality. The births to a group of women follow some distribution over time and the time since birth is the length of exposure to the risk of dying of each person. The proportions dead among the children ever born by a group of women will depend upon the distribution of the children by length of exposure to the risk of dying and upon the mortality risks themselves.

Brass (1964) developed a procedure for converting proportions of dead children ever bom reported by women in five year age groups into estimates of the probability of dying before attaining certain exact childhood ages. He found that the relation between the proportion of children dead and a life table mortality measure is primarily influenced by the age pattern of fertility because it is this pattern that determines the distribution of the children of a group of women by length of exposure to the risk of dying.

An assumption made in the development of this method is that the risk of dying of a child is a function only of the child and not of other factors such as mother's age or the child's birth order. The method also assumes that fertility and childhood mortality have remained constant in the recent past.

Sullivan (1972) and later Trussell (1975) tried to improve on Brass method by computing a set of multipliers. Preston and Palloni (1977) proposed an alternative approach to estimate the time location of births, which circumvents all the problems associated with changing fertility. Given an age pattern of mortality from regional model life tables, the combination of the proportion of children dead and the age distribution of the surviving children of women from some particular age group uniquely determine a level of mortality without recourse to fertility models.

Feeney (1976) was the first to examine the effects of changing mortality on the performance of child mortality as an index of mortality level and calculated the proportions of children dead that would be observed if infant mortality were changing linearly through time. His method is likely to yield biased infant mortality estimates when the mortality pattern in early childhood of the population under study does not resemble that embodied in the general standard.

Child mortality can be indirectly estimated using data by age. Here classification of children ever born and children surviving by sex is desirable to get sex estimates separately. Where it is not available, estimates for each sex can only be obtained by assuming that the sex differentials in the population being studied are the same as those embodied by model life tables whose mortality level is consistent with the estimated child mortality of both sexes.

When data on children ever born are classified by sex, their consistency may be ascertained by computing sex ratios (defined as the average number of male children per female child) of children ever born by age of mother. Studies made in countries where birth registration is fairly complete have shown that the sex ratio at birth is remarkably constant and its usual value is around 1.05 males per female. In Sub Saharan Africa it's closer to 1.03.

The method requires information on the number of children ever born, those surviving or dead classified by five-year age group of mother. Data on total number of women irrespective of marital status is also required, classified by five-year age group.

Childhood mortality can be estimated using data classified by duration of marriage. This method requires data on children ever born, surviving or dead classified by five year duration of marriage group of mother and the total number of ever married women in each five year marriage duration group (ever married here means having entered into at least one union).

If it is available, child mortality for each sex can be estimated separately, otherwise estimates by sex may be imputed by assuming that a certain mortality model represents the mortality pattern of the population being studied.

Inter-survey child mortality can be estimated using data for a hypothetical inter-survey cohort, that is, data by age from two surveys five or ten years apart, and total number of women in each five year age group when data are classified by age. Alternatively the number of ever married women belonging to each five-year duration if data is classified by the time elapsed since the first union from each of the surveys being considered. Again in this method, classification of children by sex is desirable but not necessary. Sex differentials in childhood mortality may be imputed by using mortality models.

Child mortality can also be estimated indirectly when the fertility experience of true cohorts is known. In this method, two types of cohorts may be considered; those defined according to age and those defined according to the duration of first marriage or union.

The method requires data on number of children ever born by five year age or duration group of mother for two surveys or censuses five or ten years apart. It also requires data on the number of children dead or surviving and the total number of women or ever married women all classified by five year age or duration group of mother for the most recent survey or censuses being considered. The data on total number of women or ever-married women should also be there for each of the surveys being considered.

Very often, information on child survival is derived from the analysis of census data or from information contained in major household surveys such as the demographic and health surveys (DHS). Programme managers may have to conduct special surveys in between DHS to monitor progress toward mortality reduction.

The PBT is a simple and inexpensive method proposed as a method suitable for ascertaining the prevailing level of under-two mortality in countries without full vital registration. It allows managers and health providers to generate running estimates of childhood mortality trends for districts and sub populations. In fact in its original form, the PBT uses routine information collected by the health centres themselves.

By asking a few questions to female patients of maternities and health centres, the PBT allows the gathering of quite recent estimates of childhood mortality. The key question posed to mothers giving birth at least the second time is whether her preceding live born child is alive or dead, at the time of current delivery. The proportion dead among the previous born children provides a good approximation to the probability of dying between birth and exact age two in a life table.

By including these questions in an on-going record keeping system as noted earlier, the method allows for the monitoring of changes in mortality rates over time thus generating useful information to evaluate the impact of health programmes in specific areas. However, as rightfully noted by Bairagi et al (1997), it is a monitoring tool rather than a method that will replace other established approaches to measuring childhood mortality levels and differentials that other demographers have developed over the last three decades.

The principal obstacle to the wider adoption of PBT is the low proportion of women who give birth in maternity clinics and hospitals. A larger proportion of mothers however, visit clinics and hospitals for antenatal care and to vaccinate their newborn.

2.3 Studies on estimation of childhood mortality using preceding birth technique

There are several studies that have been carried out in various countries that estimate childhood mortality using PBT. Bairagi and Shuaib (1993; 1994; 1997) simulated the technique in Bangladesh. In 1993, they wanted to test the validity of the measure in estimating childhood survival in Bangladesh. Using data from Matlab, they found that mortality estimation by PBT was unaffected by the occurrence of better-educated women attending extended programme on immunization, when this effect was controlled for.

Bairagi et al (1997) used data from the Matlab surveillance system to test the accuracy of mortality estimates derived using the PBT, with data obtained from mothers at antenatal visits and at the vaccination of their youngest children. The study showed that PBT estimated under three rather than under two mortality in Bangladesh due to the long birth intervals.

Materia et al (1993) applied the technique in rural Ethiopia within a system of demographic surveillance. Trained community health workers acted as interviewers and transmission flow of the routine health information system were used for data reporting. The data was used to estimate probability of dying between birth and age two and between birth and age five. They found that PBT may be inserted into a primary health care information system run by trained community health workers.

Woelk et al (1993) also tested the ability of the method to estimate current levels and trends in child mortality in Zimbabwe. The pilot study on health facilities in Mashonaland East province found PBT to be useful in estimating childhood mortality.

Macrae (1982) illustrates the technique by applying it to maternity history data collected at the time of birth registration in the Solomon Islands.

Cutts et al (1996) conducted a cluster sample survey in 1993 in Beira City in Mozambique to determine child and maternal mortality after 10 years of internal conflict. They compared the indirect estimate techniques of child ever born and PBT for child mortality and found that PBT obtained a much lower child mortality estimate than the child ever born technique.

Mbacke (1994) in his study on a Bamako health program in Mali, demonstrated how follow up interviews of postpartum mothers can broaden the already considerable advantages of PBT for studying mortality determinants.

Aguirre (1994) in his simulation of PBT data from the World Fertility Survey (WFS) for Mexico and Peru found that proportions of previously dead children in Peruvian and Mexican home deliveries underestimated mortality by 32 % in Peru and 15 % in

Mexico. He proposes interviewing women at some other point other than at the time of delivery for more accurate estimates for example during a child/ infant intervention.

Li (1992) evaluated systematically the consistency of life table estimates of q(2) based on preceding births with that based on all births in a recent five year period using data from 24 WFS countries. She found that the frequency with which PBT exceeds q(2) indicates an upward bias of the method. But she also notes that comparisons across the selected countries may exaggerate differences between low and high mortality populations. However, she finds that the overall differences between mortality estimates derived from PBT and the life table technique are not statistically significant.

Aguirre and Hill (1987) carried out a systematic trial of PBT in five urban clinics in Bamako Mali. They asked mothers giving birth at least the second time whether their previous live born child is alive or dead at the time of current delivery. They found that the proportions dead among previous born children provided a good estimation to the probability of dying between birth and exact age two in a life table. They note that PBT can yield a cheap, simple and up to date estimate of early childhood mortality that can be calculated easily from the data generated within maternal child health programmes.

Wakibi (2002) estimated mortality at 24 months of age using the 1998 demographic and health survey data for Kenya. He first simulated PBT by getting all preceding births reported by mothers in the survey and those reported by mothers who have had a medically assisted last birth in the last two and five years before the 1998 survey. He examined this by region, residence and education, and later compared these values to those derived using the life table method.

He found that the suitability of PBT vary with the level of early childhood mortality in an area. He found that the technique works best in moderate to high mortality populations whereas for the medical data, he could not make any conclusive findings about the reliability of PBT and attributed this to the small sample sizes, sampling variability and selectivity bias.

2.4 Bias analysis of preceding birth technique

The Brass-Macrae method assumes dead children, as a proportion of preceding births can be associated with the probability of dying between birth and exactly age two. This implies that, on average the exposure to the risk of dying is 80 percent of the mean birth interval (MBI), which is assumed to be around 30 months in countries with high fertility.

Aguirre and Hill (1987) citing an article by Smith analysed World Fertility Survey (WFS) results from 23 developing countries and found that the MBI was around 31 months on average when fertility was above 5 children but that in countries with an average of less than 5 children, the MBI rose to an average of 35 months.

Krishnamurthy (1986) assertion on a shorter birth interval following an early child death is also analysed by Hill and Aguirre (1987). They explain the bias to be minimal or negligible due to at least one-year period of post partum infecundity following a birth and this varies widely thereafter depending on breastfeeding behaviour.

If the preceding child method is adopted to keep an ongoing register, all births from every woman would be recorded except the final one due to the fact that a subsequent occasion to record it is non-existent. In the case of single child families, the first (only) birth would never be recorded. The extent of the bias that the omission might produce depends on the level of mortality of the children who have never been recorded.

Since DHS surveys include women only up to age 49 and that the majority of the women sampled have not completed their reproductive history, it is not possible to simulate the omission of final birth children.

This reasoning would also be used when simulations are based on birth histories. In this type of data, a problem is latent because by going backwards in time, the experience of the eldest women is lost. Since five years prior to the survey, women can only be 44 years old at the most.

The PBT assumes that infant and child deaths are a function of age and not other factors such as the birth order or age of the mother. It also assumes that the survival status of children is independent of maternal mortality. Differential reporting of deaths by selected groups can bias mortality estimates. The technique assumes recall errors since only one relatively recent event is of interest.

The PBT does not require the mother to report her age and therefore it is not vulnerable to the biases that arise when estimates are based only on women from a particular age group. However, it suffers a serious weakness in its failure to provide child mortality rates by age which provides insights regarding mortality conditions.

The fact that the basic data to estimate childhood mortality is collected among women who attend a medical centre, biases of selection would appear since they are likely to belong to certain social classes. According to the type of selection, either underestimation or overestimation of child mortality may occur. Research in both Latin America (Guzman 1988) and in the city of Bamako (Aguirre and Hill 1988), show an over representation of younger women. Guzman mentions that the ensuing bias does not greatly affect estimates because of other compensatory factors such as the under representation of older women whose children may also have a higher than average level of child mortality.

We cannot predict how well PBT will work but if the reporting was restricted to a clinic or a hospital setting as originally proposed by Brass and Macrae, Li (1992) rightly suggests it would be reasonable to assume that IT will be most reliable if the following conditions are satisfied,

i) Medical assistance at delivery is generally available.
ii) Changes in fertility and mortality occur slowly.
iii) Estimates are based on sufficiently large sample sizes especially in respect to the next to last births.
iv) Age distribution at death is such that a substantial portion of deaths among next to last births occur prior to 24 months of age, and finally,
v) Data collection is characterized by minimal omission and misreporting.

The selection by socio-economic indicators may be of greater significance than the age factor since low-income women may not have access to medical centres. It should be kept in mind that when this method is implemented in a particular health centre, biases in either direction might occur since some maternity clinics are mainly for the poor or for high-risk births. In all this, one thing that should not escape our minds is that the technique offers the potential for analysts to monitor mortality recurrently in a simple and economic way.

2.5 Summary of main issues derived from the literature review

Issues involved when estimating early childhood mortality from proportions of preceding children who have died show that most of the technical issues raised can be explained away and often found to be negligible in its impact on the final estimates derived. Among these issues include an early child death, impact of omission of only children and final birth children in the estimates. The authors however recognise that errors arising from incomplete coverage of mothers who report a last birth and recall errors would bias the estimates.

Some studies have shown that in countries where the birth intervals are greater than those envisaged by Macrae and Brass, PBT estimated under three rather than under two mortality. Mixed results are however achieved when the estimation is for under two mortality with some studies showing that PBT underestimates q(2) while others show it as over estimating it.

Many of the previous studies have evaluated institutional conditions and examined the feasibility of applying the technique to some pregnancy centres. The estimates obtained have been tested mostly against the life table estimates of under two mortality based on the same births and have found the outcome to be fairly consistent. Consensus is achieved in the ability of PBT to help project managers and clinical staff evaluate the impact of their projects.

Wakibi (2002) findings indicate that PBT is suitable in the moderate to high mortality zones, though he finds that the method consistently underestimates mortality at twenty four months of age. He attributes significant differences to selection bias and small sample sizes. His comparisons are limited to the life table method and for only three major attributes, that is, the regions, type of residence and educational status of the mother.

The aim of this study is not only to compare estimates of PBT against the direct life table estimates of mortality at twenty four months of age but also to compare it against another indirect method like the Coale Trussell technique. This technique uses proportions of children ever born who have died as indicators of child mortality. The direct life table technique also gives estimates as they are without using models to smooth the data or adjust for perceived errors.

Analysis is further done against other mother attributes like ethnicity, age, religion and work status. It also considers the estimates against child attributes like birth order and gender which affect child mortality. The function of this is to provide insights into the technique against attributes that may be considered to determine mortality conditions. The study also proves that the technique can also be used against data from surveys and not only hospital and clinic based data.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter covers the source of data, method of data collection, quality of data and the statistical techniques for data analysis. This study employs PBT, the direct life table method and the Coale-Trussell technique to come up with the probabilities of early childhood mortalities. It also uses percentages so as to work out the difference in percentage terms between the methods of estimating childhood mortality.

3.2 Source of data

This study focuses on the 1998 KDHS. In the interviewed households 8,233 eligible women were identified. Out of these 7,881 women aged 15 to 49 years were successfully interviewed yielding a response rate of 96 percent. These were women in their reproductive ages and therefore eligible for the interview.

3.3 Methods of data collection

3.3.1 The sample design

The 1998 KDHS covered the population residing in private households throughout the country, with the exception of the sparsely populated areas in the north of the country comprising about four percent of the national population.

The KDHS utilised a two stage stratified sampling approach. The first step involved selecting sample points or clusters. These sample points are selected from a national sampling frame called National Sample Survey and Evaluation Programme - 3 (NASSEP-3), maintained by the Central Bureau of Statistics (CBS). The second stage involved selecting households within sample points from a list compiled during a special KDHS household listing exercise.

3.3.2 Questionnaire

Three types of questionnaires were used in 1998 KDHS; the household, the men's and the women's questionnaire. The main purpose of the household questionnaire was to identify, among others, all the women aged 15 to 49 years for the individual interview.

The women's questionnaire among other topics called for a reproductive history, which is a detailed account of all live born children of the respondent, their survival status and these are used to arrive at fertility and childhood mortality rates. It is from questions that cover these that the PBT is derived.

3.4 The quality of data

In designing the KDHS sample and in the actual data collection, emphasis was laid upon obtaining high quality and reliable data. A number of measures were undertaken in a bid to achieve this goal. These included the selection of the sample that was adequately representative and administratively manageable. The questionnaires were pretested by language specific teams who had been adequately trained (KDHS 1998). The fieldwork commenced on 16th February 1998 and was completed on 29th July 1998.

To check for selective omission of childhood deaths or misreporting of age at death, inspections were carried out on the ratios derived and this indicated that there was no significant numbers of early infant deaths omitted in the 1998 KDHS. It should be noted however that estimates derived from the 15-19 age group and to a lesser extent those aged 20 -24 are nearly always out of line because children born by younger mothers are generally subject to unusually high mortality risks.

Data on life time fertility is collected by asking women to give the total number of children born alive that is, retrospective fertility. On the other hand, data on current fertility is collected by asking women the date (month, year) when they had the most recent birth. Errors of omission, non response and age misreporting affect the quality of data of both retrospective and current fertility.

Other common errors associated with data on children ever born include omission of births. Women tend to omit some of their live born children, particularly those who died early in life and those living elsewhere. The proportions omitted tend to increase with age, especially for women aged 35 years and above. Another problem faced is the inclusion of still births among live born children.

The inclusion of questions on the last born child in surveys or preceding birth at the moment the woman attends a health centre to give birth is strongly affected by selectivity given the fact that it collects data from women giving birth at maternity hospitals. The biases of selection will appear since they are likely to belong to certain social classes and be among women who coincidentally attend clinics with high risk birth services. According to the selection, either under estimation or over estimation of child mortality may occur. Low income women whose children are more likely to die may not have access to medical centres.

Estimates from a sample survey are affected by both sampling and non-sampling errors. Non sampling errors, which are due to shortcomings in the implementation of data collection and data processing was minimized in this survey but the authors however note that they are impossible to avoid entirely and are difficult to evaluate statistically.

Sampling errors are a measure of variability between all possible samples. Although as noted by KDHS authors, the degree of variability is not exactly known, however, it can and was estimated from the sample results and found to be satisfactory.

3.5 Brass child mortality method

Brass was the first to develop a procedure of converting proportions of dead children ever born reported by women in age groups 15-19, 20-24.... into estimates of the probability of dying before attaining exact childhood ages. He used the symbol D(i) to denote the proportions dead among children ever born to women in successive five-year age groups (here i signifies age groups).

Brass developed a procedure to convert **D**(i) values into estimates of q(x),

where :

$q(x) = 1.0 - l(x)$ the probability of dying between birth and exact age x.

The basic form of the estimation equation is:

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

Where the multiplier K(i) is meant to adjust for non-mortality factors determining the value of D(i). The multiplier being selected according to the value P(1) / P(2) which is a good indicator of fertility conditions at younger ages, where P(i) is the average parity reported by women in age group i.

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

3.6 Coale - Trussell method

To calculate child mortality, The Coale-Trussell technique was used. The technique requires information on children ever born (CEB) and children dead (CD) classified by the age of the mother. The female population (FPOP) classified by five-year age groups was also required. The probability of dying at age x is given by the formula:

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

$x = 1,2,3,5,10,15$ and 20

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

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

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

$P(i) = CEB / FPOP$ for age group i

$D(i) = CD / CEB$ for age group i as defined above

The coefficients used for all the cases studied are according to Trussell variant for the north model life tables shown on Appendix A, table 1A. This has been shown in the past to be the most appropriate for Kenya. The probability of dying q(x) is for both the sexes unless defined. The values of q(x) shall be obtained against various socio-economic characteristics such as education, place of residence, work status and provinces.

3.7 The direct life table method

The life table method was also used to calculate childhood mortality. The life table model conceptually traces a cohort of new born babies through their entire life, usually under the assumption that they are subject to the current observed schedule of age specific mortality rates.

The SPSS package, which is able to analyse large quantities of data, is used to create a child file of the KDHS data. Children born in the preceding 5 years to the survey are isolated. Using the package still, one can be able to analyse the survival of these children through the life table method. From the output, the number entering the interval or number exposed to the risk of dying, their proportions in terms of death and survival are derived.

From the cumulative proportion surviving at the end of each interval, if the value is subtracted from one, the resultant answer is the probability of dying by a particular age, and in this case, the probability of death at exactly 24 months of age. This can also be done manually through the procedure given below.

The mortality rate (nqx) is the basic function in the table; it's the initial function from which all other life table functions are derived, nqx is the proportion of the persons in the cohort alive at the beginning of an indicated age interval (x) who will die before reaching the end of that age interval (x+n)

To determine the mortality level for a region, we first calculate the probability of surviving up to age x from birth.

P(x) = 1 - q(x) for x = 1, 2, 3, 5, 10, 15, and 20

The probability of survival y = p(x)

Each p(x) is then multiplied by the radix lo to obtain the number of survivors at age (x) that is 1 (x). Other life table functions are then calculated as follows:-

npx the probability of surviving between age (x) and (x+n) is given by the formula:-

npx = 1 (x+n) / l(x)

nqx the probability of dying between age (x) and (x+n) is given by the formula:-

nqx = 1 - npx

ndx the number of persons who die between age (x) and (x+n) is given by

ndx = l(x) - l(x+n)

nLx is the person years lived between age (x) and (x+n) where:-

1L0 = ,3(lo) + .71(1(1))

4L.= 1.3(l(i)) + 2.7(1(5))

sLs = 2.5(1(5)) + 1(1(10))

Tx the total population from age (x) is given by:-

T(x) = T(x+n) + nLx

e(x) the expectation of life at age (x) is given by:-

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

3.8 The preceding birth method

The proportions dead of preceding births referred to as n, is taken to be an estimate of the probability of dying by age two years. Hill and Aguirre (1990) show n to be the integrated product of two functions.

n =oTb(x) q(x) d(x)

Where

b(x) - proportions of next to last births that occurs x months prior to last birth.

q(x) - Probability of dying by exact age x x - this can take values of 0 and oo that is the minimum and maximum birth intervals observed.

II- Weighted average of the probability of dying for all age groups of next to last births.

n depends on both the prevailing fertility and mortality conditions. The probabilities of dying in childhood in any life table falls quickly between birth and about age two, flattening gradually thereafter.

In populations where the average birth interval approaches 30 months (two and a half years), the number of mothers whose previous child has died (deaths), in simple terms, is divided by the number of mothers having a previous child (births).

According to Brass and Macrae, this relation yields an estimate of the probability of death between the time of birth and age x that according to the authors would be two years of age. This is based on their finding that this age would be equivalent to 0.8 of the mean birth interval.

The technique offers a number of advantages. It's simple because it takes only a few straightforward questions and the corresponding calculations. In its original form, it uses data collected by health centre personnel thus minimising on costs incurred in carrying out a research.

Some disadvantages are that the procedure entails a certain degree of social and demographic selectivity, which is revealed in differences in the woman's social status, education and income level. Some differences may also be observed as to their distribution by age and parity.

Consequently as Guzman (1988) observes, the estimates obtained by means of this procedure should be regarded as being representative of the death rate among the children born to women who are patients in the health centres where the research was performed rather than the existing one among the total female population in the area under study.

CHAPTER FOUR

A COMPARISON OF CHILD MORTALITY ESTIMATES FROM PBT, COALE-TRUSSELL AND DIRECT LIFE TABLE METHODS

4.1 Introduction

In this chapter, we will deal with the cross tabulations that will come up with n, that is, the proportions dead of the preceding births. This will be looked at under different socio-economic characteristics. q(x) will also be calculated using the Coale-Trussell technique and the direct life table method. A comparison will be made using the three methods, to find out if the PBT method is a good estimator of q(2). Thereafter percentage differences will be calculated between n and Coale-Trussell method and between n and the direct life table method. The ten percent cut off rule for comparability of the methods will be used so us to determine the suitability of PBT.

4.2 A comparison of q(2) estimates from PBT and Coale-Trussell methods

Table 4.1 provides mortality figures for under-two mortality for the whole country, we find that n over estimates q(2) by 0.001, which comes to 1%. This is because PBT estimates under-two mortality to be 96/1000 while Coale-Trussell estimates it at 95/1000. Figures for the whole country give very little differences in both methods applied. In fact, the difference translates to only one percent, a difference that may be seen as negligible. This implies that at national level, the results of the two methods are highly comparable

Table 4.1: Estimates of q(2) values obtained from PBT and Coale-Trussell methods

DIFFERENTIALS	PBT	COALE-TRUSSELL	DIFFERENCE	% DIFF
All Cases	0.096	0.095	0.001	1.05
Provinces				
Nairobi	0.121	0.119	0.002	1.68
Central	0.021	0.036	-0.015	-41.67
Coast	0.081	0.107	-0.026	-24.3
Eastern	0.063	0.077	-0.014	-18.18
Nyanza	0.202	0.187	0.015	8.02
Rift Valley	0.066	0.060	0.006	10
Western	0.111	0.084	0.027	32.14
Type of residence				
Urban	0.084	0.104	-0.02	-19.23
Rural	0.098	0.092	0.006	6.52
Education level				
No education	0.121	0.070	0.051	72.86
Pri education	0.103	0.106	-0.003	-2.83
Secondary+	0.063	0.065	-0.002	-3.08
Current work status				
Not working	0.088	0.086	0.002	2.33
Working	0.103	0.096	0.007	7.29

Source: Computed from study data

4.2.1 Comparisons of estimates by region

At the provincial level, varied results are obtained. Nairobi province PBT gives the figure of 121/1000 while Coale -Trussell gives the figure of 119/1000. This shows that PBT estimate is greater than the Coale-Trussell under-two mortality by 0.002. In percentage terms, it comes to 1.68%.

For Central province, PBT estimates under-two mortality as being 21 deaths per 1000 while Coale-Trussell estimates it as 36 per 1000. This shows PBT under estimates q (2) by 41.7%. This result may be due to the reliance of the Coale-Trussell method on children ever born data, which suffers from errors of omission, non response or age misreporting thereby affecting the quality of data. The sample size could also lead to the huge differences in the results obtained.

Coast province gives an estimation of 81 per 1000 for PBT and by Coale-Trussell it is 107 per 1000. Here PBT estimation of under-two mortality is less by 24%. In Eastern province, using PBT, under-two mortality comes to 63/1000 while when using the Coale-Trussell method it comes to 77/1000, giving a difference of 18%.

Differences in mortality at 24 months of age estimates obtained from PBT and Coale-Trussell in Nyanza province and Rift Valley province come to 8 percent and 10% respectively.

For Western province, the over estimation by PBT in percentage terms is 32%, since PBT estimates under-two mortality as being 111/1000 while Coale-Trussell estimates it as being 84/1000. Here again the difference is very marked and may also be attributed to errors experienced when using children ever born data. There may be inclusion of still births among live born children thus exaggerating the levels of mortality. This is especially so when the PBT method is applied.

Differentials by type of residence for urban areas, PBT estimates under-two mortality as being 84/1000 while Coale-Trussell estimates it as being 104/1000. This in percentage terms gives an under estimation of 19%. As far as rural areas are concerned, PBT estimates under-two mortality as being 98/1000 while Coale-Trussell estimates it as being 92/1000. This gives an over estimation of 6.5% by PBT over Coale -Trussell method.

In general, the regional level estimates obtained using the two methods are only comparable for Nairobi and Nyanza provinces. Estimates obtained for rural residence were also close.

4.2.2 Comparisons of estimates by socio-economic attributes

Childhood mortality was also estimated in terms of mothers' level of education where differences were also observed. Mothers with no education were estimated to experience under-two mortality of 121/1000 using the PBT method for the period recorded while when using the Coale-Trussell method, under-two mortality was estimated at 70/1000. This clearly gives a massive over estimation of 72.9% by PBT. The level of education of the mother clearly affects the estimates obtained. Worth noting is the fact that women with no education tend to give birth early in life. Together with this is the reasoning that estimates of childhood mortality derived from mothers aged 15-19 and 20 -24 age groups experience higher than average mortality risks. Errors of omission and the inclusion of still births among live born children may also lead to the huge differences observed.

Women who were recorded to have primary education experienced under-two mortality of 103/1000 when estimation was done using the PBT method and 106/1000 when using the Coale-Trussell method. This in percentage terms shows an under estimation of 2.8% by the PBT method over the Coale-Trussell method. Under-two mortality for women with secondary plus education was estimated at 63/1000 when using the PBT method and 65/1000 when using the Coale-Trussell method. This gives an under estimation of 3% by PBT.

When differentials were looked at according to current work status, women who were found not to be working by the time of the KDHS had their under-two mortality estimated at 88/1000 by the PBT method while it was found to be 86/1000 when the Coale-Trussell method was applied. This gave an over estimation of only 2% by PBT over Coale-Trussell method. For women who were found to be working, under-two mortality was estimated at 103/1000 when using the PBT method and at 96/1000 when using the Coale-Trussell method. This gives an over estimation of 7% by the PBT method over the Coal-Trussell method. In general, the estimates obtained using the two methods are fairly comparable for all the socio-economic attributes studied except for no education category

4.3 A comparison of q(2) estimates from PBT and direct life table methods

Table 4.2 gives the results of the two methods used to arrive at estimates of under-two mortality. The overall figures for PBT is 0.096 while that of the life table method is 0.083, giving an upward bias by PBT of 16.5 percent. This implies that the estimates obtained from the two methods are not comparable using the ten percentage cut off.

Table 4.2: Estimates of q(2) values obtained from PBT and the direct life table methods

Variables	PBT	Life Table	Difference	% Difference	Birth Interval
All Cases	0.096	0.083	0.014	16.53	32
Provinces					
Nairobi	0.121	0.038	0.083	218.16	37
Central	0.021	0.030	-0.009	-30.59	36
Coast	0.081	0.074	0.006	8.31	33
Eastern	0.064	0.063	0.001	1.28	35
Nyanza	0.202	0.180	0.022	12.39	32
Rift Valley	0.066	0.059	0.008	12.97	31
Type of Residence					
Urban	0.084	0.074	0.010	12.94	33
Rural	0.098	0.084	0.014	16.92	32
Education					
No education	0.121	0.097	0.024	25.03	35
Primary education	0.103	0.090	0.012	13.62	32
Secondary +	0.063	0.055	0.009	15.54	33
Current Work Status					
Currently Not Working	0.088	0.073	0.014	19.35	33
Currently Working	0.103	0.091	0.012	13.7	32

province with 21/1000. The same provinces show the highest and lowest estimates when using the direct life table method, with Nyanza province giving an estimate of 180/1000 while Central province gives an estimate of 30/1000. Regional differences in access and utilization of health service, level of social and economic development, nutritional status and ecological conditions have been mentioned in the past as possible explanations for these varied estimates.

Of interest to note is the gross over exaggeration in under-two mortality when the PBT method is used for Nairobi province. In fact, the estimates from this method give q(2) as 120/1000 while when the direct life table method is used, the estimate is 38 deaths per 1000 live births. This gives an over estimation of more than 200 percent, making the comparison unrealistic. This may be attributed to the significant difference in the birth interval for women in Nairobi. The birth interval significantly deviates from the 30months which is suggested by proponents of the PBT method.

For Western province, the over estimation by PBT stands at 51 percent, also giving an unrealistic comparison. The magnitude of the percent difference is probably related to the age distribution of deaths. Virtually all deaths of next to last births here occur at ages prior to 12 months so that mortality is virtually constant at ages surrounding 24 months and at times at ages equal to the mean birth interval.

Central province gives an under estimation of under two mortality by PBT of 31 percent. This bias by PBT can be attributed to possible omissions of births ending in premature death of the child. For the other provinces, the over estimation ranges between 13 percent for Rift Valley province and one percent for Eastern province.

Easier access to medical care is one of the reasons why infant and child mortality is lower in urban areas than in rural areas. Medical facilities, supplies and personnel are concentrated in the cities at the expense of the rural areas. As evident in type of residence, q(2) for children born in rural areas is higher than that of children born in urban areas. Comparison of PBT and the direct life table method gives a percentage difference of 13 percent for urban areas and 17 percent for rural areas. In conclusion, the estimates obtained from the two methods are not comparable for all regional attributes examined except for Coast and Eastern provinces.

4.2.2 Comparisons of estimates by socio-economic attributes

Mothers with secondary plus education experience fewer q(2) as compared to those with primary and no education backgrounds. This clearly shows the powerful effect of maternal education on child survival, which has been observed for many developing countries (Bicego and Boerma, 1993; Caldwell and MacDonald 1982). Formal education of mothers is critically important to the promotion of child health and disease prevention, so are health programmes that strengthen the capacity of mothers by providing them and their families with information, skills, resources and technologies to promote child health for improvement in survival (Hill and Mosley, 1989).

The overestimation of q(2) by n over the life table method is greatest for women with no education while for women with primary and secondary + education, the overestimation is 13.6 and 15.5 percent respectively. This can be explained by the relatively higher mortality rates by children born to mothers with no education. Here there is the possibility of the inclusion of still births into statistics of live births thereby affecting the estimates by n. Attention is also drawn to the significance difference from 30 months of the birth interval for the mothers with no education, which could explain the disparity.

When the current working status of the mothers is considered, the q(2) for children born to mothers who are currently working is higher than that of children born to mothers who are currently not working in both methods of estimation used. Comparisons of these methods give higher over estimation for children born to currently not working mothers; a percentage difference of 19 percent while for those not currently working is 14 percent. Similarly, the conclusion is that the two methods yield non comparable results for the socio-economic attributes examined

4.3.3 Comparisons of estimates by demographic factors

When under-two mortality is examined in terms of maternal ages, for both methods used, children born to mothers of less than 20 years experience the highest mortality, followed by children born to mothers between 40 and 49 years. Those born to mothers of the ages 20 -29 years experience the lowest under-two mortality. When the estimates of both the methods are compared, the highest over estimation of 56 percent is seen in the case of children born to mothers of less than 20 years while the lowest percentage difference is seen for children born to mothers of ages between 40 and 49 years. In fact the percentage difference is less than one percent.

As earlier noted, estimates derived from mothers of less than 20 years are always out of line because children born by younger mothers are generally subject to unusually high mortality risks. Another fact is that the number of children born and those who die are usually small in this age group. Again these deaths usually occur prior to 12 months of age and thereafter are generally stable. These mothers also suffer higher maternal mortality than their counterparts due to their age and the birth interval of 23 months is significantly lower than the 30 months proposed.

Differentials in child survival prospects by birth order and birth intervals is based on what Potter (1988) named simple physiological mechanisms, that is, age and parity are supposed to be related systematically for fitness to reproduce and birth intervals influence child survival in part through their effects on mothers nutritional status. When q(2) in both II and life table are viewed in terms of the child's birth order, both methods show highest q(2) to children of birth order 7+ while the lowest for children of birth order 2 - 3 . However when comparisons are made between the two methods, the highest over estimation by PBT over the life table method is witnessed in children of birth order 4 - 6 (39 percent) while lowest to children of birth order 2- 3 (7 percent). Differences here appear to correspond with mean birth intervals significantly greater than 30 months as well as with relatively high overall levels of mortality.

Another attribute considered here is the sex of the child. q(2) in both n and the life table method, male children experience higher under-two mortality than their female counter parts. When the two estimation methods are compared, q(2) for male children exudes higher over estimation, that is, 25 percent while for the female children the over estimation is only 7 percent. To note, the marked difference is most probably related to the higher mortality rates experienced for the male child as compared to his female counterpart. These deaths also happen earlier in life than the estimated 24 months. The study results indicate that the estimates from the two methods are only comparable for higher birth orders, that is, 30 years and above, birth order 2-3 and for females.

4.3.4 Comparisons of estimates by socio-cultural factors

Seven major ethnic groups were considered in this category. Estimates for the Masai, Meru/Embu, Somali and Taita were left out. This is because of the small sample sizes in this groups which would have made comparisons generally meaningless.

When q(2) is examined in ethnicity, varied results are obtained. Under-two mortality for the Luos is highest in both Ft and life table estimates while the Kikuyu experience the lowest. Over all, when comparisons are made in both methods in the estimation of q(2), the highest over estimations are seen for both Kisii and Luhya communities, that is, 60 and 53 percent respectively while the lowest is seen among the Luos, a difference of only one percent. The same argument for the larger differences in the methods is related to the distribution of deaths in these particular communities. Most of the childhood deaths occur before age 12 months and therefore more stability is seen at ages surrounding 24 months.

When the religious background of the mother is viewed, differences are seen in both II and the life table methods. The n estimates of q(2) are generally higher than those of the life table method. The PBT method shows the Catholics as having the highest estimate of 101/1000. The lower under-two mortality here is seen as being that of children whose mothers include protestants and other Christian denominations.. The estimate is at 95 deaths per 1000 live births.

When using the life table method, the highest q(2) is for children born to Muslim, giving estimates of 87/1000 while the lowest is for children born to Catholic mothers. Marked difference is seen for the Catholic, with a percent difference of 30 percent. This may be explained in relation to the deaths occurring before the age of 12 months and probably due to the reporting errors. Estimates for other religions were left out due to the small sample sizes involved. The estimates would not give meaningful comparisons due to the unstable results obtained. In conclusion, the results fro these two methods only yield comparable estimates for the Luo ethnic community

4.4 Overall assessment of the suitability of PBT in estimation of q(2).

One thing to note is that both PBT and the Coale-Trussell method are indirect methods of estimating mortality. One fact that comes up as noted earlier is that some assumptions have been made in the Coale-Trussell method. An important assumption made in the Brass method from which the Coale-Trussell is derived is that the risk of dying is a function only of the age of the child and not of other factors such as mother's age or the child's birth order.

The Coale-Trussell method depends on children ever born data. This kind of data has errors associated with it like omission of births. Women tend to omit their live born children, especially if they are not living with them, still births or if they died earlier in life. Some may even view it as taboo to even speak of such children. The proportions omitted here tend to increase with the age of the mother.

Coale-Trussell method of estimating childhood mortality would work best in situations where large data is being processed like in a census. Using this method on a household survey like the DHS has resulted in very unstable results of the q(1), q(2) and q(3); this is especially so when the samples are further segmented. On the overall, results from the PBT and Coale-Trussell are fairly comparable. As earlier pointed out, these two are indirect methods based on stable population model.

When the q(2) estimates for the two methods used to compare with those derived from PBT, different results are obtained. One thing that comes out clearly is that when another indirect method, notably the Coale-Trussell method, is compared with the PBT, estimates of PBT tend to underestimate q(2). However, this is not the case when PBT is compared to the direct life table method. Of the comparisons by attributes, more than 90 percent are positive thus giving a definite upward bias of PBT when comparisons are made with the direct life table. As rightly noted by Li (1992), these findings contradict much of existing literature which tend to discount these differences as negligible.

There is no comparability in results obtained using PBT and direct life table method. This could be attributed to the use of incomplete use of birth histories in PBT and complete use of birth history data in life table method.

Since PBT yield comparable estimates with Coale-Trussell and considering the fact that PBT estimates are easier to compute, use of PBT in computing q(2) estimates derived from household survey data would be suitable especially for non demographers and when no facility data is readily available. It is important to also note that whereas the terms over estimation and under estimation are used when comparing PBT to the other two methods; namely Coale-Trussell technique and the direct life table technique, none of the methods are perfect.

CHAPTER FIVE

SUMMARY OF RESULTS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the results

The general objective of this study was to apply the preceding birth technique to 1998 Kenya Demographic and Health Survey Data to estimate childhood mortality. Among the specific objectives were to estimate child mortality from this data set using PBT, Coale-Trussell and direct life table method. This was done for the whole country and further by different child and maternal attributes. Estimations were also done for the seven provinces of Kenya separately and for the major ethnic communities.

Theoretically children who have been born to mothers with no education, women less than twenty years old experience higher mortality as compared to their counterparts. This trend follows with the PBT and life table estimates. Children born in Nyanza, those of birth order seven and above, currently working mothers and male gender have the highest mortality levels in those categories.

In terms of ethnicity again the Luo lead with the highest under two mortality levels. When estimates were obtained by religious background of the mother, variation was limited but the Catholic had the highest under two mortality estimates in PBT method. Children born to the Muslim mothers experienced the highest mortality according to the life table estimates. For Coale-Trussell method, the highest childhood mortality estimates were observed for Nyanza Province, urban residence, mothers with primary education and currently working mothers.

The second objective was to compare the results obtained from PBT and Coale-Trussell methods. Comparisons between the two methods, using the ten percentage cut off rule at the national level implied that they were highly comparable. At the regional level, estimates were close for only Nairobi and Nyanza provinces and for rural residence. Estimates obtained were fairly comparable for all socio-economic attributes studied except for no education category.

The third objective was to compare the results obtained from PBT and direct life table methods. Here estimates obtained showed comparability could not be achieved at the national level. The estimates were also not close at the regional level except for Coast and Eastern provinces. For the socio-economic attributes studied, the results were not comparable and it is only when the demographic factors were considered that estimates were fairly close for maternal ages higher than 30 years, birth order of 2-3 and for female gender. In terms of socio-cultural factors, comparable estimates were only obtained for the Luo ethnic community.

The fourth objective was to assess the suitability of PBT in estimation of childhood mortality in Kenya using 1998 KDHS data. The last objective was to compare the results obtained from PBT with those got from the direct life table method. Difference between II and the life table estimates were obtained and percentage differences calculated. From the onset, II appears to exceed systematically the life table estimate of probability of dying at 24 months of age. There were particularly instances when the percentage differences were quite high like the case of Nairobi province where the estimates isolated the assumptions. Its mean birth interval was actually found to quite different from the one proposed by Brass and Macrae; the proponents of the PBT method.

Other than that, there is no comparability in results obtained using PBT and the life table methods. This was attributed to the use of incomplete birth histories in PBT and complete use of birth history data in the life table method.

5.2 Conclusions

In the categories that were studied when estimating under-two mortality using both the PBT and Coale-Trussell method, we realized both under estimation and over estimation by PBT over Coale-Trussell method. Overall results showed fairly comparable results between these two methods; a fact that was attributed to both methods being indirect methods based on stable population model.

When we look at the PBT method, the case of twins in the reference period was not included in the calculations. This may have led to some of the variations realized. However, it is worth noting that even with the inclusion of the twins to the calculations, the bias does not amount to more than 5 percent.

When the estimates from PBT are compared against those from the direct life table technique, one thing that is clear is that q(2) estimates from II tend to be higher than those obtained from the direct life table method. The percentage differences, in most cases, tend to be more than 10 percent but less than 30 percent.

We cannot predict how well PBT will work but as Li (1992) rightly suggests it would be reasonable to assume that II will be most reliable if certain conditions were satisfied, that medical assistance at delivery is generally available. This is important when hospital data is being used to arrive at the estimates.

Another condition that would make the technique more appropriate is if the changes in fertility and mortality occur slowly in the population being studied. A condition put across that may have led to some of the large differences observed was that estimates should be based on sufficiently large sample sizes especially in respect to the next to last births. This explains why despite the mean birth interval for certain categories almost tallying with the recommended months, huge differences were observed. This is especially so for Western province, the Kisii and the Luhya communities.

As one of the conditions laid for PBT estimates to make any sense, age distribution at death should be such that a substantial portion of deaths among next to last births occur prior to 24 months of age. This could have been used to explain the differences in n and the life table technique where n under estimated probability of dying at 24 months of age by 31 percent. Finally, data collection should be characterized by minimal omission and misreporting. This fact affected the PBT estimates since it assumed the effect of maternal mortality on childhood estimates. In this period, Kenya had a maternal mortality rate of 590 maternal deaths per 100,000 live births; this fact cannot be ignored when explaining some of the marked differences between the life table and the PBT method.

Some authors have suggested that the proportion of deceased preceding should not be considered a q(2) particularly if the length of the birth interval is unknown but instead should be regarded as a mortality index since the purpose is not necessarily to reach a conventional measurement of infant mortality but rather to follow its course over time (Aguirreand Hill, 1988).

Since PBT yield comparable estimates with Coale-Trussell and considering the fact that PBT estimates are easier to compute, use of PBT in computing q(2) estimates derived from household survey data would be suitable especially for non demographers and when no facility data is readily available.

5.3 Recommendations

5.3.1 Recommendations for the researchers

In methods that rely on demographic surveys as a vehicle for implementation, the PBT offers the potential for analysts to monitor mortality recurrently in a simple and economical way. As noted by Li (1992), PBT has been discussed primarily as a method of estimating mortality using clinic records for a small region. The ideal way to evaluate it is to use it in multiple clinic settings and compare computations of n with life table estimates of child mortality by 24 months of age obtained from reliable census, vital registration or survey data for the areas covered by the clinics. Since n would be compared to other estimates obtained from other reliable data sources, this type of comparison would test its validity.

Many previous examinations of the method's performance simply compared the mortality estimate on the PBT with the life table estimate of probability of dying at 24 months of age based on the same births. Examination of the underlying assumption that II approximates probability of dying at 24 months of age is an important first step in the assessment of the PBT method. The results of various applications of the technique in Latin America and South Asia have shown that the interval is usually closer to three years. It could be that the preceding birth technique is a better estimator of under three mortality in Kenya and not necessarily under two mortality as seen in the case of Bangladesh, (Bairagi et al, 1997).

Comparisons of mortality estimates derived from different methods but based on the same data source and the same births cannot provide an indication of the reasonableness of n as a measure of mortality conditions faced by all births in a population for a given time period because it fails to account for selection biases. When choosing a health centre for a study, great care should be taken so that the latter caters for a representative sector of the population.

Alternatively, since a large proportion of mothers visit clinics and hospitals for vaccination of their newborn, data for PBT can be obtained at such times. There is need for the studies to be carried out in Kenya in different representative hospital and clinic settings so as to find out the kind of estimates that can be derived.

5.3.2 Recommendations for the policy makers

The PBT method may prove useful for public health administrators in the formulation of sensible policies aimed at altering conditions found to be associated with lower child survival. The technique should be used to identify problem areas for special focus. It can be used to monitor impact of primary health care programmes in the catchment area of health facilities.

The technique can also be used to enable individual patient management and further follow-up of high risk mothers. It can also allow investigation of adverse outcomes and make it possible for clinic staff to evaluate their services. This would increase community awareness, making it possible for District health committees and organizations to set priorities for community health services. The technique can be used well alongside other techniques for estimating child mortality and give possible causes of death in a given catchment area.

Adoption of the technique in a particular country or setting will obviously depend largely on the alternatives available and the purpose for which II will be used. For example more accurate estimates may be required if the purpose is to evaluate the impact of a health intervention. Less precise estimates may be sufficient if the purpose is to provide some idea of the mortality level of one population group relative to another.

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APPENDICES

Appendix A

Table A1: Coefficients for estimation of child mortality multipliers, Trussell variant: north model

		Coefficients		
Age Group	**Index (i)**	**a(i)**	**b(i)**	**c(i)**
15-19	1	1.1119	-2.9287	0.8507
20-24	2	1.2390	-0.6865	-0.2745
25-29	3	1.1884	0.0421	-0.5156
30-34	4	1.2046	0.3037	-0.5656
35-39	5	1.2586	0.4236	-0.5898
40-44	6	1.2240	0.4222	-0.5456
45-49	7	1.1772	0.3486	-0.4624

Table A2: Child mortality estimated from proportions dead of next to last births by maternal age

Years	Number Born	Number dead	Props Dead
< 20	60	12	0.2
20 - 29	1433	123	0.085834
30 - 39	1107	110	0.099368
40 - 49	271	31	0.114391
Total	2871	276	0.096134

The table A2 gives the proportions dead of the next to last birth, that is, n. It is arrived at by dividing the number of next to last births that are dead to the total number that was born, that is,

Number dead / Number born = Proportions dead

For example: 12 / 60 = 0.2

Table A7: Coale-Trussell child mortality estimates: Coast Province

X	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	1852	402	51	0.217063	0.126866	1.009495	0.128071
2	2	1542	1965	187	1.274319	0.095165	0.994137	0.094607
3	3	1344	3675	351	2.734375	0.09551	0.955282	0.091239
5	4	977	4041	435	4.136131	0.107647	0.992741	0.106866

The table A3 describes how to obtain q(x) values. Column 1 stands for the exact childhood ages x =1, 2, 3 and 4 while column two stands for the age groups i = 1, 2, 3, 4 that is age groups 15-19, 20-24, 25-29, 30-34. Column three gives the data for the female population (FPOP). Column four stands for the children ever born (CEB) while column five stands for children dead (CD). The values of P(i) are in column six. It is worked out in the following way:

P(i) = CEB / FPOP
P(1) = 402/ 1852
= 0.217063

This means that P(1) is the value of the proportion of children ever born to women in the age group 15-19 divided by the total female population in this age group.

To obtain the proportions dead D(i), we divide CD in column five by the corresponding CEB in column four therefore:

D(i) = CD(i) / CEB(i)
D(1) = 51 / 402
0.126866

P(1)/P(2) = 0.170336
P(2) / P(3) = 0.466037

P(2) is the value of the proportion of children ever bom to women in the age group 20-24 divided by the total female population in this age group.

$P(3)$ is the value of the proportion of children ever born to women in the age group 25-29 divided by the total female population in this age group.

The eighth column represents the multiplier $k(i)$, which is meant to adjust for the non-mortality factors determining the value of $D(i)$. The multipliers $k(i)$ required to adjust the reported proportion dead $D(i)$ for the effects of the age pattern of child bearing are calculated from the ratios $P(1) / P(2)$ and $P(2) / P(3)$ by using the equation:

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

Where $a(i)$, $b(i)$ and $c(i)$ are from table 4.1, for example;

$k(1) = a(1) + b(1)\ P(1) / P(2) + c(1)\ P(2) / P(3)$

$= 1.1119 + -2.9287(0.170336) + 0.8507(0.466037)$

$= 1.1119 + -0.498863 + 0.396458$

$= 1.009495$

$q(x)$ values are obtained from the formula:

$q(x) = k(i)\ D(i)$ for example

$q(1) = k(1) D(1)$

$= 1.009495 * 0.126866$

$= 0.128071$

From tables' A2 and A3, we are able to come up with the $q(2)$ values when we use n and when we use the Coale-Trussell method, n gives the value 0.085834 while the Coale-Trussell (CT) method gives the value of 0.094607. To get the percent difference:

$n - (CT)/(CT) * 100 =$ percent difference

In summary, for the birth history, we found that:

$CT = 0.094607$

$n = 0.085834$

Percent difference:

$0.085834-0.094607/0.085834 * 100= -10.2\%$

Table A19: Child mortality estimated from proportions dead of next to last births by mother's current working status

Provinces	Number Born	Number Dead	Props dead
Nairobi	91	11	0.120879
Central	237	5	0.021097
Coast	421	34	0.080760
Eastern	394	25	0.063452
Nyanza	514	104	0.202335
Rift Valley	846	56	0.066194
Western	368	41	0.111413

Table A5: Coale-Trussell child mortality estimates: Nairobi Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	98	10	0	0.102041	0	1.188692	0
2	2	99	86	10	0.868687	0.116279	1.022573	0.118904
3	3	82	144	9	1.756098	0.0625	0.938294	0.058643
5	4	54	125	7	2.314815	0.056	0.960489	0.053787

Table A6: Coale-Trussell child mortality estimates: Central Province

x	1	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	144	24	0	0.166667	0	1.086154	0
2	2	159	163	6	1.025157	0.036809	0.982059	0.036149
3	3	157	304	7	1.936306	0.023026	0.922266	0.021236
5	4	115	377	18	3.278261	0.047745	0.954524	0.045574

Table A7: Coale-Trussell child mortality estimates: Coast Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	264	74	11	0.280303	0.148649	0.798692	0.118725
2	2	256	297	29	1.160156	0.097643	1.095154	0.106934
3	3	203	508	41	2.502463	0.080709	0.959536	0.077443
5	4	147	512	44	3.482993	0.085938	1.015761	0.087292

Table A8: Coale-Trussell child mortality estimates: Eastern Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	299	43	3	0.143813	0.069767	1.148322	0.080115
2	2	224	268	20	1.196429	0.074627	1.031136	0.076951
3	3	179	469	38	2.620112	0.081023	0.958021	0.077622
5	4	134	536	40	4.000000	0.074627	0.982834	0.073346

Table A9: Coale-Trussell child mortality estimates: Nyanza Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	370	88	24	0.237838	0.272727	1.036038	0.282555
2	2	250	370	69	1.48	0.186486	1.001292	0.186727
3	3	222	708	131	3.189189	0.185028	0.955892	0.176867
5	4	149	746	148	5.006711	0.198391	0.990928	0.196591

Table A10: Coale-Trussell child mortality estimates: Rift Valley Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	450	119	4	0.264444	0.033613	0.938739	0.031554
2	2	387	541	33	1.397933	0.060998	0.986244	0.060159
3	3	351	1096	73	3.122507	0.066606	0.965532	0.064310
5	4	275	1253	113	4.556364	0.090184	1.008833	0.090981

Table A11: Coale-Trussell child mortality estimates: Western Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	227	44	9	0.193833	0.204545	1.128067	0.230741
2	2	167	240	20	1.437126	0.083333	1.013732	0.084477
3	3	150	446	52	2.973333	0.116592	0.944869	0.110164
5	4	103	492	65	4.776699	0.132114	0.972186	0.128439

Table A12: Child mortality estimated from proportions dead of next to last births by type of residence

Type of residence	Number Born	Number dead	Props Dead
Urban	394	33	0.083756
Rural	2477	243	0.098103

Table A7: Coale-Trussell child mortality estimates: Coast Province

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	312	61	8	0.195513	0.131148	0.990224	0.129866
2	2	363	373	40	1.027548	0.107239	0.967831	0.103789
3	3	291	584	44	2.006873	0.075342	0.932416	0.070250
5	4	194	547	34	2.819588	0.063985	0.972790	0.062244

Table A14: Coale-Trussell child mortality estimates: Rural

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	1540	341	43	0.221429	0.126099	1.022959	0.128994
2	2	1179	1592	147	1.350297	0.092337	1.000154	0.092351
3	3	1053	3091	307	2.935423	0.099321	0.958127	0.095162
5	4	783	3494	400	4.462324	0.114482	0.994226	0.113821

Table A15: Child mortality estimated from proportions dead of next to last births by education of the mother

Education	Number Born	Number Dead	Props Dead
No Education	412	50	0.121359
Primary Education	1794	184	0.102564
Secondary +	665	42	0.063158

Table A7 : Coale-Trussell child mortality estimates: Coast Province

X	1	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	62	34	5	0.548387	0.147059	0.651957	0.095876
2	2	79	139	11	1.759494	0.079137	0.878912	0.069554
3	3	95	314	33	3.305263	0.105096	0.927052	0.097429
5	4	102	524	90	5.137255	0.171756	0.998169	0.171441

Table A17: Coale-Trussell child mortality estimates: Primary education

X	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	1377	326	44	0.236747	0.134969	1.078799	0.145604
2	2	916	1409	150	1.538209	0.106458	0.998572	0.106306
3	3	789	2472	264	3.133079	0.106796	0.941742	0.100574
5	4	555	2497	277	4.49909	0.110933	0.100574	0.973657

Table A18: Coale-Trussell child mortality estimates: Secondary + education

X	1	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	413	42	2	0.101695	0.047619	1.056783	0.050323
2	2	547	417	26	0.762340	0.062350	1.039142	0.064790
3	3	460	889	54	1.932609	0.060742	0.990631	0.060173
5	4	320	1020	68	3.1875	0.066667	1.022006	0.068134

Table A19: Child mortality estimated from proportions dead of next to last births by mother's current working status

Work Status	Number Born	Number Dead	Props Dead
Not Working	**1244**	**109**	**0.087621**
Working	**1623**	**167**	**0.102896**

Table A20: Coale-Trussell child mortality estimates: Respondent currently not working

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	1462	253	26	0.173051	0.102767	1.036634	0.106532
2	2	817	954	80	1.167687	0.083857	1.021497	0.085659
3	3	558	1545	139	2.768817	0.089968	0.977196	0.087916
5	4	364	1547	146	4.25	0.094376	1.011079	0.095422

Table A21: Coale-Trussell child mortality estimates: Respondent currently working

x	i	FPOP	CEB	CD	P(i) CEB/FPOP	D(i) CD/CEB	k(i)	q(x)
1	1	387	148	25	0.382429	0.168919	0.746597	0.126114
2	2	725	1011	107	1.394483	0.105836	0.909439	0.096251
3	3	784	2124	212	2.709184	0.099811	0.934554	0.093279
5	4	611	2485	287	4.067103	0.115493	0.996760	0.115119

Appendix B

Table Bl: Child mortality estimated from proportions dead of next to last births by child's birth order

Birth Order	Number Born	Number Dead	Proportion dead
2 - 3	1686	132	0.078292
4 - 6	796	94	0.118090
7 +	389	50	0.128535

Table B2: Child mortality estimated from proportions dead of next to last births by sex of the child

Sex	Number Born	Number Dead	Proportion Dead
Male	1463	155	0.105947
Female	1408	121	0.085938

Table B3: Child mortality estimated from proportions dead of next to last births by mother's religion

Religion	Number Born	Number Dead	Proportion Dead
Catholic	770	78	0.101299
Protestant/Other Xt	1835	174	0.094823
Muslim	152	15	0.098684

Table B4: **Child mortality estimated from proportions dead of next to last births by ethnicity**

Ethnicity	Number Born	Number Dead	Proportions Dead
Kalenjin	573	34	0.059337
Kamba	285	26	0.091228
Kikuyu	377	14	0.037135
Kisii	216	20	0.092593
Luhya	444	54	0.121622
Luo	373	85	0.227882

Table B5: **Life table for children born to women with no education in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	690	690	54	0.0783	0.9217	0.9217
12	636	636	11	0.0173	0.9827	0.9058
24	625	625	2	0.0032	0.9968	0.9029
36	623	623	3	0.0048	0.9952	0.8986

Table B6: **Life table for children born to women with primary education in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	**3610**	**3610**	**262**	**0.0726**	**0.9274**	**0.9274**
12	**3348**	**3348**	**53**	**0.0158**	**0.9842**	**0.9127**
24	**3295**	**3295**	**11**	**0.0033**	**0.9967**	**0.9097**
36	**3284**	**3284**	**7**	**0.0021**	**0.9979**	**0.9078**

Table B7: **Life table for children born to women with secondary + education in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	**1372**	**1372**	**63**	**0.0459**	**0.9541**	**0.9541**
12	**1309**	**1309**	**10**	**0.0076**	**0.9924**	**0.9468**
24	**1299**	**1299**	**2**	**0.0015**	**0.9985**	**0.9453**
36	**1297**	**1297**	**1**	**0.0008**	**0.9992**	**0.9446**

Table B6: Life table for children born to women with primary education in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	184	184	6	0.0326	0.9674	0.9674
12	178	178	1	0.0056	0.9944	0.9620
24	177	177	0	0.0000	1.0000	0.9620
36	177	177	1	0.0056	0.9944	0.9565

Table B9: Life table for children born to women in Central Province in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	460	460	14	0.0304	0.9696	0.9696
12	446	446	0	0.0000	1.0000	0.9696
24	446	446	0	0.0000	1.0000	0.9696
36	446	446	0	0.0000	1.0000	0.9696

Table B6: Life table for children born to women with primary education in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	831	831	50	0.0602	0.9398	0.9398
12	781	781	10	0.0128	0.9872	0.9278
24	771	771	2	0.0026	0.9974	0.9254
36	769	769	2	0.0026	0.9974	0.9230

Table B11: Life table for children born to women in Eastern Province in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	766	766	43	0.0561	0.9439	0.9439
12	723	723	4	0.0055	0.9945	0.9386
24	719	719	1	0.0014	0.9986	0.9373
36	718	718	0	0.0000	1.0000	0.9373

Table B 6 : Life table for children born to women with primary education in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1022	1022	144	0.1409	0.8591	0.8591
12	878	878	34	0.0387	0.9613	0.8258
24	844	844	6	0.0071	0.9929	0.8200
36	838	838	3	0.0036	0.9964	0.8170

Table B13: Life table for children born to women in the Rift Valley Province in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1637	1637	82	0.0501	0.9499	0.9499
12	1555	1555	12	0.0077	0.9923	0.9426
24	1543	1543	2	0.0013	0.9987	0.9414
36	1541	1541	2	0.0013	0.9987	0.9401

Table B14: Life table for children born to women in Western Province in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	772	772	40	0.0518	0.9482	0.9482
12	732	732	13	0.0178	0.9822	0.9313
24	719	719	4	0.0056	0.9944	0.9262
36	715	715	3	0.0042	0.9958	0.9223

Table B15: Life table for children born to women < 20years in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	391	391	41	0.1049	0.8951	0.8951
12	350	350	9	0.0257	0.9743	0.8721
24	341	341	0	0.0000	1.0000	0.8721
36	341	341	1	0.0029	0.9971	0.8696

Table B 6 : Life table for children born to women with primary education in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	3153	3153	174	0.0552	0.9448	0.9448
12	2979	2979	33	0.0111	0.9889	0.9343
24	2946	2946	7	0.0024	0.9976	0.9321
36	2939	2939	5	0.0017	0.9983	0.9305

Table B17: Life table for children born to women of ages 30 - 39years in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1769	1769	135	0.0763	0.9237	0.9237
12	1634	1634	24	0.0147	0.9853	0.9101
24	1610	1610	4	0.0025	0.9975	0.9079
36	1606	1606	5	0.0031	0.9969	0.9050

Table B6: Life table for children born to women with primary education in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	359	359	29	0.0808	0.9192	0.9192
12	330	330	8	0.0242	0.9758	0.8969
24	322	322	4	0.0124	0.9876	0.8858
36	318	318	0	0.0000	1.0000	0.8858

Table B19: Life table for children of birth order 2 - 3 in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	3285	3285	195	0.0594	0.9406	0.9406
12	3090	3090	37	0.0120	0.9880	0.9294
24	3053	3053	8	0.0026	0.9974	0.9269
36	3045	3045	5	0.0016	0.9984	0.9254

Table B34: Life table for children born to Muslim women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1554	1554	107	0.0689	0.9311	0.9311
12	1447	1447	23	0.0159	0.9841	0.9163
24	1424	1424	2	0.0014	0.9986	0.9151
36	1422	1422	6	0.0042	0.9958	0.9112

Table B21: Life table for children of birth order 7+ in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	833	833	77	0.0924	0.9076	0.9076
12	756	756	14	0.0185	0.9815	0.8908
24	742	742	5	0.0067	0.9933	0.8848
36	737	737	0	0.0000	1.0000	0.8848

Table B22: **Life table for male children born in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	2870	2870	202	0.0704	0.9296	0.9296
12	2668	2668	31	0.0116	0.9884	0.9188
24	2637	2637	10	0.0038	0.9962	0.9153
36	2627	2627	5	0.0019	0.9981	0.9136

Table B23: **Life table for female children born in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	2802	2802	177	0.0632	0.9368	0.9368
12	2625	2625	43	0.0164	0.9836	0.9215
24	2582	2582	5	0.0019	0.9981	0.9197
36	2577	2577	6	0.0023	0.9977	0.9176

Table B28: Life table for children born to Kikuyu women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	*809*	*809*	8	0.0593	*0.9407*	0.9407
12	761	761	11	0.0145	0.9855	0.9271
24	750	750	1	0.0013	0.9987	0.9258
36	749	749	2	0.0027	0.9973	0.9234

Table B25: Life table for children born in the rural areas in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	4863	4863	331	0.0681	0.9319	0.9319
12	4532	4532	63	0.0139	0.9861	0.9190
24	4469	4469	14	0.0031	0.9969	0.9161
36	4455	4455	9	0.0020	0.9980	0.9143

Table B26: Life table for children born to kalenjin women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1123	1123	55	0.0490	0.9510	0.9510
12	1068	1068	5	0.0047	0.9953	0.9466
24	1063	1063	0	0.0000	1.0000	0.9466
36	1063	1063	1	0.0009	0.9991	0.9457

Table B27: Life table for children born to Kamba women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	586	586	40	0.0683	0.9317	0.9317
12	546	546	6	0.0110	0.9890	0.9215
24	540	540	1	0.0019	0.9981	0.9198
36	539	539	0	0.0000	1.0000	0.9198

Table B28: **Life table for children born to Kikuyu women in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	733	733	20	0.0273	0.9727	0.9727
12	713	713	1	0.0014	0.9986	0.9714
24	712	712	1	0.0014	0.9986	0.9700
36	711	711	0	0.0000	1.0000	0.9700

Table B29: **Life table for children born to Kisii women in the preceding five years to the survey**

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	397	397	15	0.0378	0.9622	0.9622
12	382	382	7	0.0183	0.9817	0.9446
24	375	375	1	0.0027	0.9973	0.9421
36	374	374	2	0.0053	0.9947	0.9370

Table B34: Life table for children born to Muslim women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	906	906	52	0.0574	0.9426	0.9426
12	854	854	16	0.0187	0.9813	0.9249
24	838	838	4	0.0048	0.9952	0.9205
36	834	834	3	0.0036	0.9964	0.9172

Table B31: Life table for children born to Luo women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	782	782	143	0.1829	0.8171	0.8171
12	639	639	28	0.0438	0.9562	0.7813
24	611	611	5	0.0082	0.9918	0.7749
36	606	606	3	0.0050	0.9950	0.7711

Table B26: Life table for children born to kalenjin women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	1525	1525	95	0.0623	0.9377	0.9377
12	1430	1430	23	0.0161	0.9839	0.9226
24	1407	1407	1	0.0007	0.9993	0.9220
36	1406	1406	4	0.0028	0.9972	0.9193

Table B33: Life table for children born to Protestant or other Christian women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	3632	3632	251	0.0691	0.9309	0.9309
12	3381	3381	46	0.0136	0.9864	0.9182
24	3335	3335	11	0.0033	0.9967	0.9152
36	3324	3324	5	0.0015	0.9985	0.9138

Table B34: Life table for children born to Muslim women in the preceding five years to the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	286	286	20	0.0699	0.9301	0.9301
12	266	266	4	0.0150	0.9850	0.9161
24	262	262	1	0.0038	0.9962	0.9126
36	261	261	2	0.0077	0.9923	0.9056

Table B35: Life table for children born in the preceding five years to the survey to women found not to be working at the time of the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	2601	2601	162	0.0623	0.9377	0.9377
12	2439	2439	23	0.0094	0.9906	0.9289
24	2416	2416	6	0.0025	0.9975	0.9266
36	2410	2410	4	0.0021	0.9979	0.9246

Table B36: Life table for children born in the preceding five years to the survey to women found to be working at the time of the survey

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	3062	3062	217	0.0709	0.9291	0.9291
12	2845	2845	51	0.0179	0.9821	0.9125
24	2794	2794	9	0.0032	0.9968	0.9095
36	2785	2785	6	0.0022	0.9978	0.9076

Table B37: Life table for children born in the preceding five years to the survey to women in Kenya: All cases

Interval start time	No. Entering Interval	No. Exposed to Risk	No. of Terminal Events	Propn Terminating	Propn Surviving	Cumul Propn Surv at end
0	5672	5672	379	0.0668	0.9332	0.9332
12	5293	5293	74	0.0140	0.9860	0.9201
24	5219	5219	15	0.0029	0.9971	0.9175
36	5204	5204	11	0.0021	0.9979	0.9156