"A STUDY ON PACE AND LENGTH OF REPRODUCTION OF WOMEN IN KENYA" BASED ON KENYA DEMOGRAPHIC HEALTH SURVEY (KDHS) 1989.

BY

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DEDICATION

This work is dedicated to my parents and family.

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Kunyanga E. W.

ABSTRACT

This study estimates and examines the two end points of reproductive life of women in Kenya. These are the starting and stopping of childbearing. Of more specific interest in the study is the period of time taken by a woman in reproduction also referred to as the length of reproduction, and the pace or tempo of reproducing. These two important measures of human reproductive behaviour greatly determine fertility. The understanding of factors that affect these said measures is a good step towards general understanding of fertility phenomenon it self.

The study utilises data from the Kenya Demographic and Health Survey (KDHS) of 1989. The methodologies of Suchindran and Horne (1984) and Horne (1985),and Sivarmurthy's life table technique are used to estimate the mean age at first birth, mean age at last birth, mean reproductive span, and mean inter-birth spacing. The methods have not been extensively tested but from the results it can be said that they are reliable in that the results obtained from their use conform to those found by the previous studies. The difference in results for the above two methods can also be said to be very small and not really of any significance. Multivariate regression analysis was also used to examine the relationship between selected variables and the ages at first birth and last birth.

Based on study, the national mean age at first birth is low at about 20 years while the mean age at last birth is about 40 years. The total fertility rate obtained from unadjusted age specific fertility rates is 6.5. This leaves a reproductive span of 20 years and a national mean interbirth spacing of close to 3 years. The findings further reveal that there exists regional, and socio-cultural, socioeconomic sub-group variations in the estimated indices country wide. The

differences in these indices are also seen to cause significant impact in fertility. Education is the most important variable in determining the extent of ages at first birth, ages at last birth, and generally the spacing of children. Contraception, which is said to be responsible for fertility reduction in the country could be said to achieve this through lengthening of the childbearing interval.

The policy implications that have been arrived at from the study are such as to improve women education especially for the rural ones, availing more employment opportunities for women and developing a policy that discourages early marriages.

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1 BACKGROUND TO THE STUDY

1.1. General Introduction

Among the societies of developing countries where use of contraception is limited, factors that affect natural fertility do exert the major influence on overall fertility levels. These include variations in the duration of the reproductive span- starting with first birth and up to the last birth. The components of the intervals between births are also very important. The longer the reproductive span, the greater the possibility of a mother having many children. Like wise the shorter the spacing between births the higher the level of completed fertility. The converse is true for both of the above cases.

This study is geared towards closer understanding of the above mentioned variations by estimating the mean ages at first birth,mean age at last birth,mean reproductive span and the mean inter-birth spacing for women in various regions and subgroups Other than knowing the current levels of above indices their determinants is also one of the areas explored by the study. Since these reproductive behaviour measures do affect the fertility levels directly, it is also the interest of the author to find out the extent and manner in which they do so.

1.2. Problem statement

The major population problem in Kenya is fertility which is determined by a myriad of factors: social, economic, cultural demographic and behavioral.

Most fertility studies carried out so far have dwelt more on the indirect causes of high fertility than the proximate ones. Some of the direct causes of fertility are the length and pace of reproduction for all fecund women. Length of reproductive life should normally start with the start of sexual union and end up with the age at last birth. The pace of reproduction refers to the number of births per unit length of exposure time. Alternatively, the average birth interval during the period serves as an indicator of the pace of reproduction.

Factors determining the variations in effective reproductive lifespan of women are difficult to ascertain and often require explanations of the complex socio-economic, cultural and institutional dimensions and their relationships. A close look at such direct determinants is essential to understand the roots of high fertility in Kenya.

1.3. Objectives of the study

1.3.1. Ultimate Objective

The ultimate objective of the study is to estimate and asses the pace and length of reproduction among fecund women of reproductive age in Kenya. With a view of establishing the variations and determinants that exists for these vital reproductive behaviour indices.

1.3.2. Specific Objectives

1. To estimate by regions and sub-groups the mean ages at first birth, last birth , the length of time taken in reproduction and birth intervals for fecund women in Kenya.
2. To asses the regional and sub-group variations in ages at first birth ,last birth ,birth intervals and length of reproductive period for fecund women in Kenya.
3. To examine the determinants of ages at first birth and last birth, for fecund women in Kenya.

4. To examine the relationship between mean ages at last birth and first birth and total fertility rates for fecund women in Kenya.

1.4. Rationale of the study

Although children ever born is considered as a single variable in most fertility studies, actually fertility is the outcome of a series of behaviours, decisions, and events that give rise to a period of childbearing in the life of a woman extending over 30 years. Analysis of the sequence of steps in fertility process should provide a more comprehensive picture of the dynamics of fertility transitions in the society. The first step is the birth of the first child and the timing of this event measured by mothers' age at first birth has considerable effects on both individuals and aggregate levels of fertility as well as broader implications for women's roles and social changes in general (Rindfuss et al., 1983).

Timing of fertility in some societies may be as important for health and welfare of families as the number of births. A growing number of studies suggests that family well-being is constrained by how soon childbearing is begun and how rapidly it proceeds. Furthermore, the size of completed families appears to be strongly influenced by age at first motherhood (Bumpass et al., 1978).

In a country where fertility is not actively controlled, the total number of children women bear throughout their reproductive life span is largely a function of the age at which childbearing begins. There is evidence that childbearing timing has considerable impact on demographic, socio-economic and cultural factors of many societies.

Of the two end-points of a woman's reproductive life span, namely, the age at first birth and the age at last birth, only the former seems to have drawn attention of demographers and social scientists (Casterline, 1980; McDonald, 1984; Rahmer, 1984).

However the momentum of interest in the age at last birth seems to be increasing in the past few years in the light of some findings and observations to the effect that this variable is an important factor to be reckoned with in fertility variations.

This means ages at first birth and last birth, length of reproductive span and mean inter-birth spacing are important events which summarise temporal aspects of aggregate fertility behaviour.

This study will serve the purpose of identifying the distribution and determinants of these aspects of fertility behaviour and also come up with a set of fertility rates which can be used for further related studies. The study is based on Kenya Demographic and health Survey of 1989 data. This data set has not been used for such a study before and therefore it is hoped that the results of the study will give additional information on these important reproductive parameters.

1.5. Scope and limitation of the study

The survey was a national coverage except districts in North eastern, two districts in Rift Valley province and two districts in Eastern province which account for 5% of the Kenya's population.

The survey covered 7150 women respondents aged 15-49 years and 1116 husbands. The respondents as earlier stated were from 34 districts of Kenya.

The study is faced with methodological problems. The methods used in the analysis namely the Suchindran-Horne and Sivarmurthy's techniques have not been extensively used hence their complete reliability can not be fully pledged.

For example the Suchindran-Horne method is particularly lacking especially in estimating mean age at last birth when age specific fertility rates are likely to be unstable and analysis is only suitable in cases where data is large.

Sivarmurthy's technique could also be limited by its use of age specific fertility rates as unconditional probabilities of a birth even in absence of suitably estimated conditional probabilities.

Both methods are affected by weaknesses of the age specific fertility rates as a measure of fertility.

The other limitation could derive from the fact that the study dwells on fecund women aged 15-49 years.This is because the study uses age specific fertility rates which are not uniform for all ages.

The study also utilises secondary data which has some errors beyond the control of the author as discussed in the section on data and methodology.

1.6. Literature review

Studies carried out on fertility in developed countries so far have focused mainly on the pace of child bearing.and the age at which child bearing begins as factors largely explaining the fertility differentials. Such studies are by Craig (1982), and Finnas and Harm (1980) which have pointed out that early age at the start of recorded exposure to child bearing is indicative of rapid pace of reproduction and high level of subsequent fertility.

In Guatemala Engle (1978) found that in peri-urban areas women who gave birth before age 17 were generally living in poor dwellings and had less work experience than those who gave birth later.

Day (1986), using Australian census data of 1971, pointed out that group differences in age at completion of childbearing are affected by factors which operate throughout or by factors related to age at commencement of child bearing, pace of child bearing and the number of children ever born.

Other studies on ages at last birth in developed countries have involved the use of historical populations in which age at last birth has been used as an indicator of family limitations (Knodel, 1978; Osterd and Fulton 1981) and in family life cycles (Glick and Panke, 1979).

In developing countries however the age at first birth has been on decrease while the age at last birth has been on increase. This has obviously lead to wider reproductive span and subsequently increased the completed fertility of a mother.

Trussell (1980) in his studies of Sri Lanka and Thailand, using data drawn from World Fertility Survey, has documented that the mean age at first birth has been on the increase in these countries and that the gap between the age at first birth and first marriage was narrowing. He has attributed this to lessened adolescent sub-fecundity and artifact of data due to older women omission of reporting first births if they died.

Sinnthuray (1974), in his case study of education information and counselling for adolescent fertility matters, found that in Malaysia out-of-wedlock pregnancies are regarded as sinful and a disgrace to the young girl and her entire family, views that may lead to forced early marriages or illegal abortion and sometimes may cause the pregnant girl to commit suicide as a last resort.

In Asia as a whole the mean age at first marriage is low and hence there is generally low mean age at first birth.

There is lack of accurate data to calculate these reproductive behaviour indices in developing countries. This is why indirect methods are used to estimate various demographic indices in these countries. Sivarmurthy (1987,1988) had developed one such indirect method using "life table" type method Using the technique he has come up with the mean ages at first birth, mean age at last birth and birth intervals; parity progression ratios and proportions remaining childless. He has documented that decreased mean ages at last birth rather than increased mean ages at first birth account for a substantial reduction in fertility levels in addition to increased proportion of women who do not reproduce.

Horne and El-khorazanty (1986, 1987) have applied a model developed by Suchindran and Horne (1984) and Horne (1985) to data on Egypt and several Arab-countries. In Egypt they observed that trends indicate that greater changes have occurred in mean ages at last birth and length of reproductive span rather than age at first birth. They have observed that Arab women have moderate mean age at first birth but very long reproductive span. They observed regional differentials and variations by education of mothers. They also found out that mean age at first birth was negatively related to both crude birth rates and infant mortality rates, while mean ages at last birth and length of reproductive span had a positive relation. There was also some evidence that childbearing behaviour in Arab countries was influenced strongly by customs, traditions and beliefs.

Guo (1986), in a Chinese study using Chinese national fertility survey, estimated and analyzed mean ages at first and last birth for the Chinese population for the period 1950-1979. He noted that with the corresponding changes in the level of fertility rates there were substantial decrease in mean ages at last birth and mean length of reproductive span in both rural and urban areas.

A comparative study made in Sri Lanka, South Korea, Taiwan, Hong Kong, Malaysia and Philippines using multiple linear regression analysis revealed that education, ethnicity, rural-urban origins and birth cohort ages were major determinants of the above indices. Timing of the first child was found to vary within the above factors.

McDonald (1984) examined ways in which nuptiality patterns affect the starting, spacing and stopping behaviour of women in 34 developing societies. He observed that where contraception is low, early age at first marriage was associated with early age at stopping, reproduction and late marriage with late age at stopping the same

Gaisie (1984) did a study in Ghana using data drawn from the World Fertility Survey. He found that 75% of Ghanaian women had their first birth before their 23rd birth day.All the women had their first birth before they were 26 years old. He estimated the average age at first birth as 19.7 years (with a spread of 5 years), while the median at first birth was 20 years for all ethnic groups. He found that women in urban centres had their first birth about a year later than those in rural areas, that women with secondary education or more formal education experienced their first birth at a median age of 25 years, and those with middle and primary education had their first birth at a median age of 20 and 19 years respectively.

McDonald (1984),studying nuptiality and how it affects starting, stopping of birth, noted that women in Africa had longer birth intervals and relatively stopping birth at very late ages.

Countries such as Senegal have high fertility because of very early age at which women begin childbearing, while in Kenya it is particularly due to very late age at which they stop their child bearing.

Among the nomadic communities in Sudan, Henin (1969) noted that nomadic women who were childless and those that had children tended to have started childbearing at later ages and completed it earlier than the settled women. Their birth intervals were longer. He also noted that shorter reproductive span of nomadic women could have been due to late age at which they reach puberty and early entry into menopause.

Not many studies on these aspects of reproduction have been carried out in Kenya. Quite a number of those that have been done have related to adolescence fertility and therefore have mainly focused on ages at first birth and age at menarche.

Kingori (1984) did a study in Kenya on adolescent fertility and found that about 40% of the girls who completed primary school in 1984 dropped out before graduation, a large proportion of them because of unwanted pre-marital pregnancy. Many of these girls were found to have abandoned their babies or badly neglected them while others sought dangerous abortions.

Omondi (1980) on relationship of first marriage and first birth in adolescent women using Kenya Fertility Survey K.F.S (1977/78). He found that average age at first marriage was 15.8 years and that of birth was 16.6 years. He documented variations largely based on religion, education and ethnicity.

Lomba (1986) examined the variations in entry into motherhood and length of reproductive span using data from the Kenya Fertility survey 1977/78. He pointed out that rural-urban differentials in age at first births were very similar even when classification was considered between metropolitan births. He documented that large variations existed when mean age at last birth and mean length or reproductive span were considered between regions; rural-urban, ethnic groups and where marriage was intact or dissolved. Longer length of reproductive span was observed among the Kikuyu, Kalenjin and Kamba ethnic groups and among catholics and protestants.

A more recent study on these proximate determinants was by Otieno (1991) in his study of the estimates of some of indices of reproductive behaviour of women in Kenya from information derived from 1969 and 1979 census data. He used Suchindran-Horne (1984) and Horne (1985) methods to estimate the mean age at first birth and mean age at last birth The mean at age first birth was 20 and that at last birth was 41. This gives a reproductive span of 21 years and a mean birth spacing of 33 months. In all urban areas, fertility was lower than that experienced in rural regions. There was no significant variations in mean age of first birth between rural and urban

Angawa (1991) of the impact of age at first birth and age at first marriage on fertility using Kenya Fertility Survey 1977/88 data showed that first birth and first marriage have a significant impact on fertility as there was a decline in fertility with increasing ages at first birth and marriage.

Although the literature review is not exhaustive, it has shed light on some of the relationships between fertility and some of the socio-economic, socio-cultural and demographic factors in the more developed countries, Latin America, Asia, and other African countries, Kenya included.The review has shown that more developed countries tend to exhibit short reproductive span and hence low fertility. The developing countries are in sharp contrast,that is have longer reproductive span hence high fertility.

This study differs from the rest of the studies carried out in Kenya on the same subject, namely, by Angawa (1991), Otieno (1991), Lomba (1978), in that it utilizes data from Kenya Demographic and Health Survey (1989). The study also utilizes two methods (already mentioned in the text) in its analysis, which offers comparative analytical advantage over other studies.

1.7. Theoretical framework

Bongaart's framework of 1980 for analyzing the proximate determinants of fertility which is applied in this study, documented that, biological and behaviourial factors through which socio-economic, socio-cultural and environmental variables affect fertility constitute intermediate fertility variables. The primary characteristic of an intermediate fertility variable is its direct influence on fertility. Fertility trends and differentials among populations can be traced to variations in one or more of the intermediate fertility variables. The above frame work is represented in a model also called Bongarts model and it is shown in Figure 1.1. The improved version of the above model is also shown and indicated as Figure 1.2 in the text.

This study looks at the dynamics of intermediate variables and how they relate to fertility through age at first birth and age at last birth and the related factors.

Socio-economic and socio-cultural factors usually account for a large part of the factors which influence biological and behaviourial intermediate variables in regard to determining ages at first birth, last birth and reproductive span which in turn influence fertility.

The theoretical statement that is derived from Bongaart's work and other works as cited in the literature review reads as follows:

"Socio cultural and socio-economic factors usually influence biological and behaviourial factors which in turn influence demographic factors which are likely to influence the fertility of any given society".

1.7.1. Conceptual hypotheses

The following conceptual hypotheses have been tested in this study.

1. There are regional variations in reproductive behaviour patterns as manifested by ages at first birth, ages at last birth and reproductive span.
2. The timing of starting, stopping and family formation process may vary with various socio-economic attainments of the female population of any given population.
3. If there is control of socio-economic influence on the mentioned reproductive behaviour patterns there is still a likelihood for variation due to different cultural characteristics that may have prevailed across the regions.
4. There is a likelihood of there being substantial variations in fertility due to variations in these reproductive behaviour pattern.

1.7.2. Conceptual model

Fig. 1.1. Basic conceptual Model by Bongaarts

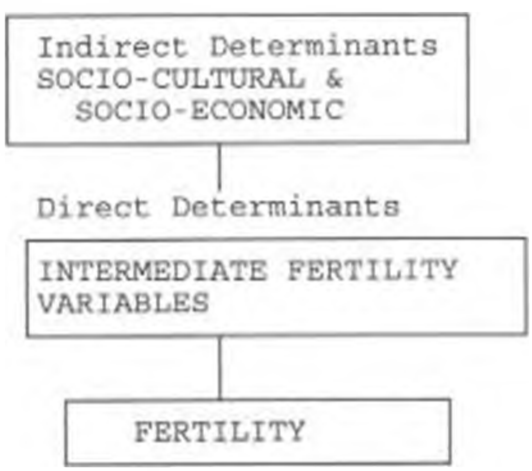
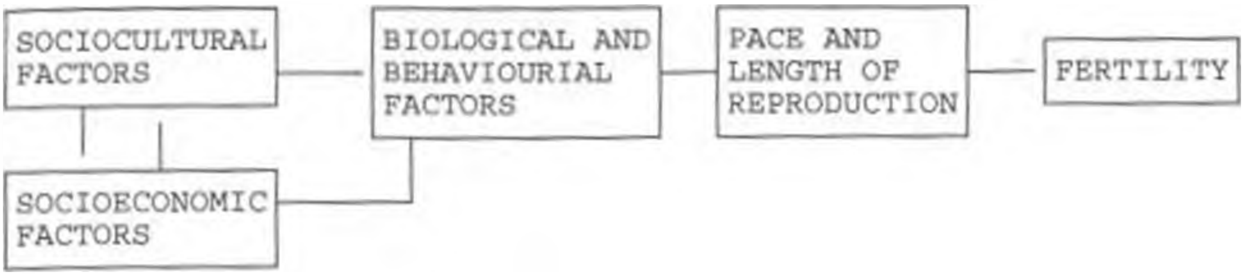


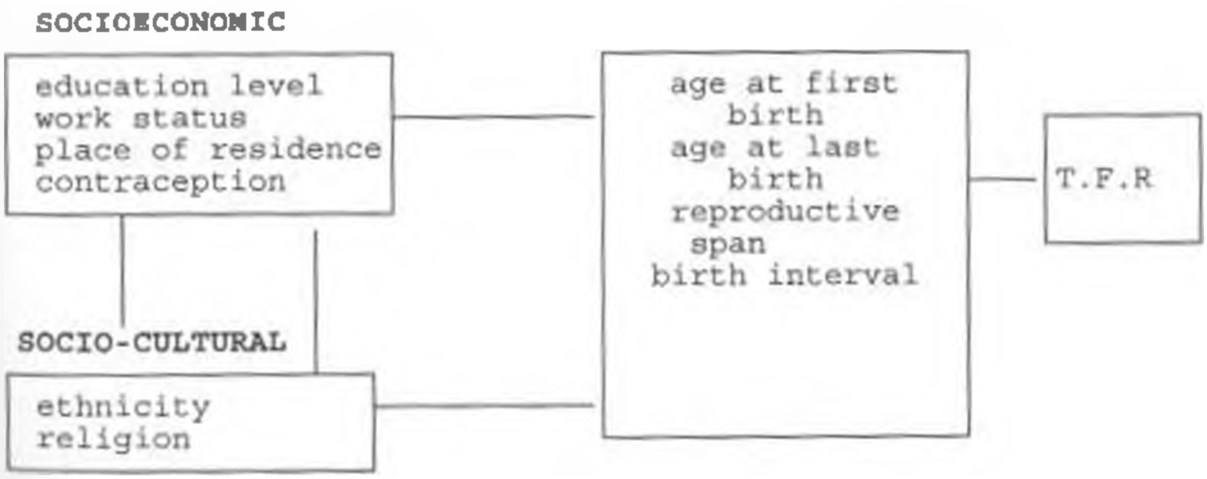
Fig 1.2. Study model adopted from Bongaart's basic model of 1981.



Source: Adapted from Bongaarts model (1981)

The model also marked as Fig.1.2 has been derived from the Bongaarts fertility model of 1981 that contained the indirect determinants of fertility such as socio-cultural and socio-economic factors. These factors act via the direct determinants also called the intermediate fertility variables such as age at birth etc., to affect fertility.

Fig 1.3. Operational model



1.7.4 Operational hypotheses

From Fig.1.3 the following operational hypothesis can be generated.

1. Mean age at first birth of women in urban areas is higher than that portrayed by women in rural areas while as the mean age at last birth of women in urban areas is lower than that portrayed by women in rural areas.
2. Mean age at first birth of women of high education is higher than that portrayed by women with low education, whereas, women of high education have their mean ages at last birth being lower than that of women of lower education in the same cohort.
3. Women who begin child bearing early have more children than women who begin child bearing late and on the same proposition it is expected that total fertility rate is higher in regions where women's age at first birth is low, than in regions where women's mean age at first birth is high.
4. TFR is lower in regions where women's mean age at last birth is low than in regions where women's mean age at last birth is high.
5. The ages at first birth and last birth, birth intervals and length of reproductive period vary within various ethnic and religious groupings.
6. The timing of starting, stopping and family formation processes are greatly influenced by contraception.
7. Women who are working (non agricultural sectors) have late ages at first birth and early ages at last birth compared to those not working or are working in agricultural sectors.

1.7.5. Definition of concepts and variables

1. Cultural factors:

These are factors that govern the way of life of the people in a given society. They include family norms, marriage norms, initiation rites, values and institutions.

2. Demographic factors:

Include variables such as age, age at first marriage, age at last birth, age at first birth, duration of marriage, marital status, etc.

3. Education:

The level of education is measured in terms of educational attainment in schooling classified into three categories: primary; secondary, and never been to school.

4 Mean age at first birth (MAFB):

This is the average age at which a woman will give birth to her first child.

5. Mean age at last birth (MALB):

This is the age at which a woman who has ever given birth will give birth to her last child.

6. Mean length of reproductive span (MRSPAN):

This is the average length of time taken between birth of the first child and birth of the last child.

7. Mean inter-birth spacing (MIBS):

This is the average length of time taken between two live births (pace of reproduction).

8. Socio-economic factors:

Refer to indices of economic status such as education, place of residence, occupation, etc.

9. Total Fertility Rate (TFR):

Is the average number of children born to women during their entire reproductive life span. It can be either a period or cohort measure.

10. Urban:

Urban place in this study is defined as places with population of 2000 and above as per the 1979 census.

2 DATA AND METHODOLOGY

2.1. Sources and quality of data

The major source of data for this study is secondary having been derived from the Kenya Demographic and Health Survey (K.D.H.S 1989). The sample was based on National Sample Survey and Evaluation Programme (NASSEP) master sample of the Central Bureau of Statistics.

The data that are essentially needed is the age-specific fertility rates that are used to calculate the age at first birth, age at last birth and the reproductive span.

Data on the required socio-economic and socio-cultural variables is also needed to be able to examine the determinants of the indices in study.

The NASSEP master sample is stratified by urban and rural residence and by individual districts. In the first stage, 1979 Census enumeration areas (EAs) were selected with probability proportional to size. The selected (EAs) were segmented into the expected number of standard-sized clusters one of which was selected at random to form the NASSEP cluster. The selected clusters were then mapped and listed by CBS field staff

In rural areas, household listings made between 1984 and 1985 were used to select the KDHS households while KDHS pretest staff were used to relist households in the selected urban clusters.

The study is faced with coverage problems of over-enumeration and under-enumeration (just like many other fertility research undertakings), content errors due to digital preferences, age heaping and under-reporting for older mothers are other sources of errors.

Other errors could be related to the errors of the overall KDHS survey e.g it has very low coverage in some regions or in some sub-groups.This interferes with accurate demographic and statistical analysis which are used in the study.

2.2. Methodology of data analysis

The data analysis techniques used in this study can be said to be of two categories i.e demographic and statistical. The demographic analysis techniques essentially involve estimation of the already mentioned reproductive indices namely the age at first birth, age at last birth, the reproductive span and the birth interval.

The statistical analysis techniques are concerned with the statistical relationships between the demographic parameters and the socio-economic, socio-cultural attributes that are in our societies.

The two demographic techniques used are:

2.2.1. Suchindran and Horne (1984) and Horne (1985)

This techniques are for estimating mean ages at first birth, mean ages at last birth, the reproductive span and birth interval. The technique requires data on age-specific fertility rates only.

The method requires that age-specific fertility rates of a given population be calculated and fitted into a derived formula. The population is divided into five-year age groups upon which the age specific fertility rates and consequentlly all other calculations are based on. The age specific fertility rates are calculated as below.

Age-Specific Fertility Rate = Children born by

females of a given age group in a given year

———————————————————————————————— (+)

Number of female population in that age group (5-year age group) during the same year

The other formulae that are used in these calculations are derived based on a mathematical concept that the probability of surviving up to a certain age say x is equivalent to the probability of not dying before age x and that the probability of dying between age x and x+dx is the same as the probability of surviving up to age x and then dying at age x. Thus using the same argument as above the probability of having the first birth in the age interval (x,x+dx) is the probability of not giving birth before age x and then giving birth between x+dx.

The full mathematical derivation of the formulae is shown in appedix 1. After the derivation the formulae that is arrived at and used is the following.

$$\mathrm{MAFB} = (15\text{-}50\exp(-\mathrm{TFR}) + 5\sum_{1}^{7}\exp(-\mathrm{TFR}(xi)))/1\text{-}\exp(-\mathrm{TFR})$$

Where MAFB refers to mean maternal age at first birth and other parameters in the equation are as defined in the procedure of application of the formulae.

2.2.2. Procedure for using the formulae

1) Calculation of age specific fertility rate

= Number of children born by women aged between x and x+5 years divided by the number of women aged x and x+5.

2) Obtaining TFR

$$= 5 \sum_{1}^{7} ASFR$$

3) To estimate cumulative fertility up to age xi

that is TFR(xi)

In this case ASFR should be computed in each age group below the age group in which xi belongs and multiply the cumulative value 5. Add this value to 2.5 times the ASFR in the age group in which xi belongs where xi is mid-point of the age group x.

e g:

$$TFR(5)= 5(ASFR(1)+ASFR(2)+ASFR(3)+ASFR(4))+2.5(ASFR(5))$$

4) Obtaining the negative exponent of each of the values obtained in step 3 above.

i.e exp(-TFR(xi))

5) Obtaining the sum of the negative exponent then multiply them by 5.

6) Then substitute in the following expression

MAFB=15+5 Σ exp(-TFR(xi))-50exp(-TFR)/1-exp(-TFR)

7) To obtain the variance and standard deviation;

By multiplying xi by exp(-TFR(xi)) and then sum. Substitute the values obtained into the variance formula to obtain the variance. For standard deviation, the squreroot of variance is sought.

Table 2.0. Table illustration for MAFB,and VAFB

Age grp	i	xi	ASFR	TFR(xi)	exp(-TFR(xi)	xiexp(-TFR(xi)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
15-19	1	17.5	0.160	0.402	0.668	11.702
20-24	2	22.5	0.355	1.69	0.183	4.136
25-29	3	27.5	0.350	3.45	0.031	0.865
30-34	4	32.5	0.302	5.09	0.006	0.1998
35-39	5	37.5	0.237	6.43	0.001	0.0598
40-44	6	42.5	0.135	7.37	0.0006	0.0598
45-49	7	47.5	0.063	7.86	0.0004	0.0182
		5*sum	5*sum	5*sum		
		=TFR	=5Σ exp(-TFR(xi)) =10xiexp(-TFR(Xi)) =10xiexp(-			

Data source: 1979 Kenya population census report.

2.2.3 Estimating mean age at last birth

The method also uses a mathematical concept derived from the probability theory. Most of the assumptions are as for the other section on estimating age at first birth. The formulae is based on two probabilities that a woman will give birth in a given age interval say between x and x+dx, and that a woman stops to give birth after a certain age.

The technique is derived and shown in Appendix A. The formula that is finally arrived at is as follows:

MALB= 50-15exp(-TFR) -5 Σ exp(-(TFR-TFR(xi)))/1-exp(TFR)

2.2.4. Computational procedure for estimating MALB and VALB

1) Estimate the cumulative fertility from age x onwards

   i.e TFR-TFR(xi)

2) Obtain the negative exponent of TFR-TFR(xi)

3) Substitute the calculated values into the derived formula to obtain MALB

4) Compute xi.exp(-(TFR-TFR(xi))), multiply the summation of it by 10 ,then substitute this into the VALB formula to obtain the variance and standard deviation thereafter.

Table 2.1. Table illustration for calculating MALB and VALB

age grp	i	xi	TFR-TFR(xi)	exp(-(TFR-TFR(xi)))	xi*(5)
(1)	(2)	(3)	(4)	(5)	(6)
15-19	1	17.5	7.62	0.00043	0 0085
20-24	2	22.5	6.33	0.00177	0.0399
......					
45-49	7	47.5	0.158	0.853	40.537

Data source: 1979 Kenya population Census report.

2.2.5. Length of reproductive span (MRSPAN)

The length of the reproductive span can be calculated by subtracting the mean age at first birth from the mean age at last birth. This arithmetic gives the mean age of reproduction span. It represents the average length of time taken by a woman to complete her child bearing and is thus spanned by mean age at last birth and first birth.This is used as a measure of the mean reproductive span.

2.2.6. Birth spacing/interval (MIBS)

This is also called the inter-birth spacing. It measures the speed of reproducing on average. Given the average number of children a woman would have and the average length of time she would take to complete her childbearing then the mean inter-birth spacing is obtained by dividing the length of reproductive span by the average number of children. Thus,

MRSPAN = MALB - MAFB AND

MIBS = MRSPAN/TFR.

2.3. Sivarmurthy's life table technique

The method uses a set of age specific fertility rates. Given detailed age specific fertility schedules, there are possibilities of obtaining a better understanding of fertility behaviour in a population and examination of the changes over time. The fertility performance follows a sequential process such that a woman can have parity two after having parity one and parity three after parity 2 and so on. This then makes it possible to estimate chance of proceeding from one state to another using a set of age specific fertility rates within some assumptions. Essentially, the age-specific fertility rates at age x can be regarded as the unconditional chance that a woman of age x will give birth before attaining x + 1 in completed years.

The assumption in this method is that the age-specific fertility rates of a particular year or time period remain constant and are applicable to a cohort of women passing through reproductive ages. The occurrence of a first or last birth to a given woman portrays events which occur once in a life time like death hence the use of life tables approach.

Due to lack of detailed sets of age-specific fertility rates in Africa and other developing countries the use of five year age groups analysis is more suitable and hence the abridged life table format will be presented in this study.

2.3.1. Steps of constructing a life table

Let f(x) represent the ASFR for the age group (x,x+1) and x=a and x=b, be the starting and ending age of reproduction.Thus no childbearing is assumed before age a and after age b. Let the radix cl(a) represent a cohort of childless persons at age x who have not experienced any childbearing.

Let $cl(a) = 10{,}000$

$cl(x+1) =$ number of persons in the cohort who have no birth by age $(x+1)$

$cl(x+1) = cl(x).(1-f(x))$

$NFB(x) =$ the number of last births in the age interval $(x, x+1)$

$NFB(x) = cl(x) - cl(x+1)$

$NLB =$ The number of last births in the age interval $(x, x+1)$

$NLB(x) = cl(x).((f(x)).(1-f(x+1))(1-f(x+2))\ldots(1-f(b))$

The technique can be used to study other indices of reproduction such as:

1) Expectation of reproductive life time with no childbearing from age x onwards

2) Expectation of reproductive life time to be spent in motherhood from age x onwards.

3) Total reproductive life time remaining at age x

Since the indices are not useful to the study, the author will not go to the details of estimating them and therefore will not be derived.

2.3.2. Extension to five-year age group

The underlying assumption in adopting this format is that the age specific fertility rate for five-year age group applies for all the five single years of ages included in that age group.

Then the probability that a woman will not have a birth in that five-year age interval denoted by GF(i) can be estimated as

$GF(i) = (1-GASFR(i)^5)$ for $i = 1,2,3,..7$.

Once GF(i) is obtained other life table functions can be obtained as follows:

$cl(a) = 10{,}000$

$cl(x+5) = cl(x).GF(x)$ where GF(i) refers to age group $(x,x+5)$

$NFB(x) = cl(x)-cl(x+5).$

$NLB(x) = cl(a)(1-GF(i).GF(i+1)\ldots GF(7))$

To derive various columns of the life table

1) Probability that a woman will not have a birth in that five-year age interval GF(i).

$GF(i) = (1-GASFR(i)^5$ for $i = 1, 2, 3, \ldots 7$

For example $GF(3) = (1 - GASFR(3))^5$

$= (1 - 0.350587)^5$

2) Calculation of number of childless women in hypothetical cohort at age x, cl(x)

This means the number of women in the cohort who have had no birth by age x.

$cl(15) = \text{radix} = 10{,}000$

$cl(40) = cl(35).GF(5)$

$cl(40) = (8.8).(0.25) = 2$

3) Calculation of the number of first births in age interval

$(x,x+5)$

$NFB(x) = cl(x) - cl(x+5)$

e.g age interval 15-19 i.e NFB(15)

$= cl(15) - cl(20)$

$=10,000 - 4158.548 = 5841.451 = 5841$

4) Calculation of number of last births in the age interval $(x, x+5)$ i.e NLB(X)

$NLB(x) = cl(15)(1-GF(j+1)..GF(7))$

Where GF(j) refers to age interval $(x, x+5)$

For example in the age group 25 -29 the value of $j = 3$

If $GF(3) = 0.115506$

Then $NLB(25) = 10,000*0.13169$

$= 131.6 = 132$ births.

5) Calculation of mean age at first birth

Let xi refer to mean or mid-age interval for age group i

$MAFB = (xi+0.5)*NFB(x)/NFB(x)$

For example $(5841.451*17.5)+(3696*22.5)+\ldots+0.3079/5841+3696+\ldots+0.307$

$= 19.84$

6) Calculation of mean age at last birth

$$MALB = \sum_{1}^{7} (x+0.5)(NLB(x)/NLB(x)$$

For example

$(1.1*17.5)+(15.2*22.5)+\ldots+(2792*47.5)/1.11+15.2+\ldots+2992.6$

$= 41.62$ years

Table 2.3. Table illustration on how to construct a life table using 1969 census data

Age(x)	Fertility rate GASFR/1000	Childless women in hypothetical cohort at age (x) cl(x)	No.of first births NFB(x)	No. of last births NLB(x)
15	160.949	10,000	5,841	1
20	355.570	4,159	3,696	15
25	350.587	462	409	132
30	302.180	53	45	751
35	237.047	9	7	2,581
40	135.472	3	1	3,726
45	63.398	1	0.3	2,793
50	--			
Total			9,999	9,999

2.4. Regression analysis

In order to solve objective number two, of examining the determinants of ages at last birth and ages at first birth statistical analysis is used. This involves use of multivariate regression analysis model. The dependent variables used are the age at first birth and last birth. The independent variables used are socio-economic, socio-cultural factors and demographic factors that are seen to affect these dependent variables.

The specific independent variables used are.

1. urban or rural residence.
2. education levels
3. work status
4. religious groups

5. contraception

6. major ethnic groups

The analysis uses a computer package known as Statistical Package for Social Science (SPSS). In summary the regression model is useful in determining the extent to which the set of explanatory variables or the independent variables are capable of predicting the dependent variables. Also the model is used to determine the absolute and relative degrees of association between each of the independent variables and the dependent variable

In most demographic studies more than one independent variables are involved. In such cases the simple linear regression model is found insufficient to handle a variety of variables. Usually a group of interrelated variables have to be considered in order to explain fully the variability in the dependent variables. This calls for the use of a multiple regression model which is an extension of the simple linear model.

The multiple linear regression is expressed as follows:

$Y_i = b_0 + b_1x_{1i} + b_2x_{2i} + \ldots + b_nx_{ni} + e_i$

Where $i = 1, 2, 3, \ldots n$

Y_i = dependent variable.

b_0 = constant

b_i = partial regression coefficients.

$x_1, x_2, \ldots x_n$ are independent variables.

e_i is the error term.

The computation of regression coefficients of the equation together with correlation coefficients can be accomplished by using either matrix technique or a computer. For this work computer use has been found necessary due to large data size. ICL package programme SPSS was used to obtain the regression coefficients and partial correlations. The programme also produces the best linear relationship for the variables.

In constructing the regression equation it is assumed that all the variables i.e criterion and the predictors together, jointly follow a multivariate normal distribution. But strictly speaking no real data follow a multivariate normal distribution exactly for this is a mathematical model of prediction.

Multiple regression analysis gives the values of the estimates of the regression weights and also their standard errors. Hence the predicted criterion ($\hat{Y}$) can be obtained and the relationship between the predicted value and the actual value gives us the multiple correlation coefficient, R.

The sign of R indicates the direction of the relationship, whether positive or negative, while the absolute value of R can be used as an index of relative strength of the relationship.

$$R^2 = 1-((Y_i-Y_j)^2)/(Y_i-Y)^2$$

Where R^2 is called coefficient of determination. The value of R shows the proportion of the total variation in dependent variable, (Y) explained by the independent variables (x1, x2...xn). Thus R provides an overall index of how well Y can be explained by all the regressors.

2.4.1. Testing of statistical significance

For the purpose of this study the F and the t-test are used to test the significance of multiple correlations of the variables involved.

In t-test , the t values are obtained as follows

$$t = R^2 / \sqrt{((1-R)^2/n-2))}.$$

This is compared with the table value of t found in the normal manner for n-2 degrees of freedom.

For F-test,which is preferred to t-test the variance ratio is defined as the ratio of predicted to non-predicted variance with n-r-1 degrees of freedom.

The variance ratio F,is therefore of the form:

$$F = (R^2 /r)/((1-R^2)/n-r-1)$$

The F distribution is used for testing the equality of two estimated variances.This problem frequently occurs when two variations are independently estimated and one wishes to test whether they are equal or not.Thus F-test suggests that there exists a relationship between multivariate analysis of variance and multiple regression models.

2.4.2. Assumptions of linear Regression Analysis

The validity of the regression model lies in the fulfilment of several assumptions namely:

1) Normality; It is assumed that the variables used are normally distributed within the population; In fact the requirement is that the conditional distribution of respodents be normal. The conditional distributions are values of $(Y_1 - Y_i)$ for every value of x. If these conditional distributions are normal then, it is certain that the distributions of Y and of x which are known as marginal distributions are also normal, but the converse is not necessarily the case.

2) It is also assumed that

(i) ei is uncorrelated with any of the independent variables.

(ii) That ei is normally distributed and

(iii) That ei's are uncorrelated

3) The independent variables should not be strongly interrelated.

4) The observations must be at least so or more. This is in order to allow for large number of degrees of freedom in testing the statistical significance of each independent variable.

5) The last assumption is that regression analysis fits a straight line trend through a scatter of data points and correlation analysis tests for goodness of fit of this line. Clearly if the trend cannot be repeated by a straight line, regression will not portray it carefully. But in cases when it is not linear it can be made linear by transforming the data by use of the logarithm.

2.4.3. Dummy Variables

Since for the purpose of this study categorical variables have been used they have to be transformed into dummy variables. The categorical data used in this study include work status, education, place of residence, religion ethnicity, contraceptive use, the factors considered in assigning the dummy variables are in these broad categories:

(i) Education - (also) level of education which has been put into three categories; namely no education (EDUCO), Primary level (EDUC1) secondary and higher (EDUC2).

(ii) Work status, has been put into two categories; those who never worked before (WORKO) those currently on wage employment for some cash or wage labourers (WORK1)

(iii) Place of residence has been put into two categories, rural (RES1) and urban (RES2)

(iv) Religion - this has been put into 4 categories i.e. catholics (REL1) Protestants (REL2) Muslims (REL3) Traditional and other (REL4)

(v) Ethnicity - has been put into 9 categories

Ethnic 1 - Kalenjin

Ethnic 2 - Kamba

Ethnic 3 - Kikuyu

Ethnic 4 - Kisii

Ethnic 5 - Luhya

Ethnic 6 - Luo

Ethnic 7 - Meru/Embu

Ethnic 8 - Mijikenda/Swahili

Ethnic 9 - Somali and 10 other:

(vi) Contraceptive use has been put into 3 categories i.e.

Cont 0 - Never used any contraceptive

Cont 0 - Ever used traditional

Cont 0 - Ever used modern methods

To avoid the problem of multicollinearity the following have been used as reference categories and therefore have been omitted from the equation. No education, Kalenjin, Catholic, rural, never used contraceptives, and not working categories.

2.4.4. Some problems of multiple regression and how they have been overcome in the study

Ideally it is not always possible to have all the assumptions already stated getting completely satisfied. For instance the dependent variable (age at 1st birth) is likely to have influence on some of the independent variables. On the other hand some of the independent variables may influence the dependent variable.

In most regression studies there usually arises a problem of multicollinearity which is normally as a result of inter- correlations of the independent variables. It also arises when independent variables are linear functions of each other. Its results are that the standard errors are either infinite or high (Zinjarati, 1976). This study is no exception to the above problem and to prepare for it reference categories have been used together with dummy variables. Since most (all) of the correlation coefficients are less than 0.5 and hence low, multicollinearity seems to have been overcome in this study.

Other problems of the model include the limitations of the ordinary least square (OLS) method of estimating the parameters of the linear regression model. Such limitations are:-

(i) It can yield probabilities outside the acceptable 0-1 interval

(ii) The two probability relationship is more likely to be S - shaped than linear, approaching the probability value of zero and one asymptotically, and that

iii) Ols assumptions that the error terms are

 (a) Normally distributed with zero expectation

 (b) Homoscedastic i.e. they have the same variance are violated.

The above limitations also do apply to this study but have not been manifested in the results.

3 ESTIMATES OF MEAN AGE AT FIRST BIRTH, LAST BIRTH, MEAN REPRODUCTIVE SPAN AND MEAN INTER-BIRTH SPACING

3.1. Suchindran and Horn(1984) and Horn(1985)

One of the objectives of this study is to come up with estimates of mean ages at first birth,mean ages at last birth, mean reproductive span, and birth spacing for fecund women in Kenya. The methods developed by Suchindran and Horn (1984), Horn (1985) and Sivarmurthy's life table technique have been used to achieve this objective. As already pointed out, the methods have not been used in many studies before and therefore their full reliability is also being tested.

It is appropriate to start the chapter by noting that any level of total fertility can be achieved by a variety of timing patterns, ranging from having all children closely spaced at early ages of childbearing to having them spaced throughout the childbearing ages. Birth patterns are subject to constraints imposed by natural and artificial factors. For countries where childbearing occurs predominantly in marriage, duration of marriage is a more direct specification than age for detecting patterns of control.

Because the tempo of fertility affects both cohort and period fertility rates it merits careful scrutiny.The difference in the length of lactation and postpartum amenorrhoea among the members of various marriage cohorts may also influence the number of children born by specified duration of marriage. The longer women spent lactating and ammenorheic the less opportunity there is for conception to occur. Other factors that may affect the tempo of reproduction and therefore the age at first birth and age at last birth are adolescent fertility and pregnancy wastage. Prolonged separation of couples in marriage may lead to cases of abstinence which also can be a factor in controlling these vital indices of reproductive behaviour. High mortality and frequency of widowhood associated with wars, famines contribute to slow rates of childbearing in particular regions and during particular periods.

Due to cases of misreporting of age information an attempt has been made to compare results obtained, using several methods and also at different times in the past in order to realise fully the objectives of the study.

3.2. National overview of the results

The age-specific fertility data which is the main input data used by these methods was obtained from the KDHS 1989. The results are presented in table 3.1. The national figures from various sources are also given.

Table 3.1. Summary of national reproductive behaviour indices trends

Data source	MAFB (YRS)	MALB (YRS)	MIBS (MONTHS)	TFR	MRSPAN (YRS)
1962 census	21.61	40.29	42.72	5.24	18.68
1969 census	19.45	41.79	33.36	8.03	22.34
1977 N.D.S	19.39	40.98	32.52	7.96	21.59
1977/78 K.F.S.	18.82	40.69	33.24	7.90	21.87
1979 census	19.25	41.28	31.32	8.45	22.03
1984 K.C.P.S	19.32	41.48	34.68	7.67	22.16
1989 KDHS	20.33	39.70	35.76	6.5	19.37

The results indicate that there has been a declining trend of mean age at first birth and mean inter-birth spacing. Mean age at last birth has fluctuated, with 1989 showing the lowest and 1969 the highest estimates. Similar trend is also seen for mean reproductive span. The overall level of fertility as shown by the TFR increased from 5.2 in 1962 to 8.5 in 1979 and dropped 6.5 in 1989. The decline could be due to increasing mean age at first birth and increasing mean length of birth spacing.

The above results can be said to be reflective of what is already discussed in the literature review that Kenyan women spend a long time in childbearing, coupled with short inter-birth spacing of about 32 months. This may explain the average high total fertility rate observed among the Kenyan women over a long period.

3.3. Results by regions (provinces)

The results indicate that provincial differentials by all the estimated parameters do exist. These results are shown in Table 3.2.

Table 3.2. Estimated TFR, MAFB, MALB, MRSPAN, MIBS by provinces in Kenya

Province	TFR	MAFB	MALB	MRSPAN	MIBS
Nairobi	4.14	20.46	32.85	12.39	35.88
Coast	5.23	20.72	38.63	17.91	41.16
Eastern	6.56	20.97	39.35	18.38	33.60
Nyanza	7.18	19.60	40.33	20.83	34.80
R/Valley	7.20	20.45	41.00	20.55	34.20
Western	8.66	19.68	39.96	20.28	28.08

Probably it could have been more indicative if the indices were estimated at the district level. This could not be possible given the small sample of women interviewed at this level.

Nairobi has the lowest fertility rates of 4.14. The mean age at first birth is among the highest among the provinces. The age at completion of childbearing is one of the lowest.

Western province, has the highest fertility exceeding a TFR of 8.0. The mean age at first birth is low.The age at last birth is high. This has necessitate a long reproductive span of 20.28 years.In addition the mean inter-birth spacing in this province is among the shortest.

In the Rift Valley the mean age at last birth is quite high (41 00 years) and the mean age at first birth is among the lowest (20.45 years). This has led to a long reproductive span in the province as a result of which it exhibits high fertility levels.

Fertility level in Nyanza is high and close to the national figure. The province has the highest mean length of childbearing. This could be due to very early mean age at first birth coupled with relatively short mean inter-birth spacing. The results for Eastern province are quite similar to those of Central province. Both provinces are characterised by high mean age at first births and relatively low mean age at last birth. The TFRs for the two provinces are also relatively low.

Coast province has the lowest mean age at last birth and relatively high mean age at first birth. It has the longest inter-birth spacing of 3.43 years. This may help explain the low fertility of 5.23 (TFR) recorded by Coast province.

In summary we can conclude that going by the KDHS 1989 survey data, there is high fertility in Kenya. This is partly due to a combination of very early age at first birth and very late age at last birth in most of the provinces.

3.4. Results by socioeconomic groups

3.4.1. Education Level

The influence of education on timing of childbearing is clearly evident. The mean age at first birth seems to increase with the increase in the level of education for every cohort of women. Those with secondary school education or higher have the highest mean age at first birth.

These results can be seen in Table 3.3. The difference between the women with education and those without is 3.1 years as far as age at first birth is concerned. The results further indicate that naturally the mean age at first birth for those without education is 18.40 years compared with those with primary which is education 20.11 years. The magnitude of difference is about 2 years. Those with secondary and above had means of about 21.50 years. It is evident then that women with higher education eventually enter int^Ored to those with no education who space their children quite closely at an interval of 2.6 years.

All these differences/variations in the estimated variables by education are a clear testimony that education may adversely shift the fertility levels of a society by affecting the starting, timing and stopping of childbearing.

3.4.2. Place of Residence

Results relating to place of residence are shown in Table 3.3. The places of residence are divided in terms of rural or urban residence. There are many urban places in Kenya with Nairobi and Mombasa taking up the greatest share of the urban population. Mostly people who live in urban areas are affected or surrounded by a totally different environment from that of rural areas. These differences have effects on the behaviour which includes reproductive behaviour.

The results indicate that urban women have a slightly higher mean age at first birth than those in the rural areas by a magnitude of 0.45 years. The mean age at last birth for women in the urban centres is lower than for women in rural areas. As a result of this, rural women end up spending longer periods in childbearing and thus fertility is significantly higher by about 1 births.

Effects of education and urbanisation are a major factor in explaining these differences. The effect of urbanisation could be mostly on age at last birth. This is probably why the effect of urbanisation is more evident in the age at last birth than in age at first birth.

3.4.3. Contraceptive Use and the Reproductive Behaviour Indices

Going by the results of previous surveys and those of the KDHS 1989 the fertility levels in Kenya have shown a sharp decline from a TFR of over 8.0 children in the late 1970s mid-eighties to approximately 6.7 by 1989. In Africa and in other developing countries there is a problem of misreporting of age data and therefore small changes in certain age-related parameters may not be regarded highly. Nevertheless, a change in fertility is now evident. This has been attributed to factors such as change in socioeconomic factors like education levels, but the greatest share is attributed to increased contraceptive use. From the results, the women who have never used contraceptives seem to have shorter spacing of their children (2.69 years), while those who have used modern methods have 3.38 years. It can be concluded that use of the traditional methods and no modern contraception at all have the same effect in the child spacing. The TFR for these two groups are also not significantly different, both of them are high at above 7.4, while those who use modern methods of contraception have TFR of 5.75.

The age at which mothers stop childbearing is also affected by contraception. From the results, it is clear that those who use modern contraception also stop childbearing earlier than either those who use traditional contraception or use no contraception at all. The age at which reproduction starts does not seem to be greatly influenced by contraception. All in all contraception seems to affect fertility rates through affecting the child spacing and also the reproductive span.

3.4.4. Work Status and Timing of Childbearing

The working category group are those working either in skilled or unskilled non-agricultural labour. Most of those working are in the urban areas, while a few others work in the rural areas.

Those working start reproduction later and also end reproduction earlier than those not working. This points to differences in length of reproductive period whereby those not working are exposed to longer period of reproduction. The spacing of births also differs by work status whereby those not working have a longer spacing. Overall, we realise a difference in total fertility between the two categories whereby those not working have higher fertility. The above phenomenon could be as a result of general lack of focus among those not working. Life is usually a boring affair to them and more often than not they find consolation in the only entertainment available to them; the activity of procreation.

One of the consequences of rapid population growth in reference to its resources is generation of surplus labour force (people who should be in employment but they are not). This has lead to the current high levels of unemployment and underemployment we are experiencing in the developing economies. Although this might lead to delayed marriages due to fear of responsibilities, it may not necessarily lead to delayed first births. What this points to is that the fertility levels may further increase due to eventual shortening of child spacing and longer reproductive span as a result of many people not working.

3.5. Results by socio-cultural groupings

3.5.1. Major Ethnic Groups

The results by ethnicity are closely a reflection of the results by regions (see Table 3.3). For example, the Kikuyu and Embu/Meru ethnic communities, which are the dominant tribes in Central and Eastern provinces respectively show high age at first birth and early age at last births. A similar pattern of results is portrayed when these estimates are done by provinces.

Table 3.3: Comparison of the reproductive indices by region and ethnicity

Ethnic Groups	Ethnicity		Region[1]	
	MALB	MAFB	MALB	MAFB
Kikuyu	40.00	20.97	39.77	20.76
Embu/Meru	39.02	21.12	39.35	20.97
Luo	41.12	19.25	40.33	19.60
Luhya	38.56	19.95	39.96	19.68
Kalenjin	41.58	19.49	41.00	20.45
Mijikenda/Swahili	38.90	*22.54	38.63	20.72

[1] Region refers to the Kenyan Provinces of Central, Eastern, Nyanza, Western, Rift-Valley and Coast, respectively as the ethnic groups appear on the table.

The Mijikenda age at first birth could be misleading because it is does not conform with what is expected; this could be due to errors inherent in the data used. for instance. misreporting of ages or dates of birth. Another reason could be that due to polygamy among the Coastals, there are many cases of divorce, and therefore woman respond to the question of age at first birth to be same as the age when the present marriage took place.

The Luo have one of the highest mean age at last birth of 41.12 and the lowest mean age at first birth of 19.25 years. This leads to a very long reproductive span. Long reproductive span coupled with short inter-birth spacing helps to explain the luo report of high total fertility rate of 7.46. The same explanation holds as far as the TFR for the Kalenjin community is concerned. The highest fertility is by Kisii,the result of a long reproductive span and a short inter-birth spacing.

3.5.2. Reproductive Behaviour Indices by Religious Groups

By different religious groups, the indices are not seen to differ significantly. The Muslims. however, are seen to have early age at last birth as compared to others. What can be seen clearly is the birth spacing among the various categories of religious groups. Catholics and Protestants have a wider childspacing as compared to the Muslims. The TFR does not differ significantly among the different religious groups.

Table 3.4: Estimated Mean Age at First Birth (MAFB), Mean Age at Last Birth (MALB), Mean Reproductive Span (MRSPAN), Mean Inter-Birth Spacing (MIBS) using Suchindran and Horne(1984) and Horne(1985)

ITEM	MALB	MAFB	TFR	MRSPAN	MIBS (yrs)	MIBS (yrs)
National estimate	39.70	20.33	6.5	19.37	2.98	35.76
Provincial estimates						
NAIROBI	32.85	20.46	4.14	12.39	2.99	35.88
CENTRAL	39.77	20.76	5.61	19.01	3.39	40.68
COAST	38.63	20.72	5.23	17.91	3.43	41.16
EASTERN	39.35	20.97	6.56	18.38	2.80	33.60
NYANZA	40.33	19.60	7.18	20.83	2.90	34.80
Rift VALLEY	41.00	20.45	7.20	20.55	2.85	34.20
WESTERN	39.96	19.68	8.66	20.28	2.34	28.08
Residence						
URBAN	37.08	20.68	4.72	16.40	3.47	41.64
RURAL	40.08	20.23	7.08	19.85	2.80	33.60
Education level						
NO EDUCATION						
PRIMARY	39.70	18.40	8.21	21.30	2.60	31.20
SECONDARY	40.84	20.11	6.85	20.73	3.03	36.36
	35.32	21.50	4.74	13.82	2.92	35.04
Ethnicity						
KALENJIN	41.58	19.49	8.12	22.09	2.72	32.64
KAMBA	40.46	20.91	6.93	19.55	2.82	33.84
KIKUYU	40.00	20.97	5.61	19.03	3.39	40.68
KISII	39.85	20.27	6.96	19.58	2.81	33.72
LUHYA	38.56	19.85	7.65	18.71	2.45	29.40
LUO	41.12	19.25	7.46	21.87	2.93	35.16
MRU/EMBU	39.02	21.12	5.77	17.90	3.10	37.20
MIJIKENDA/SWA	38.90	22.54	4.69	16.30	3.49	41.90
SOMALI AND 10 OTHERS	35.50	21.21	5.91	14.29	2.42	29.04

Table 3.4 continued

ITEM	MALB	MAFB	TFR	MESPA	MIBS (yrs)	MIBS (yrs)
Contraception						
NEVER USED	40.40	20.47	7.41	19.93	2.69	32.30
TRADITIONAL	39.62	18.91	7.45	20.71	2.78	32.40
MODERN	38.48	18.99	5.75	19.49	3.38	40.60
Work status NOT						
WORKING	35.32	20.16	5.55	15.16	2.73	32.75
WORKING	32.40	21.26	3.66	11.14	3.05	36.60
Religion						
CATHOLIC	40.89	20.39	6.89	20.50	2.98	35.76
MUSLIMS	35.49	22.06	6.73	13.43	1.99	23.88
PROTESTANTS	39.62	20.29	6.88	19.33	2.81	33.72
OTHERS	29.05	17.94	5.03	11.11	2.21	26.52
NO RELIGION	39.15	20.04	4.99	19.11	3.83	45.90

3.6. Results obtained on application of Sivarmurthy's life table technique

As already explained in the previous chapters the above method uses a life table approach called a non-reproductive life table to come up with estimates of ages of mothers at first birth and last birth, mean inter-birth spacing and the mean reproductive lifespan. The results obtained using this method are given in table 3.5 below.

Detailed discussion of results by this method will certainly be a complete repeat of what has already been discussed in the previous section and therefore the author finds it not necessary. However a quick look at these results shows close consistency with those yielded by previously discussed method except for small differences here and there.

Table 3.5: Estimated Mean Age at First Birth (MAFB), Mean Age at Last Birth (MALB), Mean Reproductive Span (MRSPAN), Mean Inter-Birth Spacing (MIBS) using Sivarmurthy's life table method

ITEM	MALB	MAFB	MRSPAN	MIBS (yrs)	MIBS (MTHS)
National estimate	39.61	20.67	18.94	2.91	34.90
Provincial estimates					
NAIROBI	33.21	20.85	12.36	2.99	35.80
CENTRAL	39.84	21.06	18.78	3.35	40.20
COAST	38.63	21.32	17.88	3.42	41.02
EASTERN	39.20	19.98	20.17	3.07	36.89
NYANZA	40.15	20.84	20.03	2.79	33.48
R/VALLEY	41.87	20.08	19.48	2.71	32.46
WESTERN	39.84	21.06	18.78	2.17	26.02
Residence					
URBAN	37.30	21.01	16.29	3.45	41.40
RURAL	39.92	20.59	19.33	2.73	32.76
Education level					
NO EDUCATION	36.89	18.88	18.01	2.19	26.32
PRIMARY	40.75	20.47	20.28	2.96	35.52
SECONDARY +	35.46	21.91	13.55	2.86	34.30
Ethnicity					
KALENJIN	41.39	20.01	21.38	2.63	21.38
KAMBA	39.21	21.29	17.92	2.59	31.03
KIKUYU	40.06	21.24	18.82	3.35	40.25
KISII	39.50	20.63	18.87	2.71	32.53
LUHYA	38.21	20.23	17.98	2.35	28.20
LUO	40.10	19.62	20.48	2.75	32.94
MERU/EMBU	38.99	21.31	17.59	3.05	36.58
MIJIKENDA/SWAH	36.89	23.62	13.27	2.83	33.95
SOMALI AND 10 OTHERS	35.20	21.63	13.57	2.29	27.55

Table 3.5 continued.

ITEM	MALB	MAFB	MRSPAN	MIBS (yrs)	MIBS (mths)
Contraception					
NEVER USED	40.26	20.87	19.39	2.62	31.40
TRADITIONAL	39.32	19.24	20.08	2.70	32.34
MODERN	38.51	19.32	19.19	3.34	40.05
Work status					
WORKING	35.23	20.56	14.67	4.02	48.23
NOT WORKING	33.11	21.66	11.45	2.06	24.71
Religion					
CATHOLIC	40.78	20.72	20.06	2.91	34.93
MUSLIMS	35.43	20.64	12.97	2.58	30.94
PROTESTANTS	39.46	20.48	18.82	2.79	33.55
OTHERS	28.91	22.46	10.32	2.08	24.82
NO RELIGION	38.98	18.59	18.50	2.69	32.27

3.7. General Discussion of the Results

In Kenya, like in any other developing countries, young women are sexually active and they are beginning sexual activity at young ages (Diverker and Natarajan, 1979). Most of pre-marital pregnancies end up in early childbearing in Kenya except for those that lead to illegal abortions or foetal loss. Illegal abortions can be used to explain why we have high age at first birth in urban areas as compared to the rural areas. Women in urban areas have higher cases of illegal abortions than the rural counterparts.

Age at first birth is a strong correlate of age at menarche. Age at menarche is an important basis for studying human growth since it marks the start of possibility of fertilization. It is not possible to talk of age at first birth without talking of age at menarche but this is not the main stay of this study.

So all the factors that affect age at menarche will in part affect the age at first birth and hence the whole reproductive life span of a woman. Similarly, age at marriage is a major precursor of age at first birth in most African countries where marriage is regarded universal.

Length of breast-feeding, abstinence, sterility and foetal losses are other factors that may affect birth-spacing, starting and stopping of the childbearing activity.

It is not enough to study the fertility levels in Kenya based on such summary indexes such as TFR. It is a preferable approach to also examine fertility trends and differentials from a birth-order perspective. Within this framework, the family building process is desegregated into a series of stages, beginning with marriage followed by first and successive births. Birth intervals model can therefore provide further insight into the mechanisms underlying fertility change.

These studies are important in trying to understand how fertility can be shifted by starting, timing and or stopping patterns of childbearing (Heckman, Hotz and Walker, 1985). Since we cannot attribute the recent Kenyan fertility decline to a later onset of childbearing, we can confidently assume that the observed reduction is due to changes in birth spacing and/or cessation of childbearing.

The speed at which births of any order occur is relatively fast in Kenya. On average birth intervals are relatively short; they oscillate between 2-3 years. Young mothers are likely to be more fecund and to breast-feed and abstain for shorter durations than older women.

There seems to be a trend for those with early age at first birth to have fewer children in their later reproductive years and therefore to complete their fertility at a level not much higher than those who start their childbearing somewhat later in life (Trussell and Meardan, 1978). Early childbearing is followed by higher fertility later so that the woman is not able to complete raising young children early enough to re-enter the educational system.

4 DETERMINANTS OF AGE AT FIRST BIRTH -A MULTIVARIATE ANALYSIS

4.0. Results of regression analysis

As already discussed in chapter 3, there are a number of factors that are observed to play an important role in determining the age at first birth and therefore changing women's reproductive behaviour In this chapter ,the results of multivariate analysis carried out on the above factors will be discussed.

The problem of multicollinearity which had been cited as being likely to arise and have the consequent effect of affecting the results has been overcome in this study by taking a reference category for each variable.This is shown in the Table 4.1.

When using stepwise regression analysis there arises a problem in that it decides for the researcher variables to be included. This means that one does not have absolute control over what he is doing.However, the advantage with stepwise regression is that it identifies variables that contribute substantially to the explanation of the dependent variable only

Table 4.1. Dummy variables, means, standard deviation and label for the variables used in the regression model

Variable	Label	Mean	Standard deviation.
V212	Age at first birth	18.120	3.264
EDUC0 *	No education	0.000	0.000
EDUC1	Primary education	0.517	0.500
EDUC2	sec. and higher	0.173	0.379
ETHNIC1*	Kalenjin	0.000	0.000
ETHNIC2	Kamba	0.129	0.335

Table 4.1 Continued

ETHNIC3	Kikuyu	0.230	0.421
ETHNIC4	Kisii	0.058	0.233
ETHNIC5	Luhya	0.167	0.373
ETHNIC6	Luo	0.151	0.358
ETHNIC7	Meru/Embu	0.066	0.248
ETHNIC8	Mijikenda/swahili	0.045	0.206
ETHNIC9	Somali and others	0.650	0.247
REL1*	Catholic	0.000	0.000
REL2	Protestant	0.575	0.494
REL3	Muslims	0.034	0.183
REL4	Traditional/others	0.045	0.208
RES1*	Rural	0.000	0.000
RES2	Urban	0.841	0.365
CONT0*	Never used contr.	0.000	0.000
CONT1	Used traditional	0.161	0.367
CONT2	Used modern contr.	0.303	0.460
WORKO*	Not working	0.000	0 000
WORK1	Working	0.119	0.323

* Refers to the reference category used in each of the cases under study.

4.1. Discussion of the results

The results obtained from the regression model are given in Table 4.2. Step wise regression analysis was used. The order of inclusion of variables into the equation was determined by the magnitude of their contribution to the unexplained variation on mean age at first birth it accounted for. At each stage of the analysis the regression coefficients, residual sum of squares together with associated degrees of freedom ,mean squares and the t-statistics are generated.

Table 4.2 shows the results of the regression analysis in terms of coefficients and sequence in which the variables were entered.

Table 4.2. Regression results: Coefficients and sequence of variables

Equations	1	2	3	4	5	6	7	8	9	10
EDUC2	1.769	1.767	1.776	1.653	1.617	1.621	1.516	1.564	1.569	1.573
ETHNIC6		-1.135	-1.234	-1.332	-1.384	-1.437	-1.416	-1.472	-1.455	-1.409
ETHNIC5			-0.500	-0.531	-0.579	-0.634	-0.640	-0.665	-0.645	-0.594
RES2				-0.515	-0.547	-0.534	-0.460	-0.518	-0.505	-0.528
ETHNIC8					-0.711	-0.765	-0.741	-0.795	-0.987	-0.942
ETHNIC4						-0.616	-0.615	-0.629	-0.612	-0.558
WORK1							0.454	0.506	0.522	0.536
CONTR2								-0.318	-0.303	-0.332
REL4									0.661	0.673
ETHNIC7										0.478
CONSTA	17.81	17.98	18.08	18.56	18.64	18.68	18.58	18.73	18.68	18.65
R^2	0.042	0.058	0.060	0.064	0.066	0.067	0.069	0.071	0.073	0.074

NB. All the B coefficients for the variables in the final equation are significant at 0.05.

From the results presented in table 4.2 the final equation would look as follows:

MAFB = 18.652 +1.573(EDUC2) -1.409(ETHNIC6) -0.594(ETHNIC5)-0.528(RES2) -0.942(ETHNIC8) -0.558(ETHNIC4) +0.536(WORK1)-0.332(CONT2) +0.673(REL4) +0.478(ETHNIC7).

The results indicate that the key variables which influence age at first birth are education, ethnicity, place of residence,work status and religion. Variables with negative effects on the age at first birth are ethnicity ,place of residence and contraceptive use.

Considering education (EDUC2) which represents secondary and above accounts for 0.042 of the R^2. This accounts for about 50% of the total observed variation . Variables like ethnic6 and ethnic5 contribute up to about 20% of the total observed variation.Others contribute to less than 30% of the observed variation in R^2. This means that education and ethnicity alone account for a very big percentage of the variation in age at first birth.

The factors that determine age at first birth can be classified into socio-cultural and socio-economic categories. Some of the socio-cultural variables are ethnicity and religion while socio-economic factors include education, work status contraceptive use and places of residence. It is therefore quite useful that further discussion be made of these categorisations.

4.2. Socio-economic determinants of age at first birth

4.2.1. Education

Education is apparently most important determinant of at first birth. Women with secondary education and above have their first birth 1.5 years later than those with no education.This shows that high education has a significant contribution to ages at first birth, which corroborates previous findings documented in the literature review.

4.2.2. Work status

Working women have a higher age at first birth than those not working by about 0.536 years. Work status is therefore also a major determinant of age at first birth.This could perhaps be due to the fact that since marriage is an important factor in determining age at first birth women who are employed are likely to have been to school longer.Hence they delay their marriage and consequently age at first birth.The policy implication in this regard is that if women employment in the country is enhanced the age at first birth can be raised and hence a reduction in fertility.

4.2.3. Contraception and age at first birth

The reference category that has been used in this case is the group of women who reported to have never used contraception at all whether traditional or modern type. From the results it is not clear whether use of contraceptives is a direct determinant of age at first birth. Women who use modern contraception have their mean age at first birth coming about 4 months earlier compared to those who do not use any contraceptives. This could probably mean that contraception affects fertility solely by affecting the spacing of childbearing and that it has little or no influence at all on starting and stopping of reproduction.

4.3. Socio-cultural determinants of age at first birth

4.3.1. Ethnicity

Different ethnic communities have different customs and traditional practices These different ways of living among different communities also contribute to occurrence of different reproductive behaviour patterns. Age at first birth is therefore not independent of this strong cultural variable. The Kalenjin has been used as the reference category. From the results ETHNIC6 (the Luo) has it's age at first birth coming about 1.5 years later than that of the Kalenjin. The Meru/Embu also have their women experiencing age at first birth later than the Kalenjin. Conversely, the luhya, Mijikenda, and Kisii, have their mean ages at first birth coming earlier than that of the Kalenjin.

4.3.2. Religion

From the results religion does not emerge as a major determinant of age at first birth in

Kenya. The reason to this could probably be due to the fact that most of the people in Kenya are christians and therefore they have a common agenda as regards the issue of childbearing. Most of the major denominations are also distributed evenly across the country and therefore the variation of the dependent variable among the various religious groups comes out to be of relatively little significance.

5 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

The objectives of this study were two fold: First, to estimate demographic parameters of human reproductive behaviour, namely mean age at first birth, mean age at last birth, mean reproductive span and the mean inter-birth spacing by regions and various socio-economic and socio-cultural sub-groups using various methods.The second objective was to identify and explain the determinants of ages at first birth and age at last birth. It was not possible to find the micro-level measure of age at last birth from the data and hence not possible for the study to develop a regression model for this estimate. Detailed discussion of the results which embraced all the objectives have been presented in the foregoing chapters. This chapter provides a summary of major findings,conclusions and recommendations.

The estimation procedures used in this study are based on age specific fertility rates which were obtained from the use of information on children born one year prior to the survey period and the number of women in the childbearing age group during the period. Suchindran and Horne (1984) and Horne (1985), and Sivarmurthy's (1987) method were used for comparison purposes. Age fertility rates are used as a force of fertility within a given age or age group. The results of the indices which are discussed in chapter 3 should be interpreted to represent a sythentic cohort and not a real cohort just like the total fertility (TFR).

The results are presented on basis of regions, socio-cultural or socio-economic groupings. At regional level the age at first birth raged from 19.60 years in Nyanza to 20. 97 years in Eastern province. All the indices estimated seems to vary mostly with education levels of the respondents. On basis of completion of childbearing earlier mean age at last birth have been observed central and major urban areas. Differentials of this variable by education, ethnicity, place of residence and contraceptive use also do exist.

The results can be put in summary form as follows.

5.2. Summary of the major findings

One of the major findings of this study is that in Kenya there exists variations in age at first birth, age at last birth , mean reproductive span,and the spacing of childbearing.These variations are found to exist among provinces and various sub-groups,or across varying socio-cultural and socio-economic dimensions. From this study and the previous studies, it is evident these parameters, which are measures of reproductive behaviour, affect fertility differently. Fertility levels are lowest in places and for women whose childbearing activity starts late and ends early. This means that the amount of time spent on childbearing in such a case is short and consequently leads to low fertility levels. The converse is true for women who start childbearing activity early and stop late. From the findings of the study, although most women in Kenya engage in marriage later in life, they have their first births coming quite early in life. They also end up their childbearing later in life. This scenario seems to have favoured the persistently high fertility that has remained a menace in Kenya for a long period.

The study also dwelt much on child spacing as well as starting and stopping of childbearing. The spacing of children by a mother comes out as an important family forming factor and therefore it is a force to reckon with in terms of determining the number of children born to a woman. In Kenya children are closely spaced at an average interval of about 3 years.

With this kind of spacing, and a long reproductive span then it is not surprising that fertility levels are high.

Fertility levels have declined in Kenya. This has been attributed to the increased use of contraceptives. Related to this study is the use of contraceptives which has lengthened birth spacing. This has lead to fewer children per woman per unit time and therefore lower levels of completed fertility and consequently lower total fertility per woman.

As far as the determinants of age at first birth are concerned it has been noted that education has the greatest influence. This probably indicates that mothers who have been to school for long tend to delay getting married and hence age at which they get their first birth. Alternatively those with some education have shaken of most of the cultural ties that could relate to the traditional value of children and therefore have accepted the modern realities of having fewer children.

Place of residence,ethnicity, work status and contraceptive use are some of the other variables which had a positive effect on age at first birth. Religion did not show a significant contribution to age at first birth.

As concerns the methodology the two methods used present similar results with very little differences. The indices obtained are only pointers and may not necessarily be very strict indicators as such. This is true because the methods used to come up with these indicators are derived mathematical models based on assumptions. For example retrospective data set is most suitable for estimating mean age at last birth. Therefore use of survey data to estimate the same index is a high mathematical approximation. Similarly the difference between age at last birth and age at first birth to obtain the reproductive span is not very realistic considering that they are not in the same universe.

5.3. Recommendations

The Kenyan government has made a concerted effort to control the dangerous incident of high fertility. Accordingly the following recommendations are aimed at improving the people's welfare by reducing their fertility.

1. Education seems to have a significant impact on reproductive behaviour of women in many studies including this one. It is therefore strongly recommended that female education particularly for rural women should be enhanced. In the case of this study education was found to be a major determinant of age at first birth. Some women in the rural areas are less educated as compared to those in the urban places, improvements in education should mostly be aimed at sensitising the rural women on the importance of having smaller families by delaying the onset and controlling the tempo of childbearing. The socio-economic and health implications of child spacing should be explained.
2. Work status was found to be positively related to age at first birth and thus fertility. Working mothers have smaller families through having short reproductive span and slower pace/tempo of childbearing. This means that if more employment opportunities are availed to women, probably this could result in a reduction of fertility.
3. It is also recommended that those aspects of life that lead to postponement of conception and therefore childbearing need to be encouraged in the society. Some of these aspects include breast-feeding, contraceptive use and periodic abstinence. The longer the breast-feeding periods the wider the children are spaced. Similarly the more the use of

contraceptive methods and the periodic abstinence the longer the birth intervals hence lower fertility.

4. With deteriorating economic situation in Kenya, there is a likelihood of age at first birth going further down with all its health and socio-economic implications. This calls for an integrated approach in alleviating this unfortunate trend from taking place -it can easily down pedal the whole process of demographic change. So it is recommended that all government and non-governmental agencies be mobilised fully to play significant roles in sensitising people on the importance of socio-economic advancement as a way to having smaller families and therefore better welfare for the whole society. A case in mind is that of making use of agricultural extension workers and other front line workers that are in close and constant contact with the people. They could be most useful in passing population messages alongside with their professional messages. This is likely to reduce the cost and increase the effectiveness of the overall family planning programme.

5. Marriage is a major precursor to age at first birth. In Kenya marriage is regarded universal. Therefore to be able to be in control of age at first birth for a woman there should be an effort to discourage early marriages. This can be achieved easily by say having primary education compulsory so that the youths spend a little more time in school and therefore delay early childbearing. 6) The family planning programme planners should encourage women to give birth during their prime age of say between 25-35 years. This will have quite an impact in fertility in that fertility regulation will be dependent on both parity and age of the mother.

5.4. Possible Areas for Further Research

The following areas are suggested for further research.

1. The contribution of nutritional and environmental factors to age at first birth and age at last birth need to be investigated in detail.
2. The association of age at first birth, age at menarche,and age at last birth as factors that are closely related to fertility behaviour need to be assessed with a view to identifying their impact on each other and to the fertility itself.
3. The effects of intermediate variables such as breast-feeding, post partum amenorrhoea and abstinence on child spacing need to be studied in detail.This is necessary because child spacing is an important factor in both mortality (infant and maternal).and fertility trends in Kenya today. The understanding of this important relationship needs to be complete and precise in order to enable successful implementation of the various related projects in the country.

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Appendix A: Derivation of Suchindran and Horne(1984) and Horne (1985) technique Mean age at first birth

Let m(x)dx denote the probability that a woman of age x will have a birth in the age interval (x,x+dx). The probability of not having a birth before age x is

$$\exp(-\int_{\alpha}^{B} m(t)dt)$$

where α is the lower age of childbearing

This is derived from the analogy that the probability of surviving up to age x is equivalent to the probability of not dying before

age x which is $p(x) = \exp(-\int_{0}^{x} u(t)dt)$.

The probability of dying between age x and x+dx is the same as the probability of surviving up to age x and then dying at age x; which is $\mu(x)p(x)$

where $\mu(x) = d\ln l(x)/dx$

Thus using the same argument as above the probability of having the first birth in the age interval (x,x+dx) is the probability of not giving birth before age x and then giving birth between x+dx.

i.e $g^1(x)=m(x)\exp(- m(t)dt$ for α x β

The probability that a new-born girl will ever become a mother is of $g_1(x)$ which is

$$s_1=\int_{\alpha}^{\beta} g_1(x)dx$$

i.e $$s_1=\int_{\alpha}^{\beta} m(x)\exp(-\int_{\alpha}^{\beta} m(t)dt$$

But $d/dx \exp(-m(t)dt=\exp(-m(t).d/dx(m(t))$

$$=-m(x)\exp(-m(t)dt)$$

$$s_1=-\int_{\alpha}^{\beta} d/dx \exp(-\int_{\alpha}^{\beta}(m(t)dt)dx$$

$$=\int_{\alpha}^{\beta} d\exp(-\int_{\alpha}^{\beta}(m(t)dt)$$

$$=-\exp(\int_{\alpha}^{\beta}(m(t)dt)=-(\exp(-\int_{\alpha}^{\beta}(m(t)dt)-\exp(-\int(m(t)dt)$$

But $\int_{\alpha}^{\beta}(m(t))dt=TFR$ and $\int_{\alpha}^{\alpha}(m(t)dt)=1$

$$s_1=-((\exp(-TFR))-1) =1-\exp(-TFR)$$

The mean maternal age at birth (MAFB) is then given as

$$MAFB=\int_{\alpha}^{\beta} x.g_1(x)dx/\int_{\alpha}^{\beta} g_1(x)dx$$

$$=\int_{\alpha}^{\beta} x.g_1(x)dx/s_1$$

$$= x.g(x)dx/1-\exp(-TFR)$$

But $xg_1(x)= x.d(\exp(- m(t)dt))$

Integrating by parts

Let $u=x$, $du=dx$

and $dv=d(\exp(- m(t)dt))$

$v=\exp(- m(t)dt)$

$x.g_1(x)dx = -x.\exp(- m(t)dt + \exp(- m(t)dt.dx)$

$= -\beta\exp(-TFR) + \exp(m(t)dt)dx$

$MAFB = a-\beta\exp(-TFR) + \exp(- m(t)dt)dx/1-\exp(-TFR)$

Suppose $a = 15$ and $\beta = 50$

$MAFB = 15-50\exp(-TFR) + \exp(- m(t)dt)dx/1-\exp(-TFR)$

But $\exp(- (m(t)dt)dx$ can be modified further

The expression $m(t)dt$ represents cumulative fertility from age 15 to age x and can be referred to as TFR(X)

The expression $\exp(- m(t)dt)dx$ can be approximated further to look as follows.

$\exp(- m(t)dt)dx = \exp(- m(t)dx) + \exp(- m(t)dx) + \text{------------------------} + \exp(-m(t)dt)dx$

$= 5\exp(- m(t)dt) + 5\exp(- m(t)dt) + 5\exp(m(t)dt + \text{--------------------} + 5\exp(- m(t)dt$

$= 5\exp(-TFR(17.5)) + 5\exp(-TFR(22.5)) + 5\exp(-TFR(27.5) + \text{------}$

$\text{------------} + 5\exp(-TFR(47.5)$

Let m_i be the ith age-specific fertility rates which are assumed constant within the ith group; then we have

$TFR(17.5) = 0 + 2.5m1$

$TFR(22.5) = 5M1 + 2.5M2$

$TFR(27.5) = 5M1 + 5M2 + 2.5M3$

$TFR(32.5)=5M1+5M2+5M3+2.5M4$

$TFR(47.5)=5M1+5M2+5M3+5M4+5M5+5M6+2.5M7$

Therefore the value of the integral

$exp(- m(t)dt).dx) = 5 \quad exp(-TFR(xi))$

Where x_i refers to the mid range interval in the ith age group.

$MAFB = (15\text{-}50exp(-TFR) + 5 \quad exp(-TFR(xi)))/1\text{-}exp(-TFR)$

variance of the mean age at first birth (MAFB).

It can be defined as follows

$VAFB = x^2.g_1(x)/g_1(x) - MAFB^2$

Using the same procedure of simplifying as in MAFB it can be shown that ;

$VAFB = ((15^2 - 50^2 exp(-TFR) + 2*5 \quad xiexp(-TFR))/1\text{-}exp(-TFR)) - MAFB^2$

mean age at last birth (MALB).

Derivation of mean age at last birth formula is as follows:

Let m(x) denote the probability that a woman of age x will give birth in the age interval (x,x+dx) with assumptions taken as in the previous section.

Let T(x) be probability that a woman aged x will not give birth after age x.

$T(x)=exp(- m(t)dt)$

Thus the probability that a woman will have her last birth will be

$g1(x)=m(x).T(x)$

$= m(x).\exp(- m(t)dt$

0 else where where a x β

Then the mean maternal age at last birth is given by

MALB$=$ $x.g^{1}(x)/ g^{1}(x) =$ $x.m(x)\exp(- m(t)dt).dx/ m(x)\exp(- m(t)dt.dx$

To evaluate the denominator

$m(x)\exp(- m(t)dt).dx = d/dx \exp(- m(t)dt)dx$

Since $d/dx(\exp(- m(t)dx) = \exp(- m(t)dt \quad d/dx(- m(t)dt)$

$= -m(t) - \exp(- m(t)dt)$

$=(-m(\beta) + m(x))\exp(- m(t)dt)$

$= m(x) \exp(- m(t)dt)$

$= \exp(m(t)dt \quad = \exp(- m(t)- \exp(- m(t)dt)$

$= 1-\exp(-TFR) = S_1$

In the numerator we had the expression that

$x.m(x)\exp(- m(t)dt) = x.d/dx \exp(- m(t)dt).dx$

By use of integration by parts ;

We let $u=x$, $du=dx$

$dv = d/dx \exp(-m(t)dt).dx$

$v = \exp(- m(t)dt)$

Therefore

$x\ m(x)\exp(-m(t)dt) = x.\exp(- m(t)dt) - \exp(- m(t)dt).dx$

$=\beta\exp($ m(t)dt= x exp(- m(t)dt) - exp(m(t)dt).dx

$=\beta$-A exp(-TFR) - exp(- m(t)dt).dx

But we know that TFR

m(t)dt= m(t)dt + m(t)dt

Therefore m(t)dt= m(t)dt - m(t)dt

=TFR-TFR(x)

Let a=15 and β=50

Then

MALB= 50-15exp(-TFR)- exp(-(TFR-TFR(X))dx/1-exp(-TFR)

But exp(-(TFR-TFR(x)+ exp(-(TFR-TFR(x)))+------------+ exp(-(TFR-TFR(x)))

=5exp(-(TFR-TFR(17.5)+5exp(-(TFR-TFR(22.5)))+---------+5exp(-(TFR-TFR(47.5)))

=5 exp(-(TFR-TFR(xi)))

Where x_i is the mid-point of ith age group.

MALB= 50-15 exp (-TFR) -5 exp(-(TFR-TFR(xi)))/1-exp(-TFR)

Variance of mean age at last birth (VALB).

This can be defined as

VALB = x^2.gi(x)/ gi(x)

=x^2m(x) exp(- m(t)dt.dx/ m(x)exp(- m(t)dt).dx

Using quite a similar procedure of simplifying as in the previous section, it can be shown that

yVALB =(50^2-15^2 exp(-TFR) -2.5 xi exp(-(TFR-TFR(xi)))/1-exp(-TFR)) -$MALB^2$