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The Dynamics of Birth Spacing and Marital Fertility in Kenya

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The Dynamics of Birth Spacing and Marital Fertility in Kenya

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1 Introduction

In 1979 Kenya was reported to have a population growth rate of four per cent per year, the highest rate of any country in the world (Population Reference Bureau 1979). This is due to the unique combination of a very high birth rate (54 per 1000) and an unusually low death rate for a tropical African country (14 per 1000).

Studies of recent trends in birth and death rates have yielded both expected and unexpected findings (Population Studies and Research Institute 1979). There has been a steady decline in mortality over the past decades and, consistent with classical demographic theory, this has been associated with economic development and a general improvement in social welfare. Some specific factors shown to be important were improvements in infant and child nutrition, the rising level of female education, and the control of malaria (Anker and Knowles 1977; Mott 1982). Fertility, by contrast, has not shown a parallel decline with development as anticipated. Rather, evidence points to generally sustained high fertility rates (Henin, Korten and Werner, forthcoming) in spite of the existence of a national family planning programme since 1968. More significantly, an examination of differentials in current fertility within Kenya shows higher levels associated with some development indicators such as the proportion of females with primary education (Central Bureau of Statistics 1979; Henin and Mott 1979).

A rise in fertility associated with the introduction of primary education among women may be attributed partly to improved health conditions. For example, Henin *et al* (forthcoming) have documented a decline in childlessness which may be attributed first, to a reduction in sterility due to effective treatment of venereal diseases, and secondly, to a decline in foetal losses due to malaria control. It is likely that health conditions such as these are continuing to contribute to regional and social fertility differentials, both because the diseases that significantly decrease fertility are largely concentrated in certain ecological areas or cultural groups and because the limited coverage of the country by health services could favour some social groups more than others.[1] There is considerable variation in nutritional levels in Kenya, but numerous studies indicate that this has only a modest effect on fertility (Mosley 1980; Bongaarts 1980). Recent studies in several African countries indicate that social transformations associated with development can lead to higher fertility, at least in the early stages (Kocher 1977; see also Caldwell 1975: 3–28, 29–57, 187–235). This is due to the breakdown of cultural traditions concerned with breastfeeding, post-partum abstinence and polygamy. Given the complex dynamics of childbearing, it is evident that an analysis of current fertility differentials must take into account both social and biological variables.

[1] For a discussion of the malaria patterns and the role of venereal disease in infertility in Kenya, see Vogel *et al* (1974) and Government of Kenya (ND). An example of the limited coverage of the health system is the ratio of one health centre per 72 000 population in the rural areas.

To address this problem, the analytical framework first presented by Davis and Blake in 1956 and recently modified by Bongaarts (1978) provides a useful approach. This formulation identifies the biological and behavioural factors which are the direct determinants of fertility, called the intermediate fertility variables. These are acted on by social, economic and environmental factors which are the indirect determinants of fertility. Bongaarts has classified eight intermediate fertility variables into three groups as follows:

I Exposure factors
1 Proportion of reproductive period spent in marriage, ie any stable sexual union
II Deliberate marital fertility control factors
2 Contraception
3 Induced abortion
III Natural marital fertility factors
4 Post-partum infecundability (this can include abstinence as well as lactational amenorrhoea)
5 Frequency of intercourse
6 Sterility (related to menarche and menopause as well as disease)
7 Spontaneous foetal mortality
8 Duration of fertile period (in each menstrual cycle).

With this framework, it is possible to examine the factors that could result in higher fertility with modernization in Kenya.

Consider the 'exposure factors'. Essentially all Kenyan women marry, so celibacy is not a consideration. Improvements in life expectancy of the spouses can be expected to lengthen the duration of a marital union slightly and raise fertility. Changes in the age at marriage, or stability of the marital union also affect fertility levels.

The 'marital fertility control factors' (contraception and abortion) contribute to a decline in fertility. In the Kenya Fertility Survey only seven per cent of women were practising any method of contraception in 1978 (Central Bureau of Statistics 1980).

Among the 'natural marital fertility factors', as noted earlier, sterility and spontaneous abortions may have been reduced. However, the study by Henin *et al* (forthcoming) suggests that changes in the levels of childlessness have not been of importance in Kenya in the past decade, except perhaps among localized groups in the Coastal districts.[2]

Post-partum infecundability and the frequency of

[2] The per cent of women reporting childlessness in the 30–34 age group by province are: Nyanza 5.3, Western 3.3, Rift Valley 1.0, Central 1.7, Eastern 1.2, Coast 8.1 and Nairobi 7.0.

intercourse are two factors that are likely to change significantly as a traditional African society modernizes. The period of infertility after childbirth is prolonged biologically by the practice of breastfeeding (Tyson and Perez 1978; Van Ginneken 1978); it can also be extended further by abstinence (Caldwell and Caldwell 1977). Both breastfeeding and abstinence have shown a tendency to decline in some African countries, particularly as women's education, women's participation in the modern workforce and adoption of 'Western' values advance (Nag 1979; Bongaarts 1979).

The frequency of intercourse is related to the type of marital union. In East Africa, polygamy, though still common, is declining. Polygamy has been associated with lower fertility, in part through reduced sexual exposure because of the lack of husband-wife intimacy in such relationships (Whiting 1977). This would be particularly true of older women as new wives come into the household. Also, the practice of husbands and wives sleeping together in the same house every night was uncommon with many earlier East African traditions (Whiting and Whiting 1975); urbanization and the introduction of 'Western' cultural values, however, has changed this (Whiting 1977; Molnos 1973).

2 Methods

2.1 THE ANALYTICAL MODEL

From the above discussion it is apparent that a study of the 'natural fertility factors' influencing fertility levels among married women is important. The level of fertility is related directly to the proportion of women actually producing children and inversely to the interval between live births among these women. Thus birth interval models provide a useful analytical approach (Potter 1963). In simplified form, the time interval between two successive live births can be expressed as the sum of four components:

1 The duration of the period of post-partum infecundability (or lactational amenorrhoea);
2 The duration of the period of ovulatory exposure after menstruation has resumed (menstruating interval);
3 The duration of gestation;
4 Time added by foetal losses.

If all pregnancies terminated in live births, then the sum of the first three components would estimate the live birth interval. In fact, a certain fraction of pregnancies terminate in non-live births. This event is associated with a shorter duration of gestation and a shorter period of post-partum infecundability because of the absence of breastfeeding. Foetal losses thus effectively lengthen the interval between live births, the amount of lengthening depending upon the proportion of pregnancies terminating in this event.

A simple fertility model permits decomposition of marital fertility into its two major components, the pregnancy progression ratio and the mean duration of the live birth interval. Further, based on the proportions of women who report that they are currently breastfeeding and amenorrhoeic following a live birth, durations of these components can be estimated. The method thus uses data on the current reproductive status of women. It also permits a direct assessment of the relative contribution of breastfeeding, contraceptive practice and other fertility-limiting behaviour to variations in marital fertility between subgroups of the population.

The model considers all currently married women entering by marriage and leaving by divorce, separation or widowhood. Figure 1 depicts six reproductive states that women pass through in the course of childbearing. Equations for the model are developed briefly below and more fully in appendix A.

If we let: μ_1 = mean duration of the menstruating interval for women who will become pregnant

$\mu_2 + \mu_3$ = mean duration of gestation for a live birth

$\mu_2 + \mu_5$ = mean duration of gestation for a non-live birth

μ_4 = mean duration of post-partum amenorrhoea after a live birth

μ_6 = mean duration of post-partum amenorrhoea after a non-live birth

p = proportion of pregnancies terminating in non-live births

G = proportion of women who will progress to the next pregnancy.

Then letting T_4 be the mean time interval between live births, we find:

$$T_4 = \mu_4 + \mu_1 + \mu_2 + \mu_3 + \left[\frac{p}{1-p} \times (\mu_1 + \mu_2 + \mu_5 + \mu_6)\right]$$

For all practical purposes the following components may

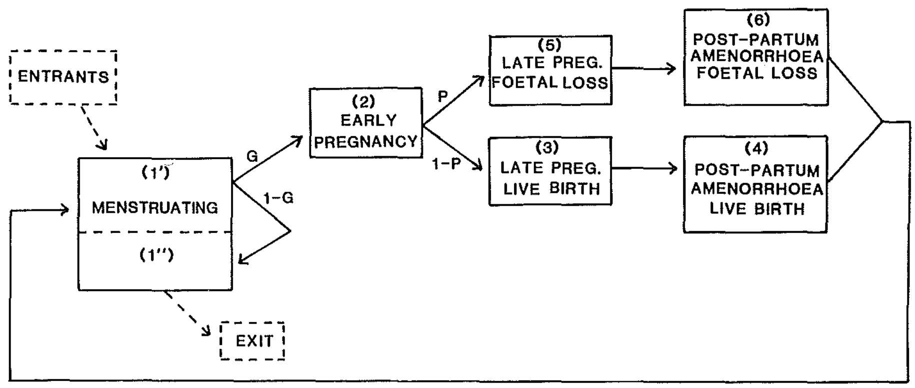

Figure 1 A Fertility Model Illustrating the States that Women Pass through in the Reproductive Process

NOTE: State 1 is subdivided into 1′ and 1″ representing the respective proportions of women who do and do not progress to the next pregnancy.

be taken as constant:

$$\mu_2 + \mu_3 = 9 \text{ months}$$
$$\mu_2 + \mu_5 = 3.5 \text{ months}$$
$$\mu_6 = 2 \text{ months}$$

Thus the components that contribute to variations in the live birth interval (T_4) are μ_4, μ_1 and p.

The marital fertility rate is related to the live birth interval as follows:

$$MFR = \frac{G}{T_4}$$

Thus the pregnancy progression ratio is another variable influencing marital fertility. The relationship of each of the four variables (μ_4, μ_1, p, G) to fertility is briefly noted below.

Physiologically the duration of post-partum infecundability (μ_4) is directly related to the duration of breastfeeding which delays ovulation and produces lactational amenorrhoea (Tyson and Perez 1978). In societies where post-partum abstinence extends beyond the period of amenorrhoea, it may be considered as a component of μ_4.

The menstruating interval, or waiting time to conception (μ_1), represents the time from the resumption of menstruation (and ovulation) until the next conception (Leridon 1977). This time may be extended deliberately by contraception. The duration may also vary with the frequency of intercourse.

The proportion of pregnancies terminating in non-live births (p) has been estimated between 0.12 and 0.24 in studies of healthy women (Leridon 1977). It varies with age of the women, increasing after 30 years. The most common cause of variation in foetal losses, however, is the practice of induced abortion. Assuming the absence of specific diseases, or induced abortions, p may be assigned constant values depending upon the age group of the women.

The proportion of married women who will progress to another pregnancy (G) is a function of the level of fecundity and is related physiologically to the onsets of menarch and menopause. Based on studies in healthy (European) populations, the decline in fecundity with age has the following pattern (Henry 1961):[3]

	Women's (exact) age				
	20	25	30	35	40
Proportion fecund	0.97	0.94	0.90	0.84	0.69

Fecundity, which is estimated in this study by the pregnancy progression ratio among non-contracepting married women, may be reduced by sterility-producing diseases such as gonorrhoea or tuberculosis, and by the complications of repeated childbirth under insanitary conditions.

[3] The table is derived as one minus the proportion sterile at the specified ages.

2.2 THE DATA

The source of data for this study is the 1978 Kenya Fertility Survey (KFS). It was a probability sample of 8100 women aged 15–50, covering 96 per cent of the population in all but the most sparsely populated areas of the country. Details of the survey are reported elsewhere (Central Bureau of Statistics 1980).

The following current status information was available for the women surveyed:

1 Age
2 Parity
3 Marital status
4 Social and economic background variables
5 Reproductive status at time of interview, that is whether or not the woman was currently:
  a. Still breastfeeding
  b. Still abstaining post partum
  c. Still amenorrhoeic post partum
  d. Using 'effective' contraception (pill, IUD, condom, sterilization, injection)
  e. Using 'ineffective' contraception (rhythm, withdrawal, etc).

For this analysis, three age groups were used, 15–24, 25–34 and 35–44; marital fertility was estimated on the basis of the number of live births reported for the period 0–11 months preceding the interview.[4] p and G were estimated as described in appendix A and then using the proportions of women in each state, the equations of the model were solved to provide estimates of μ_1 and μ_4.

Mean durations of the birth interval (in months) by age group and method of estimation

Method of estimation	15–24	25–34	35–44	45 +
Current status method	28.0	30.1	35.6	–
Closed interval method[a]	27.7	31.7	36.8	40.8

[a] Source: KFS First Report, appendix table 4.2.2.

[4] An analysis of the quality of the data from the birth history questionnaire in the KFS indicated that an estimate of the MFR on the basis of births reported 0–11 months before the interview does not result in major biases which would compromise the objectives and findings of this study. For example, the number of births reported 12–23 months before the interview is different from the number of births reported 0–11 months by only 1 per cent. Examining the distribution of reported births by months over the first year revealed no gross irregularities except, as expected, a smaller number in month 0 (the month of interview). No adjustment was made for this bias (of about 4 per cent), as it is not expected to affect the comparisons between subgroups in the population. The good quality of the KFS birth history data no doubt reflects the fact that most of these women have been interviewed twice previously, as a part of the 1977 and 1978 National Demographic Survey in Kenya.

To make comparisons between subgroups of the population, data were weighted to a standard age distribution before calculations were made. The standard for this study was simply the age distribution of the entire study population.

The estimates of the birth interval from this current status analysis are compared above with the estimates of the mean duration of the last closed birth interval reported in the KFS. The latter estimates were derived from the birth history questionnaire.

The close correspondence of these estimates indicates that the current status method can be a useful technique for estimating birth interval components. The method utilizes data which can be obtained from very basic questions focusing primarily on the woman's current reproductive status. These data are considerably more accurate than inquiries about events in the retrospective period. The only retrospective information required relates to the last pregnancy termination and to marital status at one point in the past.

3 Results

3.1 MARITAL FERTILITY, FECUNDITY AND BIRTH INTERVALS

Marital fertility, the durations of the birth interval components and the per cent of women using an effective contraceptive method by age group are given in table 1. Fertility among women under age 25 is 399, declining to 338 in the 25–34 age group and to 196 for women aged 35–44.

The rates are directly related to the proportion of fecund women in the respective age groups, and inversely to the average duration of the live-birth interval. Based on the pattern of natural decline in fecundity with age, expected values for the pregnancy progression ratios can be estimated.[5] These are compared below with the observed values in the KFS data.

	All ages	15–24	25–34	35–44
Expected PPR	0.86	0.97	0.90	0.68
Observed PPR	0.80	0.93	0.85	0.58
% difference	−7.0	−4.1	−5.5	−14.7

The fecundity levels of Kenyan women are significantly below those in natural fertility populations and the differences increase with age. This matter will be considered further below.

3.2 BREASTFEEDING, LACTATIONAL AMENORRHOEA AND ABSTINENCE

The mean duration of breastfeeding is 17 months and ranges from 15 months for women under age 25 to 21 months for women aged 35–44 (table 1). It should be noted that 97 per cent of the women with a live birth initiate breastfeeding.

Lactational amenorrhoea averages 11 months for all women and its variation with age parallels the pattern of breastfeeding; for women under age 25 amenorrhoea averages 9 months, while it is 14 months for women aged 35–44.

Abstinence from sexual relations in the post-partum period is of limited duration. Based on the proportion of women reporting post-partum abstinence, the mean duration is estimated as only 3 months. Since this is much shorter than the mean duration of lactational amenorrhoea, the contribution of post-partum abstinence to a prolongation of the birth interval is negligible in the population at present.

3.3 CONTRACEPTION AND THE MENSTRUATING INTERVAL

Only four per cent of the women reported the current use of an 'effective' method of contraception. (In the KFS, the pill, the intra-uterine device, condoms, injections and other female scientific methods and sterilization were defined as effective.) The vast majority of current users were taking oral contraceptives. Among all currently married women, less than one per cent were sterilized at the time of the survey. The primary motivation for accepting contraception in Kenya is birth spacing, not terminating childbearing.[6] Only two per cent of the women reported the use of 'ineffective' methods such as rhythm, withdrawal, or traditional methods.

Contraceptive practice influences marital fertility through a lengthening of the menstruating interval. However, the level of contraceptive use in this population is so low that it is impossible to detect a measurable effect. The mean menstruating interval of eight months for contracepting women is in the range that may be expected under circumstances of natural fertility.

3.4 POLYGAMY

Twenty per cent of men in Kenya are polygamous, thus approximately 30 per cent of the wives are in polygamous unions. Polygamy may be a cause or a consequence of lower fertility. It can reduce marital fertility to the extent that separate living arrangements reduce coital frequency and promote post-partum or terminal abstinence. However, in other cases a man may take other wives because of infertility of his first wife.

Women in polygamous unions are further subdivided as to whether they are the latest or an earlier wife. (In the KFS, if a woman was in a polygamous union she was asked how many wives her husband had and what number wife she was. When the two answers were equal, the woman was considered to be the latest wife.)

Marital fertility among wives in polygamous unions is 11 per cent lower than among wives in monogamous unions (table 2). This difference is seen in all age groups. The birth interval length is virtually the same in the two groups; the difference in fertility is due to lower pregnancy progression ratios among wives in polygamous unions.

[5] These estimates were obtained by multiplying the number of women at each year of age (using a smoothed distribution) by the expected proportion sterile using model data developed by Leridon. See Leridon 1977: table B.6.

[6] Only 37 per cent of the women reporting current use of any contraceptive method stated they did not want a future birth. See table 7.9 of KFS First Report.

Table 1 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception for Currently Married Women in the KFS by Age Group

Age group	MFR (per 1000)	PPR	Birth interval components (mean length in months): LBI	BF	A	M	%C	Number of women
All ages	318	0.80	30	17	11	8	4	5159
15–24	399	0.93	28	15	9	8	3	1548
25–34	338	0.85	30	17	12	7	5	2229
35–44	196	0.58	36	21	14	9	5	1382

NOTE: The column headings of tables are:
MFR = Marital fertility rate
PPR = Pregnancy progression ratio (G)
LBI = Estimated mean live birth interval (T_4)
BF = Estimated mean duration of breastfeeding
A = Estimated mean duration of post-partum amenorrhoea (μ_4)
M = Estimated mean duration of the menstruating interval (μ_1)
%C = Per cent using effective contraception (pill, IUD, condom, sterilization, and other female scientific methods).

Table 2 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception for Currently Married Women by Age Group and Type of Marital Union

Age group and type of union	MFR[a] (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
All women (age adjusted)								
Monogamous	328	0.83	31	16	11	8	5	3703
Polygamous	292	0.76	31	18	12	8	3	1457
Latest wife	300	0.80	32	17	12	9	2	849
Earlier wife	288	0.73	31	18	11	8	3	608
Age 15–24								
Monogamous	413	0.95	28	14	9	8	3	1201
Polygamous	352	0.90	31	15	10	10	1	347
Age 25–34								
Monogamous	342	0.88	31	17	12	8	6	1606
Polygamous	326	0.80	29	18	12	6	3	623
Age 35–44								
Monogamous	210	0.63	36	21	14	9	5	896
Polygamous	170	0.54	38	21	14	11	4	487

[a] The abbreviations used in the tables are explained in the note to table 1.

Earlier wives in polygamous unions have still lower fertility than later wives in such unions.

Lower fecundity with polygamy, particularly among earlier wives, could be explained in part by reproductive diseases among these women leading the husbands to marry again. However, because the latest wives also have lower fertility and lower pregnancy progression ratios than wives in monogamous unions, it seems reasonable to conclude that factors related to the practice of polygamy may also be contributing to lower fertility. Biological factors such as a wider age difference between husbands and wives as well as marital instability related to living arrangements among the spouses or diseases affecting the husbands' reproductive capacity could all be relevant in this regard.

3.5 EDUCATION OF WOMEN

Education, particularly female education, has been demonstrated to have a significant effect on fertility in many countries (Caldwell 1980). Education brings a new set of values, new aspirations and a new outlook on life as well as skills for taking advantage of new opportunities. Typically, a rise in the level of female education leads eventually to a decline in fertility. In the short run, however, increased female education can actually raise fertility as it often leads to abandonment of traditional practices which have fertility-supressing effects, ie prolonged breastfeeding, postpartum abstinence and polygamy.

The government of Kenya has made a major investment in education since independence in 1963. As a result the educational attainment of women has risen substantially in recent years as is shown below.

Percentage of women attaining standard 1–8 and form 1 by age for 1969 and 1977

Age	Standard 1–8		Form 1	
	1969[a]	1977[b]	1969[a]	1977[b]
15–19	45.0	64.9	4.7	10.6
20–24	33.7	44.6	4.7	15.1
25–29	22.3	39.4	2.3	6.7
30–34	15.0	29.6	1.7	3.2
35–39		21.4		1.7

[a] 1969 Census.
[b] 1977 National Demographic Survey.

A rise in female education can result in lower fertility due to a rise in the age of marriage. In Kenya, however, the rising age at marriage has had only a partial impact on fertility, as a rise in age of first birth has not been directly associated with it. The tabulation below illustrates this dissociation.

Median age at first marriage and at first birth by educational level of the mother

Educational level	First marriage	First birth	Difference (years)
All levels	18.1	18.5	0.4
None	16.5	17.7	1.2
Std. 1–4	17.0	17.7	0.7
Std. 5–8	18.3	18.3	0.0
Form 1 +	23.5	21.2	– 2.3

Source: Tables 4.4 and 5.10 of KFS First Report

The impact of women's education on fertility within marriage is the major concern of this analysis. After age adjustment, women with some schooling have a fertility rate 4 per cent higher than those with no schooling (table 3). This small rise appears to be due to a higher level of fecundity as reflected by the higher pregnancy progression ratios, particularly among women with 1–4 years of education. The most consistent effects of education on the birth interval components relate to breastfeeding and contraceptive practice. There is a two-month decline in the average duration of breastfeeding among women with 5–8 years of schooling, resulting in a reduction of 25 per cent in the duration of lactational amenorrhoea. This is fully compensated by the higher level of contraceptive practice among more educated women, so that the total birth interval remains virtually unchanged among these educational groups.

Among educated women below age 25, fertility is significantly higher than among uneducated women, eg among women with nine or more years of education, fertility is 20 per cent higher than among women with no education). This is due to both a higher pregnancy progression ratio and a decline in breastfeeding and amenorrhoea in the more educated group. The unusually high pregnancy progression ratio could be explained by the fact that many of these women did not marry until they were pregnant or had a child and thus were selected for proven fecundity. Although contraceptive practice is much higher among these young women with nine or more years of education, it apparently does not compensate for the shortening of the birth interval produced by the substantial decline in breastfeeding.

Among women aged 25–34, fertility also tends to rise with education, and again this is associated with a progressive decline in breastfeeding and amenorrhoea as well as higher fecundity. Among women over age 35, though the numbers of educated women are small, the data do indicate some decline in fertility among this group as compared to those with no schooling.

Thus among younger women a rise in education is associated with a rise in fertility, due to both higher fecundity and a decline in breastfeeding and amenorrhoea. Among older educated women, the declines in breastfeeding and amenorrhoea are increasingly compensated for by higher levels of contraceptive practice, so that education is associated with lower fertility. Because the vast majority of educated women in Kenya have only primary education (up to standard 8) and since most of these women are young, the net effect, at least in the short run, is a substantial rise in current marital fertility with increasing education.

3.6 EDUCATION AND TYPE OF MARITAL UNION

The higher fertility among women with some primary education is related to both a higher pregnancy progression ratio and to a decline in the practice of breastfeeding. Women's education can have another effect on marital fertility, however, by changing the pattern of marital relationships. As noted earlier, women in polygamous unions have lower fertility than women in monogamous unions. In Kenya the rise in the levels of women's education is associated with a substantial decline in the proportion of women entering a polygamous marital union. This is shown for the KFS sample women below:

Per cent of women in polygamous unions

Educational level of women	Age < 25	25–34	35 +
No education	27	35	41
Std. 1–4	24	22	28
Std. 5–8	20	21	32
Form 1 +	12	17	*

*Data insufficient.

Table 4 gives the marital fertility and birth interval components by education for women in monogamous and polygamous unions. Consistent with earlier findings, women in polygamous unions have lower fertility at every educational level with the difference due primarily to lower pregnancy progression ratios. It is also evident that among women in monogamous unions, fertility is higher for educated women as compared to those with no education

Table 3 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception for Currently Married Women by Level of Education and Age Group of the Woman

Age group and type of union	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
All women (age adjusted)								
No education	308	0.79	31	18	13	7	2	2598
Std. 1–4	319	0.84	32	17	12	9	4	1027
Std. 5–8	316	0.81	31	16	9	10	8	1222
Form 1 +	*	*	*	*	*	*	*	312
Age 15–24								
No education	384	0.92	29	16	11	7	0	575
Std. 1–4	398	0.93	28	14	10	7	0	266
Std. 5–8	396	0.95	29	15	8	10	4	541
Form 1 +	463	0.97	25	12	7	7	10	164
Age 25–34								
No education	330	0.84	30	18	13	6	2	1096
Std. 1–4	309	0.90	35	18	12	11	5	430
Std. 5–8	367	0.83	27	15	10	6	9	564
Form 1 +	370	0.94	31	11	8	11	17	138
Age 35–44								
No education	188	0.57	36	22	15	9	3	927
Std. 1–4	248	0.65	31	18	12	7	5	331
Std. 5–8	145	0.63	52	21	11	24	13	117
Form 1 +	*	*	*	*	*	*	*	10

*Insufficient data to estimate.

Table 4 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception for Currently Married Women by Type of Marital Union and Educational Level of the Wife

Type of union and level of education[a]	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
Monogamous union								
No education	316	0.81	31	18	13	7	2	1696
Std. 1–4	332	0.86	31	17	11	8	4	776
Std. 5–8	326	0.85	31	15	10	10	9	959
Polygamous union								
No education	292	0.75	31	18	13	7	2	901
Std. 1–4	279	0.78	34	17	12	10	2	251
Std. 5–8	284	0.75	32	17	9	11	6	261

[a] All groups age adjusted.

because of a rise in fecundity. Yet the birth intervals are nearly the same for all groups because the effect of declining breastfeeding is fully compensated for by the rise in contraceptive practice.

3.7 HUSBAND'S OCCUPATIONAL CLASS

The study women were stratified into three classes according to the type of occupation of their husbands. These classes and selected characteristics of the wives in each class are shown in table 5. Class I primarily includes husbands who work in traditional agrarian occupations or as household servants. The vast majority are in the rural areas and about two-thirds of the wives in these households have no education. Class II includes husbands with some technical skills, a significant proportion of whom reside in urban areas. Approximately half of the wives in this group have some education. Class III includes husbands with professional or white collar jobs; 20–30 per cent of this group reside in urban areas and over 70 per cent of the wives have some education. With respect to poly-

Table 5 Selected Characteristics of Women by Husband's Occupation, for All Women in the KFS Sample

Husband's occupation	Per cent polygamous	Per cent no with education	Area of residence (%) Rural	Metropolitan	Number of women[a]
Occupational class I					
Agr., self-employed	34	66	99	1	1509
Agr., labourer	22	65	98	1	394
Service, household	26	62	92	4	117
Occupational class II					
Skilled manual	28	48	80	12	944
Unskilled manual	25	40	86	11	261
Sales	33	47	86	6	394
Service, other	31	46	84	11	500
Occupational class III					
Professional	27	19	82	11	519
Clerical	25	27	71	20	273

[a]185 women reported that their husbands had never worked.

Table 6 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Age Group of the Woman and Husband's Occupational Class

Age group and husband's occupational class	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
All ages (age adjusted)								
I	308	0.80	31	18	13	7	2	2021
II	325	0.80	30	16	10	7	5	2099
III	327	0.79	29	14	9	9	10	792
Age 15–24								
I	400	0.93	28	15	11	7	1	538
II	391	0.93	28	14	9	8	3	662
III	408	0.94	28	14	8	9	5	262
Age 25–34								
I	314	0.85	33	20	14	8	2	841
II	355	0.85	29	16	11	6	5	899
III	350	0.84	29	13	9	9	12	383
Age 35–44								
I	196	0.58	36	21	15	8	3	642
II	203	0.59	35	21	13	9	6	538
III	197	0.55	34	17	12	9	13	147

gamy, there is relatively little difference in its level between these occupational classes. Paralleling the educational trends, the entry of husbands into the technical, professional and white collar occupations is a relatively recent phenomenon; thus couples in class III are significantly younger than those in class I.

The relationship of husband's occupational class to marital fertility is given in table 6. The age-adjusted data reveal that fertility is slightly higher for women in classes II and III compared to women in class I. These higher levels are related not to differences in fecundity, as was the case in the education comparisons, but to shorter birth intervals, ie women with husbands in classes II and III have shorter durations of breastfeeding and lactational amenorrhoea. This decline in lactational amenorrhoea is not compensated by a rise in the menstruating interval despite the higher level of contraceptive practice among these women.

However the fertility differences are quite small, being only 6 per cent for the age-adjusted rates between women in class III and class I. The more notable point is the fact that families in the professional and white collar sectors of the society are maintaining approximately the same level of fertility as families in traditional agrarian occu-

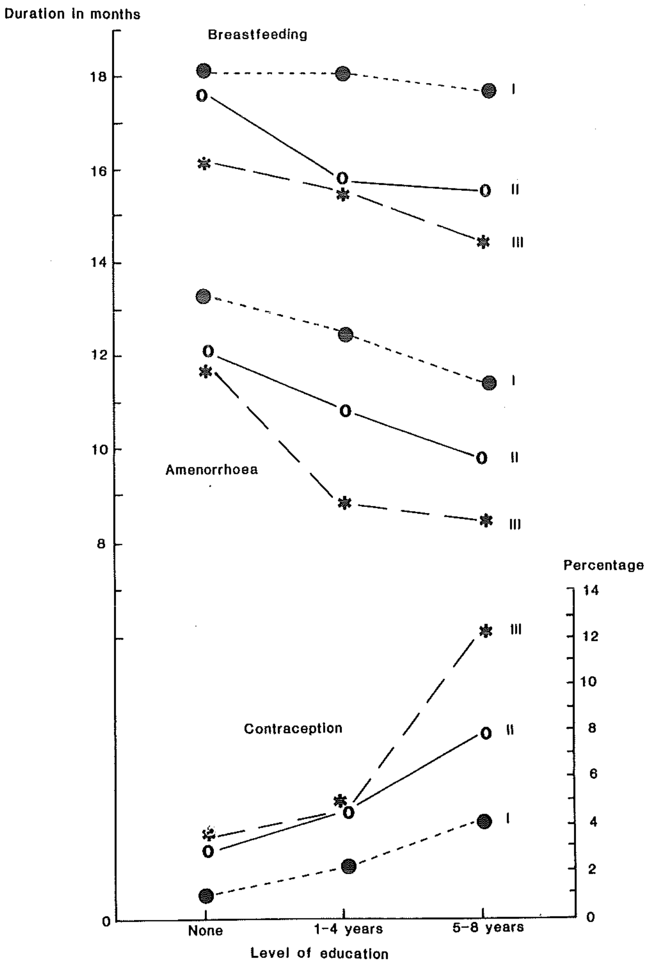

Figure 2 Duration of Breastfeeding and of Post-Partum Amenorrhoea, and Per Cent Using Effective Contraception by Education of Wife and Occupational Class of Husband

NOTE: Occupational classes: I - Traditional agrarian; II – Service, unskilled/skilled manual; III – Professional and clerical.

pations though by significantly different mechanisms. Traditionally, birth spacing is largely a function of breastfeeding and lactational amenorrhoea, while in the more modern sector contraceptive practice is beginning to replace breastfeeding as a preferred method of fertility control.

3.8 INTERACTIONS OF HUSBAND'S OCCUPATION AND WIFE'S EDUCATION

Because both the husband's occupation and the wife's education have an effect on birth spacing practices, it is of interest to examine the effects of variations in occupational class on fertility among women at various levels of education (table 7). Within each occupational class, a rise in the level of wife's education is consistently associated with a decline in the durations of breastfeeding and lactational amenorrhoea. Likewise the occupational class of the husband has an independent effect in reducing breastfeeding and amenorrhoea at each educational level. Thus breastfeeding is 18 months with 13 months of amenorrhoea among women with no education in class I, while breastfeeding is only 15 months and amenorrhoea 9 months among women with 5–8 years of education in class III (figure 2).

With the decline in breastfeeding, there is a corresponding rise in contraceptive practice which is also a function of both the level of the wife's education and the husband's occupational class, ranging from a low of one per cent among wives with no education in class I to 12 per cent among wives with 5–8 years of education in class III.

There is an interaction effect between education and occupational class with respect to fecundity. Among women with no schooling the pregnancy progression ratios are relatively low and rise very slowly with a rise in husband's occupational class. For women with some schooling, the pattern is quite different. The pregnancy

Table 7 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Educational Level of the Woman and Husband's Occupational Class

Educational level and husband's occupational class[a]	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
No education								
I	307	0.79	31	18	13	7	1	1311
II	316	0.79	30	18	12	7	3	994
III	274	0.81	35	16	12	11	3	146
Standard 1–4								
I	305	0.85	33	18	13	9	2	413
II	338	0.83	30	16	11	8	5	464
III	268	0.79	36	16	9	14	5	112
Standard 5–8								
I	307	0.86	34	18	11	10	4	274
II	311	0.82	32	16	10	10	8	553
III	332	0.75	27	15	8	8	12	340

[a] All groups age adjusted.

progression ratios are highest among women whose husbands are in the lowest social class, but decline substantially as occupational class rises. While a rise in fecundity with a rise in education or social class might be expected on the basis of better health, the substantial decline in fecundity observed among more educated women as social class rises is surprising. The table below provides a closer examination of this question.

Pregnancy progression ratios for women with 5–8 years of education

Husband's occupational level	All ages	Age group 15–24	25–34	35–44	Number of women
I	0.86	0.98	0.84	0.76	119
II	0.82	0.93	0.84	0.67	271
III	0.75	0.95	0.82	0.42	185

The largest decline in the pregnancy progression ratio is among older women in the highest social class. This must represent a substantial degree of voluntary fertility control which the women did not report.

3.9 WOMEN'S WAGE EMPLOYMENT AND FERTILITY

In many societies women's participation in wage employment has been associated with a decline in fertility. In Kenya, while essentially all married women are fully engaged in the rural agricultural economy, few are in the formal labour sector. In the KFS sample, 304 married women reported that they were currently in a salaried job. The fertility of these women is 15 per cent lower than that of other women (table 8). The difference is largely the result of contraceptive practice which produces a significant prolongation in the menstruating interval. Working in a salaried job is apparently not interfering greatly with breastfeeding; the mean durations of breastfeeding and lactational amenorrhoea are respectively two and one month lower than for the average Kenyan woman.

3.10 URBANIZATION

Ninety per cent of the Kenyan population resides in rural areas. Urban-rural fertility differentials are shown in table 9. Though urban women have shorter durations of breastfeeding, post-partum amenorrhoea and birth intervals than rural women, age-adjusted fertility is 16 per cent lower among urban women than among rural women. This

Table 8 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Employment Status of the Woman

Work status[a]	MFR	PPR	LBI	BF	A	M	%C	Number of women
Currently working	273	0.76	33	15	10	11	16	304
Not currently working	321	0.81	30	17	11	8	4	4857

[a]Groups are age adjusted.

Table 9 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Age Group of the Woman and Place of Residence

Age group and area of residence	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
All ages (age adjusted)								
Rural	322	0.81	30	17	12	8	4	4543
Urban	271	0.67	30	14	9	9	11	619
Age 15–24								
Rural	397	0.94	28	15	10	8	2	1281
Urban	408	0.89	26	12	7	8	6	267
Age 25–34								
Rural	342	0.86	30	17	12	7	4	1964
Urban	309	0.72	28	14	10	7	15	265
Age 35–44								
Rural	206	0.60	35	20	14	8	5	1298
Urban	57	0.33	66	36	22	27	9	87

reduction in fertility is consistent with the higher level of contraceptive practice in urban areas, but urban women also have significantly lower pregnancy progression ratios.

Among women below age 25, urban residents have higher fertility than their rural counterparts, due to shorter birth intervals. In the age group 25–34, urban residents continue to have shorter birth intervals than rural residents, but their fertility is lower due to a large difference in the levels of fecundity.

There is an even greater urban-rural fertility difference in the age group over 35, though the small number of urban residents makes interpretation tenuous. All components of the birth interval are prolonged and the pregnancy progression ratio is very low among the urban women.

These urban-rural differentials in fertility with age follow the patterns seen for education and occupation. The results reinforce the thesis that as Kenyan women enter the modern sector of society, they tend to have higher fertility when young, due to better health and shorter birth intervals. However, as they get older, they begin to take measures to reduce fertility effectively. But reported levels of contraceptive practice cannot account for the very low levels of fertility seen among urban women. Again, one must suspect a significant level of unreported fertility control, including possibly induced abortion, in order to account for the very low reported fecundity.

3.11 REGIONAL VARIATIONS IN FERTILITY

Ecologically and climatically Kenya is a very diverse country. Over half the area, chiefly in the north and north-east, is arid. The main agriculturally productive regions are the Lake Plateau in the west, the Central Highlands and the south-eastern Coastal strip. The Highlands and the Lake Plateau are the most densely populated with over 200 inhabitants per square kilometre.

Kenya has consistently had significant variations in fertility by region (Central Bureau of Statistics 1969: 26–8). Marital fertility for the eight provinces covered in the KFS sample is shown in table 10. (North-Eastern Province and the arid, sparsely populated northern districts of Rift Valley and Eastern Provinces were not covered in the KFS.)

Looking at the rural regions of Kenya which are listed geographically in table 10 from Lake Victoria region in the extreme west to the Indian Ocean on the east, there is a definite trend towards higher fertility in the central areas, and lower fertility in both Coastal regions. This parallels the pattern of fecundity variations. The pregnancy progression ratios are lowest in both Coastal regions, reflecting the poorer health conditions in these areas.

If birth spacing were the same in all regions, then levels of marital fertility would parallel the levels of fecundity. Generally this is the case. Exceptions are Central Province and Coast Province. In the rural Coast Province, breast-feeding is very prolonged and there is also a long menstruating interval. Central Province, the most developed region in Kenya with the highest fecundity, might be expected to have the highest fertility, but it also has the highest level of contraceptive practice, resulting in somewhat longer than average birth intervals.

The two metropolitan areas, Nairobi and Mombasa, are strikingly similar in the durations of the birth interval and its components. In both of these urban areas, the durations of breastfeeding and amenorrhoea are almost identical and much shorter than in the rural regions of Kenya. Both urban areas also have pregnancy progression ratios that are much lower than in the rural regions. The net result is that urban fertility is lower than in all rural regions, except for rural Coast.

Nairobi and Mombasa do differ, however, in that Nairobi has a higher level of fertility in spite of more contraceptive practice and a longer birth interval. The difference is due to higher fecundity in Nairobi, presumably related to a difference in the general level of health in the two areas. Nairobi is adjacent to Central Province, which has the highest fecundity, while Mombasa is in Coast Province, which has the lowest.

3.12 ETHNIC VARIATIONS IN FERTILITY

Kenya also has a great diversity of ethnic groups. Indicative of this diversity is the fact that the KFS questionnaire was

Table 10 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Province of Residence

Province	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
Nyanza	309	0.77	30	17	12	7	2	1228
Western	333	0.78	28	17	10	7	2	721
Rift Valley	350	0.84	29	16	12	6	3	972
Central	325	0.88	33	15	11	10	8	714
Eastern	333	0.82	30	18	11	7	6	751
Coast	236	0.72	36	20	14	11	4	501
• Rural	236	0.78	40	22	16	12	3	365
• Mombasa[a]	235	0.54	28	14	9	8	7	136
Nairobi[a]	279	0.69	30	14	9	9	16	262

[a]Metropolitan area.
NOTE: All groups age adjusted.

Table 11 Percentage Distribution of the KFS Sample Women by Province for Nine Ethnic Groups and Characteristics of the Women in these Ethnic Groups

	Ethnic group								
	Luo	Luhya	Kisii	Kalenjin	Kikuyu	Meru/Embu	Kamba	Mijikenda	Other
Province of residence									
All provinces	100	100	100	100	100	100	100	100	100
Nyanza	84	3	87	0	0	0	1	3	4
Western	3	80	10	1	0	0	1	0	4
Rift	9	3	2	98	28	1	2	0	53
Central	1	0	0	0	60	1	1	0	2
Eastern	0	0	0	1	2	97	78	0	1
Coast[a]	2	2	0	0	1	1	11	97	20
Nairobi	5	8	1	0	8	0	7	0	5
Characteristics of wives									
Polygamous %	44	35	32	24	11	21	25	38	45
No school %	55	48	62	59	36	46	46	89	44
Occupational									
Class I %	33	42	62	63	33	54	34	49	51
Class II %	17	16	14	13	17	12	18	8	15
Area of residence									
Rural %	85	89	98	97	86	99	89	79	82
Metropolitan %	9	6	1	0.3	8	1	9	20	12

[a] Includes Mombasa metropolitan area.

translated into eight tribal languages, as well as using English and Kiswahili versions. Since the ethnic groups tend to be clustered in different regions of Kenya, regional differences in fertility may be a reflection of cultural variations between ethnic groups as well as ecological variations between regions. This geographic clustering of ethnic groups is illustrated in table 11. Nyanza and Western Provinces along the Lake Plateau consist primarily of Luo, Kisii and Luhya groups. The highland areas of Rift Valley Province are primarily peopled by the Kalenjin, while in the highlands of Central Province there are primarily Kikuyus. The Meru/Embu group occupy the highland areas of Eastern Province, and the Kamba occupy the lower semi-arid plateaus of Eastern Province, extending toward the Coast. The Coast Province consists largely of several tribes of the Mijikenda group. The category 'other' tribes is a heterogeneous group, including nomadic populations such as the Masai in Rift Valley Province. The African population of the Nairobi metropolitan area is composed primarily of Kikuyu, Luhyas, Luos and Kambas.

Some variations and social characteristics between these ethnic groups are shown in panel 2 of table 11. Polygamy is most prevalent among the three tribes in the Lake Plateau (Luo, Luhya and Kisii), the Mijikenda in Coast Province and among the 'other' tribes. The Kikuyu have the lowest level of polygamy and the highest level of education. The lowest level of education is found among the Mijikenda of the Coast area. The Luo, Kikuyu and Kamba have the highest proportions in occupational class III, consistent with the fact that a higher percentage of women from these tribes are metropolitan residents. By contrast the Kisii, Kalenjin and Meru/Embu represent predominantly rural agrarian families. The Mijikenda remain exceptional by most characteristics. They have a very low level of education, the lowest percentage of husbands in occupational class III and yet the highest percentage of metropolitan residents (mainly in the Mombasa municipality). This group is also predominantly Muslim, while the other groups are largely Christian.

Variations in fertility and the components of the birth interval by ethnic group are shown in table 12. The groups are listed geographically from the extreme west coast to the east coast and the data are presented for all women and separately for women in monogamous unions. The lowest level of fertility (217 per 1000) is among the Mijikenda who reside in the eastern Coastal area. This group has the lowest fecundity and births spaced at intervals of almost three and a half years. Breastfeeding is prolonged to almost two years, with amenorrhoea extending over 17 months. The menstruating interval is also long. It is noteworthy, among Mijikenda in monogamous unions, that fertility is 20 per cent higher because of a shortening in the birth interval and not because of any change in the pregnancy progression ratio.

Marital fertility is also low among the Luo on the west coast. This group, which has the highest level of polygamy, also has a very low pregnancy progression ratio. Among Luo in monogamous unions, fertility is higher due to a higher proportion of women progressing to the next pregnancy.

The highest levels of fertility are seen among the Kalenjin (388 per 1000) and Kisii (361 per 1000). These

Table 12 Fertility, Pregnancy Progression Ratios, Durations of the Birth Interval Components and Per Cent Using Effective Contraception by Type of Marital Union and Ethnic Group

Ethnic group[a]	MFR (per 1000)	PPR	LBI	BF	A	M	%C	Number of women
All women								
Luo	285	0.74	31	17	11	9	2	1007
Luhya	337	0.78	28	16	10	6	3	807
Kisii	361	0.84	28	17	13	5	1	357
Kalenjin	388	0.86	27	16	9	6	2	345
Kikuyu	342	0.85	30	14	10	8	8	1180
Meru/Embu	335	0.82	29	18	11	7	9	319
Kamba	322	0.82	30	18	11	8	4	537
Mijikenda	217	0.74	41	23	17	12	2	323
Other	247	0.79	39	22	17	10	2	287
Monogamous women								
Luo	299	0.78	31	17	11	9	3	572
Luhya	362	0.83	27	16	11	6	4	530
Kisii	375	0.86	27	17	13	4	1	240
Kalenjin	368	0.86	28	17	9	8	2	269
Kikuyu	343	0.87	31	15	11	9	8	1052
Meru/Embu	318	0.85	32	19	12	9	11	258
Kamba	310	0.83	32	18	11	10	4	407
Mijikenda	260	0.74	34	20	16	7	1	200
Other	224	0.82	44	18	14	17	4	165

[a] All groups age adjusted.

two groups combine high fecundity with births at intervals of 2.3 years or less. Among the Kalenjin, the short interval is due to short durations of both lactational amenorrhoea and the menstruating interval (nine and six months respectively). The Kisii have a relatively longer duration of breastfeeding with lactational amenorrhoea averaging thirteen months. However, they have by far the shortest menstruating interval with a mean of only five months among all Kisii in monogamous unions.

Intermediate levels of fertility are seen among the Luhya (337), the Kikuyu (342), the Meru/Embu (335) and the Kamba (322). In the case of the Luhya, overall fertility is apparently lowered by the relatively high proportion of women in a polygamous union. When only monogamous Luhya are considered, the pregnancy progression ratio is higher and fertility reaches 362.

Thus there are significant geographic differences in fertility between ethnic groups which can be related to geographic variations in fecundity as well as to variations in breastfeeding and patterns of cohabitation, which affect post-partum amenorrhoea and the menstruating interval.

3.13 ANOTHER LOOK – FERTILITY INDICES

Another approach for assessing the relative contribution of each of the intermediate variables to levels of fertility is the quantitative framework proposed by Bongaarts (1978). This model uses a series of indices taking values between 0 and 1 which measure the fertility-inhibiting effects related to marriage patterns, contraception, induced abortion and post-partum non-susceptibility. The model as specified does not include an index for infecundity which has been seen to contribute significantly to fertility variations in Kenya; we therefore added such an index. The components of the model and the estimation procedure are as follows:

C_m = index of proportion married. For this analysis the index is calculated using the age-specific proportions ever married from the KFS and the standard schedule of marital fertility reported by Coale and Trussell (1974 and 1975). This index measures the fertility-inhibiting effects related to delays in the age of marriage.

C_c = index of non-contraception. $C_c = 1-1.8\,ue$ where u is the proportion of women contracepting and e = effectiveness, modern and traditional methods taken separately. For modern methods e = 0.9, for traditional methods e = 0.5. Thus C_c equals $1-1.18\,(0.9\,u_m + 0.5\,u_t)$.

C_a = index of induced abortion. This index is assumed to be 1.0 in the absence of any data.

C_i = index of lactational infecundability. This index is estimated as described by Bongaarts.

C_f = index of fecundity. For this analysis the index is estimated from the ratio of the observed to the expected level of the parity progression ratio (G). As noted earlier, the expected value of G is 0.86. Therefore C_f = observed G/0.86.

Table 13 gives the estimates of the indices of the intermediate variables for all Kenya, and for regions, provinces, and the metropolitan areas. The indices are grouped according to those which inhibit fertility by prolonging birth

Table 13 Estimates of Bongaarts's Indices of the Intermediate Fertility Variables for Kenya, for Rural and Urban Areas, Rural Provinces and Metropolitan Areas

	Birth spacing[a]			Reproductive span			Combined
	Contra-ception	Amenorrhoea		Delayed marriage	Infecundity		
	(C_c)	(C_i)	($C_c \times C_i$)	(C_m)	(C_f)	($C_m \times C_f$)	($C_c \times C_i \times C_m \times C_f$)
Kenya	0.94	0.67	0.63	0.81	0.93	0.75	0.47
Rural	0.94	0.67	0.63	0.82	0.94	0.77	0.49
Urban metropolitan	0.87	0.72	0.63	0.79	0.78	0.62	0.39
Rural provinces							
Nyanza	0.96	0.66	0.63	0.85	0.89	0.76	0.48
Western	0.97	0.69	0.67	0.85	0.91	0.77	0.52
Rift	0.95	0.66	0.63	0.81	0.97	0.79	0.49
Central	0.90	0.69	0.62	0.76	1.00	0.76	0.47
Eastern	0.93	0.68	0.63	0.75	0.95	0.71	0.45
Coast (rural)	0.96	0.58	0.56	0.91	0.90	0.82	0.46
Metropolitan areas							
Nairobi	0.83	0.73	0.61	0.76	0.81	0.62	0.37
Mombasa	0.93	0.74	0.69	0.83	0.63	0.52	0.36

[a] Induced abortion (C_a) is assumed to be 1.00 in all cases.

Table 14 Estimates of the Indices of the Intermediate Fertility Variables by Wife's Level of Education and Husband's Social Class

	Birth spacing[a]			Reproductive span			Combined
Level of wife's education and occupational class of husband	Contra-ception	Amenorrhoea		Delayed marriage	Infecundity		
	(C_c)	(C_i)	($C_c \times C_i$)	(C_m)	(C_f)	($C_m \times C_f$)	($C_c \times C_i \times C_m \times C_f$)
No education	0.97	0.64	0.62	0.90	0.92	0.83	0.51
Lower (I)	0.98	0.63	0.62	(0.90)[b]	0.92	0.83	0.51
Middle (II)	0.96	0.66	0.63	(0.90)	0.92	0.83	0.52
Upper (III)	0.95	0.66	0.63	(0.90)	0.94	0.85	0.53
Standard 1–4	0.95	0.67	0.64	0.83	0.98	0.81	0.52
Lower (I)	0.96	0.65	0.62	(0.83)[b]	0.99	0.82	0.51
Middle (II)	0.94	0.68	0.64	(0.83)	0.97	0.81	0.51
Upper (III)	0.89	0.73	0.65	(0.83)	0.92	0.76	0.50
Standard 5–8	0.89	0.72	0.64	0.79	0.94	0.74	0.48
Lower (I)	0.94	0.67	0.63	(0.79)[b]	1.00	0.79	0.50
Middle (II)	0.89	0.71	0.63	(0.79)	0.95	0.75	0.47
Upper (III)	0.84	0.74	0.62	(0.79)	0.87	0.69	0.43

[a] Induced abortion (C_a) assumed to be 1.00.
[b] Marriage age within subgroups assumed to be constant for educational category of wife.

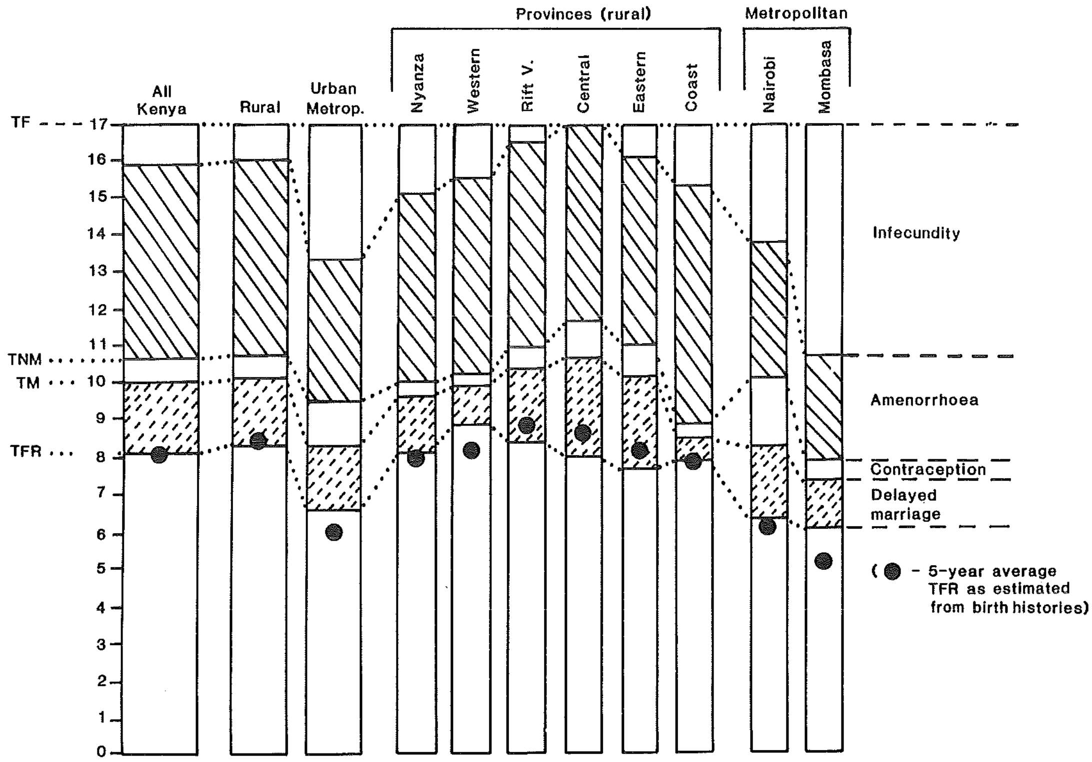

Figure 3 Estimates of Total Fertility Rate (TFR), Total Marital Fertility Rate (TM), Total Natural Marital Fertility Rate (TNM) and Total Fecundity Rate (TF) for All Kenya, Rural Provinces, and Metropolitan Areas Using Bongaarts's Indices

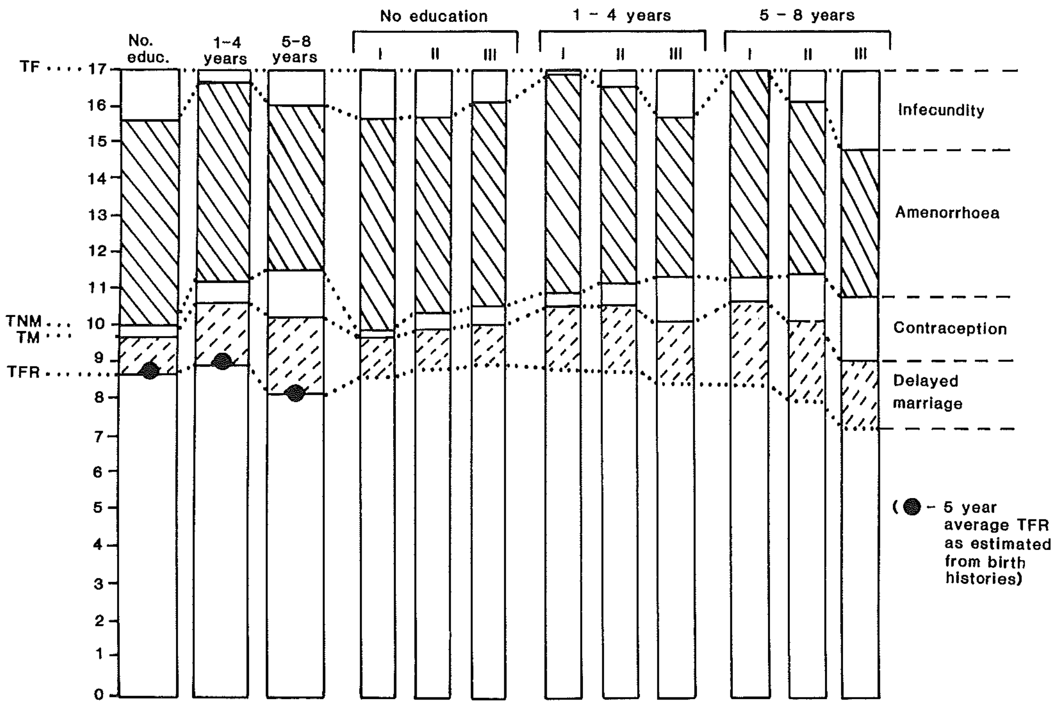

Figure 4 Estimates of Total Fertility Rate (TFR), Total Marital Fertility Rate (TM), Total Natural Marital Fertility Rate (TNM) and Total Fecundity Rate (TF) Using Bongaarts's Indices by Level of Education of Woman and Occupational Class of Husband

NOTE: Occupational classes: I – Traditional agrarian; II – Service, unskilled/skilled manual; III – Professional and clerical.

spacing (C_c and C_i) and those which shorten the reproduction span (C_m and C_f). The products of each of these pairs are also shown to facilitate the analysis.

Consider first birth spacing. As noted earlier, there is not a great variation in birth intervals between regions of Kenya with the exception of rural Coast Province with the longest (39 months) and Mombasa with the shortest (28 months). Not surprisingly, then, the combined indices of contraception and amenorrhoea have products mostly in the narrow range of 0.61 to 0.63.

Quite a different picture is seen when we examine the indices affecting the reproductive span. First, there is a large rural-urban difference. The urban reproductive span is much shorter because of a rise in age at marriage and a decline in fecundity. In the provinces, another picture emerges. There tends to be direct relationship between a rising age at marriage (producing a lower C_m) and a rising fecundity as one moves from the coasts to the central areas. The net effect is to attenuate greatly any impact delayed marriage would have had on the reproductive span. Nairobi and Mombasa stand out with very low indices of fecundity which greatly reduce the potential reproductive span.

As Bongaarts has shown, these indices can be related to a series of fertility measures defined as follows:

TF = total fecundity rate. This is the total natural marital fertility in the absence of lactation or any fecundity impairment
TNM = total natural marital fertility rate = TF × C_f × C_i
TM = total marital fertility rate = TNM × C_c × C_a
TFR = total fertility rate = TM × C_m

For all Kenya, starting with a TFR of 8.1 we have the following estimates: TM = 10.0, TNM = 10.6, TF = 17.1.[7] Using this TF and the fertility indices given in table 13, we can see how the fertility-inhibiting effects of the intermediate variables result in the fertility patterns seen in the regions of Kenya. These results are depicted in figure 3. The TFRs obtained directly from the KFS birth histories are also shown. The validity of the inferences derived from the indices of the intermediate variables is supported by the fact that the TFR estimates correspond closely to the actual TFRs.

The regional fertility patterns estimated using only the indices of the intermediate variables correspond reasonably well with the levels obtained directly. Most revealing is the very substantial rise in the TNM in the central regions of Kenya due to the declines in infecundity. This explains the paradox of having quite high levels of fertility in Central Province and at the same time high age at marriage and considerable contraceptive use.

For the metropolitan areas, the low fertility can only be explained on the basis of reported infecundity among women who did not admit to using contraceptives. Since it seems unlikely that all of this could be produced by disease, one must speculate on unreported fertility control measures, including induced abortion.

The indices also add clarity to the analysis of the effects of wife's education and husband's social class on fertility (table 14 and figure 4). There is almost no net variation in the index of birth spacing over the full range of education and social classes represented. Thus for all practical purposes, the rise in contraceptive use is balanced by the decline in breastfeeding.

Fertility differentials that do arise relate to the effects of marriage delay, and changes in fecundity. As noted earlier, most striking is the rise in fecundity with 1–4 years of primary education which is not compensated for by the rise in age at marriage. Among women with 5–8 years of education, the TFR begins to decline. This is a function of a combination of lower fecundity, more contraceptive practice, and a higher age at marriage.

[7] The TFR of 8.1 includes about 0.3 pre-marital births per woman (see KFS First Report, vol 1, p 93). If we use 7.8 as the legitimate TFR, we then get the following values: TM – 9.6; TNM – 10.2; TF – 16.4.

4 Discussion

Childbearing patterns of currently married Kenyan women aged 15–44 were analysed by new methods in this paper. These methods allowed estimation of the levels of fecundity and the birth intervals and assessment of the relative contributions of breastfeeding, lactational amenorrhoea and the menstruating interval to birth spacing and thus to marital fertility. The first technique requires survey data of the current reproductive status of women in conjunction with an estimate of the pregnancy progression ratio and births in the past 12 months. With data of the 1978 Kenya Fertility Survey, we were able to demonstrate how social and cultural factors operate on the intermediate variables to produce some of the major differentials in marital fertility that exist in Kenya. In particular, this analysis indicates that 'modernization' is in some cases resulting in higher fertility.

Currently married women aged 15–44 in Kenya have a general fertility rate (MFR) of 310 per 1000. This results from a combination of an average pregnancy progression ratio of 0.80 and an average live birth interval of 30 months. With these parameters, a Kenyan woman continuously married from age 15 could expect 9.6 live births over a 30-year reproductive life. The difference between this estimate and the TFR of 8.1 estimated in the KFS is a function of the proportion of a woman's potential reproductive life that is actually spent in a marital union.[8] While this total marital fertility rate is extremely high, it does not represent the maximum childbearing potential of Kenyan women. This is because 97 per cent of women breastfeed their babies, with an average duration of breastfeeding of 17 months associated with 11 months of lactational amenorrhoea. If the practice of breastfeeding were to decline to levels seen in Western populations, the duration of post-partum amenorrhoea could decline to as short as two months. This could result in a 25 per cent rise in the fertility rate, unless compensated for by contraceptive practice.

Historically, abstinence from sexual relations throughout breastfeeding and even beyond probably played a significant role in prolonging child spacing in Kenya (Molnos 1973). Currently, the average duration of post-partum abstinence is about three months. Since this is much shorter than the duration of lactational amenorrhoea, abstinence is not contributing significantly to birth spacing in Kenya. The reasons for the decline in post-partum abstinence have not been explained, though the demise of this tradition may be linked to the disappearance of separate living quarters for husbands and wives, which were part of many tribal traditions. This is described vividly by Whiting (1977):

> There is a new style of architecture which reflects the increasing autonomy of the nuclear family. Traditionally . . . each woman had her own one-room house . . . adult males all aspired to have separate dwellings. Men not only frequently slept apart but also ate apart from women and children. Now houses are . . . with two bedrooms and a central living area. Husbands and wives now have some privacy from a master bedroom shared only with the youngest children. Such living arrangements lead inevitably to an increase in the intimacy of the husband and wife.

Polygamy is another traditional practice associated with lower marital fertility. In Kenya the birth interval for women in polygamous unions is essentially the same as that for women in monogamous unions, so that the difference in fertility is almost entirely due to a lower pregnancy progression ratio among women in polygamous unions. This difference is more evident when polygamous wives are separated according to whether they are the latest or an earlier wife. While this pattern may indicate poor health among wives in polygamous unions, it is also consistent with patterns of life among couples in polygamous unions that could lead to earlier termination of childbearing.

Impairment in fecundity, presumably due to poor health, is an important factor in explaining the regional variations in fertility in the rural areas. This is seen most clearly among the ethnic groups, where the parity progression ratios range from a high 0.85 to 0.86 among the Kikuyu and Kalenjin in the central highland regions to lows of 0.74 among Luos on the west coast and Mijikenda on the east coast.

There is a definite correlation between the level of infecundity and the practice of polygamy among the tribal groups. Polygamy may thus in part be a compensation for infecundity which could explain the lower pregnancy progression ratios among wives in polygamous unions. At the same time, it is possible that the cultural patterns of sexual relationships in polygamous societies actually produce infecundity through transmission of venereal diseases, particularly gonorrhoea. This has been well documented in studies in Uganda (Arya, Nsanzumuhrie and Taber 1973). Chronic gonorrhoeal salpingitis has been confirmed as the major cause of female sterility among a series of cases studied in Coast Province in Kenya (Vogel *et al* 1974; Mati, Anderson, Carty and McGlashaw 1973).

Modernization is affecting fertility in Kenya in several ways. First and foremost, it is breaking down the traditional constraints to childbearing – breastfeeding, post-partum abstinence and polygamy.

As indicators of modernization, educational level of the wife, and the occupational class of the husband were used. Although only 48 per cent of the wives had any education (for 88 per cent of them it was limited to a primary education), rising levels of education among women are associated with progressively shorter durations of breastfeeding and lactational amenorrhoea, as well as lower proportions in polygamous unions. For married women under age 35,

[8] According to the KFS First Report, the median age of first marriage ranges from 17.1 to 18.1 years and the average percentage of elapsed time since first marriage spent in the married state is 94.6.

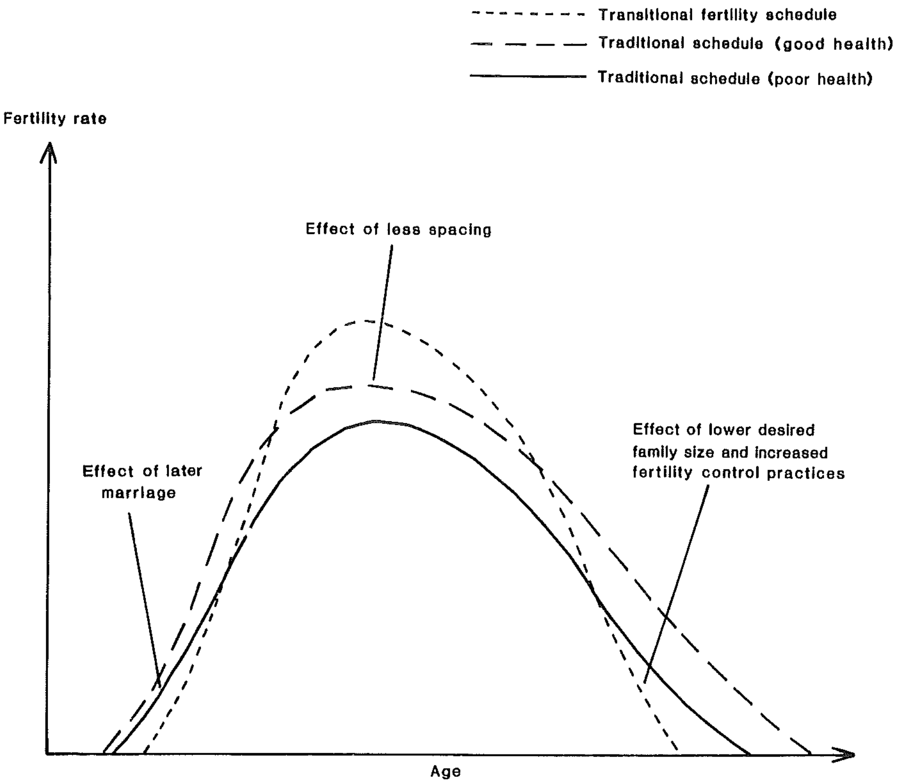

Figure 5 Comparison of Traditional and Transitional Fertility Schedules (Modified from Lesthaeghe, Page and Adegbola 1981; reproduced with permission from H.J. Page and R. Lesthaeghe (eds), *Child-Spacing in Tropical Africa.* Copyright: Academic Press Inc. (London) Ltd)

the latter factor actually leads to higher fertility for the educated women.

Women whose husbands are in technical, white collar, or professional occupations also have shorter durations of breastfeeding than women whose husbands are in the traditional agricultural occupations. Though wife's educational level and husband's occupational level are correlated, each of these factors contributes independently to a decline in breastfeeding.

The same modernization factors that are breaking down the fertility-inhibiting traditions are leading to an increase in the practice of modern contraception. Only among women over age 35, however, is there evidence that higher levels of reported contraceptive practice (plus other unreported means of fertility control) sufficiently compensate for the decline in traditional fertility-restricting practices, to produce a net fertility decline.

Perhaps the best illustration of the changing patterns of reproduction in Kenya is the contrast between rural and urban women. Among women under age 25, fertility is actually slightly higher in the urban areas due to shorter breastfeeding. A shift in relative fertility levels begins in the 25–34 year age groups, so that by age 35–44, fertility is 72 per cent lower among urban residents.

The actual methods that urban dwellers use to restrict childbearing cannot be determined from this analysis. The low pregnancy progression ratios, which are even more evident when one limits the analysis to the Nairobi and Mombasa metropolitan areas, simply tell us that many more reportedly non-contracepting women than expected have had no pregnancy terminations in the past seven years. While it is possible that much of this may be due to disease-related sterility,[9] it is also possible that there is considerable under-reporting of contraceptive practice or that there are a considerable number of unreported pregnancies terminated by abortion.

A tendency for fertility to increase with the early stages of modernization is not atypical for African populations (Caldwell 1975). Some years ago Henin reported evidence of rising fertility in the Sudan, and Olusanya described similar trends in Western Nigeria (Henin 1969; Olusanya 1969). More recently Romaniuk (1980) examined fertility trends over three decades in Zaïre and documented a substantial rise in birth rates. He attributed this largely to a drop in sterility from venereal disease, and a decline in post-natal abstinence.

Particularly relevant to the Kenyan situation are a series of studies in Nigeria which have demonstrated the breakdown of breastfeeding and post-natal abstinence with modernization and urbanization (Caldwell and Caldwell 1977). Generally this has been combined with the adoption of modern contraception, though the net effect on fertility has been variable. Lesthaeghe, Page and Adegbola (1981) have undertaken a critical analysis of these counteracting factors affecting fertility using survey data from Lagos. They summarize with a simple illustration which seems appropriate to the observations in Kenya, comparing 'traditional' and 'transitional' fertility schedules (figure 5). The notable differences in childbearing patterns with a shift to a transitional fertility sched-

[9] One epidemiological study suggested that in some cities and towns up to one-third of all women are sterile by age 30. See Bennet (1962).

ule are a slight fertility decline among very young women due to later marriage; an increase in the birth rate in the earlier reproductive years due to less spacing; and then a significant fertility decline among older women due to desire for a smaller family and increased contraceptive use. To this figure we have added the additional factor of improved fecundity due to improved health.

It appears that Kenya is at a very early stage of the fertility transition, with a primary manifestation in the increase in fertility, particularly among younger, more modern women. How rapidly, and by how much, fertility may decline as these younger women get older will depend upon a combination of the social and economic changes that may influence their own preferences for family size and the effectiveness of the national family planning programme.

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Appendix A – Fertility Model

DEFINITIONS AND NOTATION

States (see figure 1): (1) Menstruating; (2) early pregnancy; (3) late live birth pregnancy; (4) post-partum amenorrhoea (PPA) after a live birth; (5) late pregnancy of a non-live birth; (6) PPA after a non-live birth.

p = probability that a recognized pregnancy will result in a non-live birth

G = probability that a woman in state 1 will progress to state 2

Z_i = random variable for the length of time a woman spends in state i

$F_i(z), f_i(z)$ = distribution and density functions associated with Z_i

$$\mu_i = \begin{cases} E[Z_i] & i = 2,3,\ldots,6 \\ E[Z_i \mid \text{state 2 is entered}] & i = 1 \end{cases}$$

For convenience let $\mu_S = \mu_1 + \mu_2$
$\mu_L = \mu_3 + \mu_4$
$\mu_F = \mu_5 + \mu_6$

T_i = Expected time between visits to state i for a woman who visits state i more than once.

$N(t)$ = Expected number of live births up to time t of process.

ASSUMPTIONS

1 Women enter the model in state 1 at the time of marriage.
2 Women exit from the system only from the menstruating state.
3 In external time, the number of women entering the system is identical to the number exiting.
4 The distribution of Z_i is independent of the path of states leading to that state and independent of the time spent in those previous states and is identical for all women.

RESULTS

From simple probability considerations we find:

$$T_1 = \mu_1 + \mu_2 + p(\mu_5 + \mu_6) + (1-p)(\mu_3 + \mu_4)$$

$$T_2 = T_1$$

$$T_3 = \mu_3 + \mu_4 + \mu_S(1-p) + (\mu_F + 2\mu_S)p(1-p) + (2\mu_F + 3\mu_S)p^2(1-p) + \ldots$$

$$= \mu_3 + \mu_4 + \mu_S(1-p)\sum_{j=0}^{\infty}(j+1)p^j + \mu_F(1-p)\sum_{j=1}^{\infty} jp^j$$

$$= \mu_3 + \mu_4 + \frac{\mu_S}{1-p} + \frac{\mu_F p}{1-p} \quad (1)$$

$$T_4 = T_3$$

$$T_5 = \mu_F + \mu_S p + (\mu_L + 2\mu_S)(1-p)p + (2\mu_L + 3\mu_S)(1-p)^2 p + \ldots$$

$$= \mu_F + \mu_S p \sum_{j=0}^{\infty}(j+1)(1-p)^j + \mu_L p \sum_{j=1}^{\infty} j(1-p)^j$$

$$= \mu_F + \frac{\mu_S}{p} + \frac{\mu_L(1-p)}{p}$$

$$T_6 = T_5$$

Let $r_i(t)$ be the probability that a randomly chosen woman in the system at time t is in state i, i = 2, 3, 4, . . . , 6, then from Markov renewal theory it is known that

$$\lim_{t\to\infty} r_i(t) = G\frac{\mu_i}{T_i} \quad \text{(cf Sheps and Menken 1973: 287)}$$

For i = 1 we find:

$$\lim_{t\to\infty} r_i(t) = G\frac{\mu_i}{T_i} + 1 - G \quad (2)$$

This can be seen as the sum of two component probabilities:

Pr (a woman is in state 1| she will go to state 2) x Pr

(a woman will go to state 2)

+ Pr (a woman is in state 1| she will not go to state 2)

x Pr (a woman will not go to state 2)

where the four terms in order are $\frac{\mu_i}{T_i}$, G, 1.0 and 1 – G

As a check it is easily shown that $\sum_{i=1}^{6} r_i(t) = 1$

Also it is known from Markov renewal theory that:

$$\lim_{t\to\infty} [E[N(t+\Delta)] - E[N(t)]] = \frac{G.\Delta}{T_4} \quad (3)$$

where Δ is some positive constant.

Estimation from data

At some point in time a fertility survey is taken for N currently married women and the following information is reported by each woman:

1 marital status;

2 whether the woman has had a live birth in the last 12 months;

3 parity;

4 her current reproductive status

(a) menstruating

(b) pregnancy

(c) post-partum amenorrhoea after a live birth

(d) post-partum amenorrhoea aftter a non-live birth;

5 whether the woman was married seven years ago or not.

For the j^{th} woman define:

$$X_j = \begin{cases} 1 & \text{if menstruating or early pregnancy state} \\ 2 & \text{if late pregnancy state} \\ 3 & \text{if in post-partum amenorrhoea after a live birth} \\ 4 & \text{if in post-partum amenorrhoea after a non-live birth} \end{cases}$$

$$Y_j = \begin{cases} 1 & \text{if the woman has had a birth in the past 12 months} \\ 0 & \text{otherwise} \end{cases}$$

Then under equilibrium conditions

$$\Pr(X_j = 1) = r_1 + r_2$$
$$\Pr(X_j = 2) = r_3 + r_5$$
$$\Pr(X_j = 3) = r_4$$
$$\Pr(X_j = 4) = r_6$$

Assuming the women are independent, the observed sample $(X_1, X_2, \ldots, X_N)$ follows a multinomial distribution and the probability of our observed sample is:

$$\frac{N!}{n_1!\,n_2!\,n_3!\,n_4!}(r_1 + r_2)^{n_1}(r_3 + r_5)^{n_2} r_4^{n_3} r_6^{n_4}$$

where n_i = the number of women with $X_j = 1$

In this case the maximum likelihood estimates (MLEs) for $(r_1 + r_2)$, $(r_3 + r_5)$, r_4 and r_6 are:

$$\widehat{(r_1 + r_2)} = \frac{n_1}{N}$$
$$\widehat{(r_3 + r_5)} = \frac{n_2}{N}$$
$$\hat{r}_4 = \frac{n_3}{N} \qquad (4)$$
$$\hat{r}_6 = \frac{n_4}{N}$$

To use data on births in the last year (Y_j), we can rewrite $E[N(t + \Delta)] - E[N(t)]$ in equation (3) as:

$$\sum_{n=0}^{\infty} \Pr(S_n < t + \Delta) - \sum_{n=0}^{\infty} \Pr(S_n < t)$$

where S_n = the time of the nth live birth (cf Cinlar 1975: 286).

This simplifies to

$$\sum_{n=0}^{\infty} \Pr(t < S_n < t + \Delta)$$

but if we take $\Delta = 1$ year and assume no woman can have two live births in one year, then this reduces to simply:

$$\Pr(\text{a woman will have a birth in } (t, t + \Delta))$$

and the MLE estimate of this when Δ is one year is simply

$$\frac{\sum_{j=1}^{N} Y_j}{N}$$

or the fertility rate for the year prior to the survey. Thus equating MFR with equation (3) we have:

$$\text{MFR} = \frac{G.1}{T_4} \qquad (5)$$

where it is understood that the units of MFR and T_4 are the same.

Solving for μ_1 and μ_4

Since the reproductive parameters are known to vary with age, for the analysis the estimation was done for three separate age groups, 15–24, 25–34 and 35–44.

In all age groups the following parameters were assumed constant:

$$\mu_2 + \mu_3 = 9 \text{ months}$$
$$\mu_2 + \mu_5 = 3.5 \text{ months} \qquad (6)$$
$$\mu_6 = 2 \text{ months}$$

Values of G were estimated separately for each of the age groups by selecting women currently in the age groups 22–31, 32–41 and 42–50 who were married seven years previously and had never used an efficient contraceptive method, and then determining the proportion who had a pregnancy termination (either live birth or foetal loss) in the seven years interval.[10]

[10] This estimate of the pregnancy progression ratio (G) will have a small downward bias for several reasons: first, a few women did have their next termination more than seven years after their last live birth; secondly, there is likely to be under-reporting of terminations among women who have only pregnancy losses. Thirdly, the estimate is based on a period seven years past. If fecundity is rising due to improved health over time, the estimate will be too low for the current situation. Regarding the first point, it was observed in the KFS that among women currently pregnant at the time of survey, over 98 per cent were within seven years of their last live birth. Also, an analysis of the duration of the last closed interval revealed that 97 per cent were less than seven years in length.

Any underestimate of G will result in proportional underestimate of the birth interval, and this will appear as a shorter duration of the menstruating interval component. A downward bias is more likely to occur among older women but it should not affect this analysis of the comparison between subgroups in the population.

Since there is no evidence that induced abortion is commonly practised in Kenya, the following values – representing the average rate of foetal losses usually observed and reported by women – were assigned to p (Leridon 1977):

Age group	p
All ages	0.15
15–24	0.12
25–34	0.15
35–44	0.20

Combining equations (2) and (5) gives an immediate estimate of μ_4 as

$$\frac{r_4}{MFR}$$

Then using equation (1) for T_4 and equation (2) and substituting the constants given in (6) we find:

$$\frac{MFR}{12} = \frac{G}{\mu_4 + \mu_1 + 9 + \frac{p}{1-p}(\mu_1 + 5.5)} \qquad (7)$$

Where the factor 12 is to convert MFR into a value with months as units. Solving (7) for μ_1 yields

$$\mu_1 = \frac{\frac{12\,G}{MFR} - \mu_4 - 9 - 5.5\left(\frac{p}{1-p}\right)}{1 + \frac{p}{1-p}}$$

The mean durations of breastfeeding and post-partum abstinence can be estimated in the same fashion as μ_4 by using the respective proportions breastfeeding and abstaining in conjunction with the MFR.