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The Proximate Determinants of Fertility and Their Effect on Fertility Patterns: an Illustrative Analysis Applied to Kenya

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The World Fertility Survey is an international research programme whose purpose is to assess the current state of human fertility throughout the world. This is being done principally through promoting and supporting nationally representative, internationally comparable, and scientifically designed and conducted sample surveys of fertility behaviour in as many countries as possible.
The WFS is being undertaken, with the collaboration of the United Nations, by the International Statistical Institute in cooperation with the International Union for the Scientific Study of Population. Financial support is provided principally by the United Nations Fund for Population Activities and the United States Agency for International Development.
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Preface

The World Fertility Survey was the first large-scale endeavour to attempt to measure nearly all the proximate determinants of fertility in a comprehensive and systematic manner through inclusion of a wide range of questions about these variables in those countries that adopted the Factors other than Contraception Affecting Fertility (FOTCAF) module. By virtue of its novelty, the exercise provided a number of challenges in terms of both data collection and analysis.

Following an exploratory analysis of the FOTCAF data for Kenya (Ferry, Benoît (1981). Les déterminants les plus proches de la fécondité: exploration des mesures et de leurs analyses. WFS Technical Papers no 1698) and work on childspacing in other countries of Africa (Page, H.J. and R. Lesthaeghe (eds) (1981). *Child-Spacing in Tropical Africa: Traditions and Changes.* London: Academic Press) a simple programme of analysis that would provide a suitable outline for basic analyses of the FOTCAF module in a variety of countries was developed. The proposed outline was not, however, restricted exclusively to the variables in the FOTCAF module; these data were set squarely within the context of a comprehensive analysis of the proximate determinants (including those covered in other parts of the questionnaire).

The basic ideas were tested and further developed during a six-country workshop in 1982. The present text is a revised and expanded version of the analysis carried out in the preparation of the workshop. It was intended not only to serve as an illustration of a simple, relatively brief, analysis of the proximate determinants of fertility for countries that use questionnaires like the FOTCAF module, but also to document the methods used.

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Project Director

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We are grateful to a number of people for their considerable input to the original workshop, particularly to the six national representatives – Moustafa Alwani, Hafedh Chekir, Frantz Fortunat, Sam Gaisie, A.M. Mpiti and Zelda Zablan – who took up the challenge of testing out a number of relatively untried analyses, and to Shea Rutstein and Andrew Westlake of the WFS central staff.

1 Introduction

1.1 INTERMEDIATE FERTILITY VARIABLES AND THE WORLD FERTILITY SURVEY

There are two major reasons for close study of the proximate determinants of fertility. First, these variables are the locus of the institutional arrangements through which societies restrict their reproductive capacity. As Davis and Blake (1956) pointed out, cultural, social and economic settings impinge on fertility only indirectly through the 'intermediate fertility variables', that is through the series of biological and behavioural factors that determine exposure to sexual intercourse, the probability that intercourse will lead to pregnancy and the probability that a pregnancy will lead to a live birth. In all known societies fertility is restricted in one way or another through these variables but the relative importance of each varies tremendously between societies. For a long time demographers tended to focus their attention on just two variables – age at entry into marriage, and contraception and abortion. The former was the best known check on fertility in pre-transitional Europe and the latter is the predominant check in present western populations and likely to become increasingly so elsewhere. While these two variables can exert a powerful inhibiting check on fertility, the almost exclusive focus on them to the detriment of the study of other factors has led to a somewhat lopsided view of fertility in general, and of its social context in particular: other variables have been just as, or even more, important in other societies (Leridon and Menken 1979).

Secondly, in a period of change, the various proximate determinants may respond to the same general set of factors but their responses may exhibit different elasticities, and may even be in opposite directions. In particular, not all the proximate determinants necessarily shift in the direction of lower fertility in the process of modernization: on the contrary, the changes that occur in some, especially early in the process, tend to lead to an increase in fertility. The most obvious examples are reductions in breastfeeding and in the observance of any traditions of prolonged post-partum abstinence. It is now clear that fertility-increasing changes in this group of proximate determinants can absorb for a time the impact of fertility-reducing changes in other determinants – such as later marriage and greater use of contraception – and thus give rise to a period during which overall fertility levels remain constant although fertility transition has, in a sense, already started. They may even outstrip temporarily the fertility-reducing changes, leading to an initial fertility rise before decline starts. Study of the proximate determinants is thus likely to pick up trends in fertility behaviour well in advance of a study of fertility levels themselves.

A comprehensive study of all the intermediate fertility variables and an evaluation of the contribution of each to fertility itself is, therefore, essential if we are to understand fertility behaviour and the likely impact of any policy interventions. For countries that adopted the FOTCAF module or a similar questionnaire, a much more comprehensive analysis than was previously possible can now be made.

1.2 THE KENYA FERTILITY SURVEY (KFS)

Our data come from the Kenya Fertility Survey (KFS), carried out in 1977–8. The target population was defined as all women aged 15–50 regardless of marital status. The sample consisted of 8100 such women, selected using a multi-stage, disproportionate stratified sample design: the differential selection probabilities have been taken into account in the analysis. For more details concerning the sample design and the survey itself see the Kenya First Country Report (Kenya, Ministry of Economic Affairs and Development Planning 1980).

The results presented here were derived from the first version of the KFS Standard Recode Tape: analyses based on other versions may differ slightly in detail.

1.3 SCOPE AND ORGANIZATION OF THE ANALYSIS

Scope

The emphasis here is on estimating the proximate determinants and their impact on fertility levels and differentials, rather than on attempting to explain why they are at the observed levels. WFS material is, in general, much better suited to this type of analysis.

The analysis is carried out at the level of aggregates. Estimates are presented at national level, and differentials are studied in terms of the differences between major subgroups. Detailed multivariate analysis of the intermediate variables studied, based on individual level data, is not included.[1] The major subgroups considered here are differentiated by current age, education, province and rural/urban residence. Table 1 shows the sample size for each of the subgroups within the total.

Analysis strategy

The strategy adopted here is built explicitly on a dynamic approach to fertility, based on the process of

[1]For an extended multivariate analysis of some of the variables in Kenya, that examines contextual as well as individual effects, see Lesthaeghe, Vanderhoeft, Becker and Kibet (1983).

Table 1 Sample sizes for subgroups used in this report

Subgroup	Current age			
	15–24	25–34	35–50	15–50
Residence				
Rural	2822	2161	2111	7094
Town[a]	198	122	47	367
City[a]	323	208	101	632
Education				
No schooling	775	1214	1590	3580
⩽3 years	290	272	311	874
⩾4 years	2269	1003	354	3626
Province				
Nairobi	246	130	57	434
Central	478	382	373	1232
Coast	266	230	183	680
Nyanza	711	499	564	1774
Rift Valley	613	510	356	1479
Western	468	330	284	1082
Eastern and Northeastern	553	399	440	1392

[a]Town is defined as the urban area excluding Nairobi and Mombasa and City is defined as Nairobi and Mombasa throughout this report.

family formation. More specifically we analyse in turn:

- the starting pattern of family formation (the age at first birth);
- the spacing pattern (birth intervals); and
- the stopping pattern (the age at last birth).

In each case we examine first the pattern itself (age at first birth, birth intervals, age at last birth), and then its proximate determinants. We have grouped the latter into three broad categories – capacity to bear children ('risk'), sexual union (exposure to risk), and contraception and abortion (risk reduction) – which we analyse in turn.[2]

Finally we use decompositions of the fertility rate to assess the relative contribution of each of the major proximate determinants to fertility levels and differentials.

Methods of analysis and presentation of results

Most of the characteristics we are interested in are duration variables, that is, the time elapsed before a particular event is experienced – age at marriage, length of birth interval, duration of breastfeeding. For many of these variables the available information is incomplete because insufficient time has elapsed for all those concerned to have experienced the event in question (marriage, closing the birth interval concerned, weaning, etc). Appropriate techniques for the analysis of censored data sets, which take into account the information that these persons have not yet experienced the event, must therefore be employed. Here we have employed both classic life-table methods and current status data, the choice between them being made according to the type and quality of the data available.

Appendix A serves as a reference document for both this report and related reports for other countries and explains the estimation and analysis methods used.

To summarize the detailed distributions obtained for the duration variables, we present a series of quantiles, T_x, the time elapsed before x per cent of the persons concerned have experienced the event. Typically we give T_{10}, T_{25}, T_{50}, T_{75} and T_{90}, the time elapsed before 10, 25, 50, 75 and 90 per cent have experienced it. As overall measure of central tendency we use the trimean, ie a weighted average of the quantiles that gives twice as much weight to the median as to the other two quantiles – $(T_{25}+2T_{50}+T_{75})/4$ – or the arithmetic mean.

[2]Our objective has been to provide an integrated set of results achievable through very simple, basic forms of analysis. More sophisticated analyses have already been carried out for some (but by no means all) of the variables, notably by Mosley, Werner and Becker (1982).

2 The Starting Patterns of Family Formation

2.1 INTRODUCTION

The major fertility variables to be considered in the starting patterns of family formation are:

(i) the age at first birth for those who do bear children; and
(ii) the proportion who remain childless.

Since marriage is virtually universal in Kenya (less than 0.5 per cent of women over the age of 35 are still single) and voluntary childlessness almost unknown, the main proximate determinants to be considered are the incidence of primary sterility (for the proportion remaining childless) and the age at puberty, age at entry into a sexual union and any contraception or pregnancy wastage at the outset of childbearing (for the age at first birth). We discuss each of these in turn.

2.2 AGE AT FIRST LIVE BIRTH

The reported age at first live birth is relatively early, the average is estimated at 19 years: 25 per cent of all women have their first birth by age 17, and 10 per cent are mothers before or shortly after their 15th birthday (table 2). The data, however, should be treated with some caution. The distributions show a slight increase in age at first birth for the most recent cohorts (table 2 and figure 1) which is quite plausible, but they also exhibit a more marked and less plausible higher age for the oldest cohorts. This suggests that misreporting of the date or age at first birth may be affecting the results and causing a relative upwards bias in the estimates for older women. This suspicion is reinforced by the finding that the estimates are not higher for older women among those subgroups where one might expect to find higher quality reporting (notably the more educated and the urban subgroups, see table 3). The same pattern recurs for other variables.

Table 3 shows modest but systematic differentials by subgroup (excluding the older women). The provinces fall into two neat groups. Nairobi, Central and Eastern and Northeastern form one group (median ages at first birth estimated at 19.0–19.5 for the cohort currently aged 25–34, 19.5–20.0 for the cohort aged 15–24), while

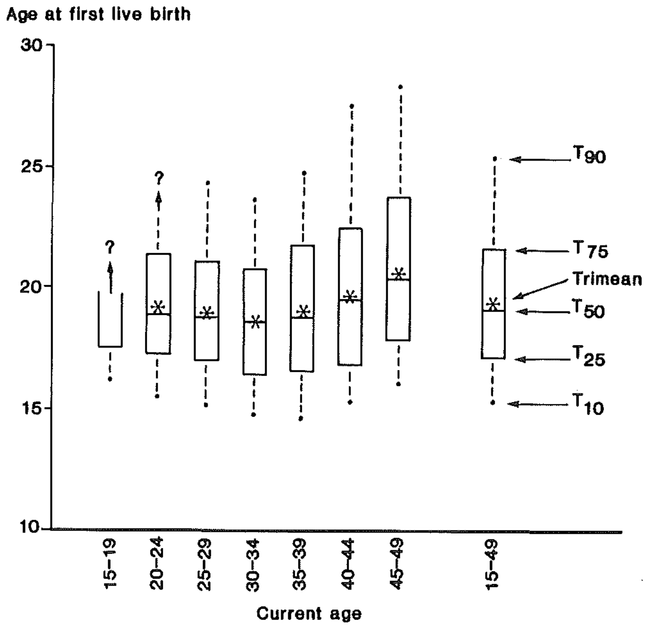


Figure 1 Age at first live birth, by current age[a]

[a]See table 2.

Table 2 Age at first live birth, by current age

Current age	Quantiles[a]					Average (trimean)	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	16.2	17.6	–	–	–	–	1907
20–24	15.5	17.2	18.9	21.4	–	19.1	1436
25–29	15.1	17.0	18.8	21.1	24.3	18.9	1479
30–34	14.8	16.4	18.6	20.8	23.7	18.6	1011
35–39	14.6	16.6	18.8	21.8	24.8	19.0	926
40–44	15.2	16.8	19.5	22.5	27.7	19.6	614
45–49	16.0	17.8	20.4	23.8	28.4	20.6	644
15–49	15.3	17.1	19.1	21.7	25.4	19.3	8018

[a]T_x indicates the age by which x per cent of the women have had their first live birth, estimated using life-table methods.

Table 3 Median age at first live birth[a] by current age: differentials between subgroups

Subgroup	Current age			
	15–24	25–34	35–50	15–50
Residence				
Rural	18.9	18.7	19.6	19.0
Town	18.9	19.0	(18.0)	18.9
City	19.6	19.4	18.2	19.5
Education				
No schooling	18.0	18.4	19.5	18.7
⩽3 years	18.4	18.1	19.7	18.7
⩾4 years	19.4	19.3	19.4	19.4
Province				
Nairobi	19.7	19.6	(18.2)	19.6
Central	19.9	19.2	20.2	19.7
Coast	18.3	18.7	18.9	18.6
Nyanza	18.5	18.0	18.9	18.5
Rift Valley	18.6	18.6	19.8	18.8
Western	18.6	18.3	18.7	18.5
Eastern and Northeastern	19.5	19.2	20.1	19.6

[a]Median age estimated using life-table methods.
NOTE: Figures in parentheses are based on less than 100 women.

Coast, Nyanza, Rift Valley and Western form another (medians close to 18.5). City residents have their first birth about a year later than rural residents and those who have four or more years of schooling also have a delay of a year or more in the first birth.

2.3 THE PROXIMATE DETERMINANTS OF AGE AT FIRST LIVE BIRTH

Age at puberty

The earliest possible age for starting childbearing is defined by the age at reaching sexual maturity. The onset of ovulation defines the starting point of a woman's fecund life, but since the woman herself cannot easily tell when ovulation occurs we are usually restricted in survey work to information on the onset of menstruation. This has the advantage that it is an easily recognizable sign that a girl is physically on the threshold of her reproductive life, and it often heralds a change in social as well as physical status. Its disadvantage is that it is not related perfectly to the onset of ovulation: menarche can precede the onset of ovulation by several months.

In the KFS, the following question was asked of all women:

222 How old were you when you had your first menstrual period?
_____ years old Not yet started

The range of ages given and the estimated age at menarche (14.5 years) are entirely plausible (table 4 and figure 2), but the results warrant considerable caution. Although women probably recall their first menstruation quite vividly, it is questionable whether they are able to report precisely the age at which it occurred; it is

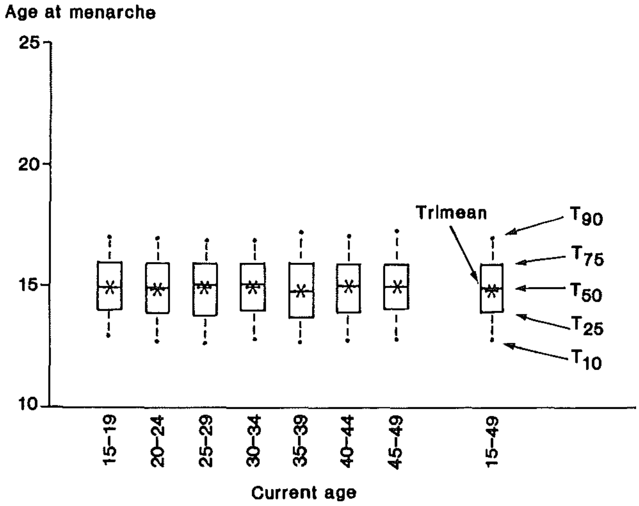


Figure 2 Age at menarche, by current age[a]

[a]See table 4.

Table 4 Age at menarche, by current age

Current age	Quantiles[a]					Average (trimean)	N		
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		Response	No response	Total
15–19	12.9	14.0	14.9	15.9	17.0	14.9	1769	138	1907
20–24	12.7	13.9	14.9	15.9	17.0	14.9	1217	219	1436
25–29	12.6	13.8	15.0	15.9	16.9	14.9	1142	337	1437
30–34	12.8	14.0	15.1	15.9	16.9	15.0	742	269	1011
35–39	12.6	13.7	14.8	15.9	17.2	14.8	605	321	926
40–44	12.7	13.9	15.0	15.9	17.1	15.0	384	230	614
45–49	12.8	14.1	15.0	15.9	17.3	15.0	395	249	644
15–49	12.8	13.9	14.9	15.9	17.0	14.9	6253	1765	8018

[a]T_x indicates the age by which x per cent have reached menarche, estimated using life-table methods.

Table 5 Median age at menarche[a] by current age: differentials between subgroups

Subgroup	Current age			
	15–24	25–34	35–50	15–50
Residence				
Rural	14.9	15.0	15.0	15.0
Town	14.8	15.2	(14.8)	14.9
City	14.8	15.0	14.7	14.9
Education				
No schooling	14.7	14.7	14.9	14.8
⩽3 years	14.9	15.0	15.1	15.0
⩾4 years	14.9	15.2	15.1	15.0
Province				
Nairobi	14.9	15.1	(14.6)	14.9
Central	14.8	14.9	15.2	14.9
Coast	14.8	15.0	15.0	14.9
Nyanza	14.7	14.7	14.4	14.6
Rift Valley	15.0	15.0	14.8	15.0
Western	15.0	15.0	15.1	15.0
Eastern and Northeastern	15.2	15.4	15.6	15.4

[a]Median age estimated using life-table methods.
NOTE: Figures in parentheses are based on less than 100 women.

especially questionable for older and uneducated women whose knowledge of birth dates and ages in general is often, at best, very vague. The proportion of non-responses was indeed rather high (22 per cent) and increased steadily with age (from 7 per cent among women currently aged 15–19 and 15 per cent for those aged 20–24, to 39 per cent for those currently aged 45–49). It is possible that the plausibility and consistency of the information given by those who did respond reflect plausible stereotypes about age at menarche as much as they reflect actual experience.

There is no evidence of systematic differentials between cohorts or between subgroups (table 5).

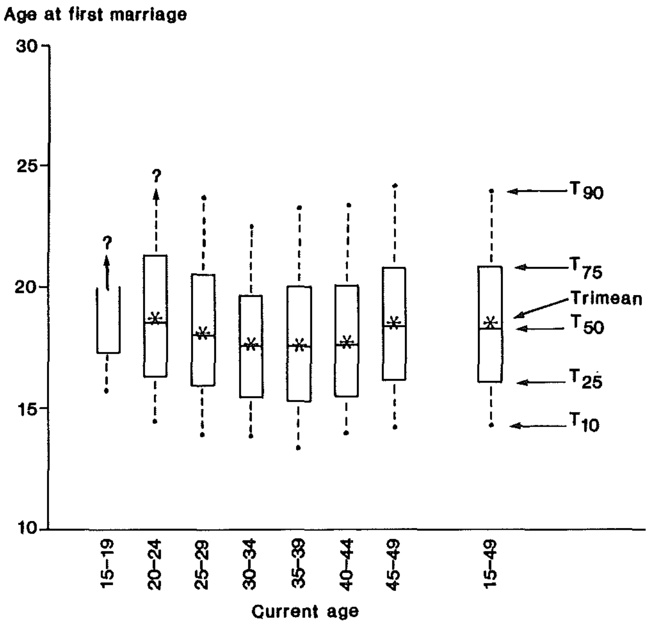


Figure 3 Age at first marriage, by current age[a]

[a]See table 6.

Age at first union

Although menarche indicates in most cases that a girl is about to become able to bear children, the start of actual childbearing depends on subsequent exposure to sexual intercourse. In the KFS it was decided to ask only about age at first marriage (defined broadly as any legal or religious marriage ceremony or, for common law or other stable unions, the age at which the couple started living together). The results (table 6 and figure 3) are generally plausible, especially when considered in isolation (except perhaps for the higher ages estimated for the very oldest age group), and suggest that age at marriage has risen by a year between the cohorts now in their thirties and those aged 20–24 and is rising further among those now aged under 20. Again the estimates are somewhat higher for the oldest cohorts, probably reflecting differential misreporting.

Table 6 Age at first marriage, by current age

Current age	Quantiles[a]					Average (trimean)	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	15.7	17.3	–	–	–	–	1907
20–24	14.5	16.3	18.6	21.4	–	18.7	1436
25–29	13.9	15.9	18.0	20.6	23.7	18.1	1479
30–34	13.8	15.4	17.6	19.7	22.5	17.6	1011
35–39	13.3	15.3	17.6	20.0	23.2	17.6	926
40–44	14.0	15.5	17.7	20.1	23.5	17.8	614
45–49	14.2	16.2	18.4	20.8	24.2	18.5	644
15–49	14.3	16.1	18.3	20.8	23.9	18.4	8018

[a]T_x indicates the age by which x per cent of the women have married, estimated using life-table methods.

Table 7 Median age at first marriage[a] by current age: differentials between subgroups

Subgroup	Current age			
	15–24	25–34	35–50	15–50
Residence				
Rural	18.9	17.7	17.9	18.2
Urban	19.4	18.2	(16.2)	18.6
City	19.6	18.6	16.8	18.9
Education				
No schooling	17.0	16.8	17.6	17.2
⩽3 years	17.7	17.0	17.9	17.6
⩾4 years	19.9	18.9	18.5	19.5
Province				
Nairobi	19.9	19.5	(17.6)	19.6
Central	20.3	18.7	19.3	19.4
Coast	17.0	17.0	16.6	16.9
Nyanza	17.7	16.8	17.2	17.3
Rift Valley	18.7	17.7	18.0	18.2
Western	18.4	17.1	17.2	17.7
Eastern and Northeastern	20.8	18.8	18.6	19.6

[a]Median age estimated using life-table methods.
NOTE: Figures in parentheses are based on less than 100 women.

Table 7 shows the estimated median age at first marriage for each of the subgroups. There are systematic patterns which are similar to those for age at first birth, but more marked. There is a difference of three years between the estimates for Coast and Nyanza provinces on the one hand (median ages at marriage between 17 and 18 years) and Nairobi, Central and Eastern and Northeastern on the other (medians of about 20–21 years); the other two provinces fall in between these limits. The differences between the educational subgroups are of the same order: women with four or more years of schooling marry on average two or more years later than those with no schooling.

The median ages at marriage are two to six years higher than the estimated median ages at menarche. The data thus suggest that delay in marriage and, particularly, differentials in this delay play a significant role in determining fertility levels and differentials. This is probably true, but the picture is not as clear as it might seem, for the beginning of first marriage is not necessarily synonymous with the beginning of sexual activity. The difference between the estimated average age at first marriage and average age at first birth is too small, for example, especially for the youngest cohorts: comparison of tables 2 and 6 shows that the difference is only four months for the cohort currently aged 20–24.

Table 8 gives more information on the relationship between entry into marriage and age at first birth. Of 6243 women who were ever married (third row of table 8), 1260 (20.2 per cent) were recorded as having had at least one birth before marriage and another 1158 (18.5 per cent) as having their first birth within nine months of their marriage: in other words 38.7 per cent apparently either already had a child or were already pregnant before marriage. Similarly, the bottom line of table 8 shows that of 6167 women who had ever had a birth, 1607 (26.1 per cent) were recorded as having their first birth before marriage and another 1158 (18.8 per cent) apparently had their first birth within the first nine months of marriage. It is possible that misreporting of the date of marriage or of first birth (or imputation of a date where the exact date was unknown) is responsible for some of these cases. It cannot account for them all, however: the pattern persists even where there are not two dates to compare (19.5 per cent of those who were not yet married had already had a birth). In many areas of tropical Africa, a couple may start having sexual relations several months before celebrating a formal marriage ceremony or starting to live together. Indeed, marriage as defined in the KFS is not infrequently conditional on the fecundity of the couple already being demonstrated. It is evident that although the data on age at first marriage may well reflect the intended definition, they do not necessarily reflect the beginning of sexual activity. We cannot use them to estimate either the time

Table 8 Relationship between dates recorded for first marriage and for first live birth

	Parous women				Nulliparous women	All women
	First birth before marriage	First birth <9 months after marriage	First birth ⩾9 months after marriage	Total		
Ever married						
Married <9 months	48	33	–	81	134	216
Married ⩾9 months	1212	1125	3402	5739	289	6029
Total	1260	1158	3402	5820	423	6243
Never married	346	–	–	346	1427	1773
All women	1607	1158	3402	6167	1851	8018

elapsed between puberty and first sexual union, nor that elapsed between first sexual union and first birth.

Contraception and pregnancy wastage before the first live birth

The questionnaire did not include specific questions on the use of contraception before the first birth. We can only glean very indirect and partial information from other questions.

Table 9 shows the proportions who have ever used contraception among women who have not yet had a live birth. Obviously non-contraceptors tend to be selected out of this group and the proportions reporting ever having used contraception will consequently overstate the proportions who use contraception to delay their first birth. Looking at women under 30 (nulliparous women over 30 are both very few and very exceptional), we see that 10–20 per cent of all nulliparous women report ever having used contraception (left-hand section of table 9). A sizeable proportion of the 80–90 per cent non-users are presumably women who have never been in a union, especially for the youngest age group. Interestingly enough though, when we restrict the sample further to ever-married women (right-hand section of the table) the proportions reporting never having used contraception are higher, not lower. This suggests that those who marry relatively late are more likely to use contraception before marriage, reflecting the fact that first birth and marriage as defined and interpreted in the KFS are commonly interlinked.

Overall, we can probably take the figure of 10 per cent as a very rough estimate of the proportions who use contraception to delay their first birth. This is a relatively low though not negligible figure: taken together with the fact that most of the users report use of the less efficient contraceptive methods, it suggests that contraception has only a limited impact on fertility through delaying the first birth, at least at national level.

Finally, miscarriages and still births are so under-reported in general (see section 3.1) that we have not attempted to assess the extent to which the time elapsed before the first live birth is affected by pregnancy wastage.

Primary sterility

There is no way of measuring directly primary sterility in WFS data sets. However, since voluntary childlessness is virtually unknown in Kenya, the proportion remaining childless is a fair indicator of the proportion with either primary sterility or very marked subfecundity. In total, 23.4 per cent of women aged 15–49 reported themselves as never having had a live birth (20.7 per cent as never having had a pregnancy), but most of these were young women who were either not yet married or who had been married only a very short time (table 10, left-hand panel). Among women over the age of 30 the proportion childless was only 2.7 per cent, and among women married five years or more this proportion was only 2.8 per cent (table 10, right-hand panel). An incidence of primary sterility of 2–3 per cent is low by African standards and lies well down in the range usually found in countries with no widespread primary fecundity impairments.

Table 11 shows the proportions childless by subgroup, for women married five or more years. Both town and city dwellers stand out as having slightly higher proportions childless (4–8 per cent) in nearly all age groups. In the breakdown by region, not only Nairobi and Coast, but also Nyanza province have above average proportions childless, especially among younger women (some of these may, however, be contraceptors).

2.4 CONCLUSIONS

The vast majority of Kenyan women both can and do bear children. Moreover, they start childbearing at a relatively early age – 19 years on average, but as early as 14 or 15 for 10 per cent of the women.

The data suggest a difference of between four and five years between average age at menarche and average age at first birth, but it is impossible to decompose this

Table 9 Percentage of nulliparous women who have ever used contraception, by current age

Current age	All women				Ever-married			
	Never used	Used		N	Never used	Used		N
		Inefficient method	Efficient method			Inefficient method	Efficient method	
15–19	87.8	11.0	1.2	1409	89.0	10.4	0.6	181
20–24	80.3	11.2	8.5	274	89.9	4.9	5.2	99
25–29	84.5	8.3	7.1	80	90.9	6.7	2.4	66
30–34	(83.3)	(7.6)	(9.1)	33	(77.2)	(10.4)	(12.4)	24
35–39	(100.0)	(0.0)	(0.0)	15	(100.0)	(0.0)	(0.0)	15
40–44	(84.8)	(9.6)	(5.6)	21	(84.8)	(9.6)	(5.6)	21
45–49	(93.1)	(6.9)	(0.0)	18	(93.1)	(6.9)	(0.0)	18
15–49	86.6	10.7	2.7	1853	89.2	8.0	0.8	426

NOTE: Figures in parentheses are based on less than 50 women.

Table 10 Percentage childless, by current age: all women and women married 5+ years

Current age	All women			Women married 5+ years		
	Per cent no live births	Per cent no pregnancies	N	Per cent no live births	Per cent no pregnancies	N
15–19	73.9	68.3	1907	(3.6)	(3.6)	38
20–24	19.1	15.8	1436	4.9	4.2	511
25–29	5.4	3.9	1479	2.6	1.9	1232
30–34	3.3	2.8	1011	2.3	1.8	986
35–39	1.6	1.2	926	1.6	1.2	916
40–44	3.5	2.8	614	3.5	2.9	608
45–49	2.8	2.5	644	2.8	2.5	641
15–49	23.1	20.7	8018	2.8	2.2	4931

NOTE: Figures in parentheses are based on less than 50 women.

Table 11 Percentage childless, by current age: women married 5+ years, differentials between subgroups

Subgroup	Current age 15–24			25–34			35–50			25–50		
	per cent no live births	per cent no pregnancies	N	per cent no live births	per cent no pregnancies	N	per cent no live births	per cent no pregnancies	N	per cent no live births	per cent no pregnancies	N
Residence												
Rural	4.0	3.5	462	2.2	1.7	1941	2.3	1.9	2094	2.4	1.9	4497
Town	(10.0)	(9.5)	33	5.0	4.6	100	(3.4)	(3.4)	46	5.5	5.2	179
City	8.0	6.4	54	4.2	2.6	176	6.9	6.0	99	5.6	4.2	329
Education												
No schooling	4.1	2.8	243	3.4	2.5	1120	3.0	2.4	1579	3.2	2.5	2941
⩽3 years	7.6	7.6	69	1.0	1.0	252	0.9	0.9	309	1.7	1.7	630
⩾4 years	4.7	4.6	237	1.8	1.3	844	1.8	1.5	347	2.3	1.9	1428
Province												
Nairobi	(6.3)	(6.3)	34	1.5	0.0	103	5.3	4.4	55	3.4	2.4	191
Central	(0.0)	(0.0)	30	1.5	1.5	335	2.0	1.7	365	1.7	1.6	729
Coast	2.9	1.8	75	5.3	3.0	215	4.5	3.4	183	4.6	3.0	473
Nyanza	7.4	6.9	166	5.1	4.1	457	2.9	2.7	564	4.4	3.8	1187
Rift Valley	5.8	5.2	97	1.0	1.0	457	1.8	1.5	351	1.8	1.6	905
Western	1.3	1.3	94	2.2	1.3	299	2.8	2.0	284	2.3	1.6	677
Northern and Northeastern	5.3	3.1	52	0.6	0.5	345	1.5	1.1	435	1.4	1.0	831

NOTE: Figures in parentheses are based on less than 50 women.

waiting time into biological and behavioural components with the data available. An unknown part would be due to the delay between menarche and the onset of ovulation. A probably larger portion is due to the delay before entry into a sexual union. We cannot estimate reliably how large this is, nor can we estimate the waiting time between first sexual union and first live birth since the data available on first union refer only to first marriage (albeit fairly broadly defined) rather than to first sexual union. We can say, however, that attempts to delay the first birth by contraception or abortion are apparently made by only a small subgroup of women, and that for most women entry into sexual union is followed fairly rapidly by the first birth.

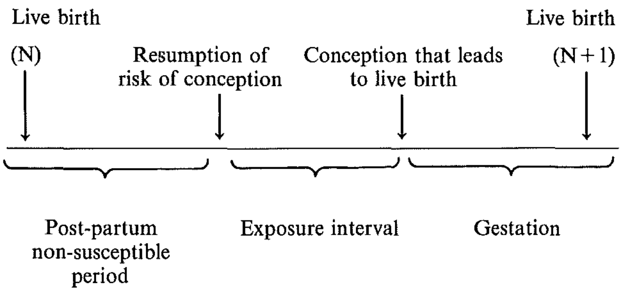
3 Birth-Spacing Patterns

3.1 INTRODUCTION: BIRTH INTERVALS AND THEIR COMPONENTS

Birth spacing has probably been the most important way in which pre-transitional societies (with the possible exception of Europe) have regulated their fertility. Increasing modernization, however, has resulted in the erosion of many of the institutional supports that upheld the traditional methods of spacing, many of which have not been fully replaced by new ones.

For the analysis of WFS data sets, birth spacing can be most easily studied by considering the interval between successive live births and dividing this into just three main components:

(i) The post-partum non-susceptible period during which the woman is not susceptible to conception because she is not ovulating (usually measured by the more readily observable and fairly closely correlated period of post-partum amenorrhoea).
(ii) The exposure interval, or period between the return of susceptibility and the conception that leads to the next live birth (including any months 'lost' due to pregnancies that do not end in a live birth).
(iii) The period of gestation.



Note that although detailed information on intervals between pregnancies was collected in many WFS surveys (especially those that were the first to incorporate the FOTCAF module), it is usually preferable to analyse the data in terms of live-birth intervals than to attempt to work with pregnancy intervals. The reason is that pregnancies that end in a foetal loss are often seriously under-reported: typically only 5–10 per cent of the reported pregnancies are said to end in a miscarriage or still birth. It is clear that a large proportion of unfruitful pregnancies tend to be undetected, forgotten, or simply not reported in surveys of this kind.

Although data on the length of the intervals themselves were collected for every interval each woman had experienced, questions on the proximate determinants of these intervals were posed for recent births only, typically for the two most recent births or pregnancies for each woman. We shall, therefore, restrict analysis to intervals started in a period of a few years preceding the survey. In most versions of the FOTCAF questionnaire, we have useful data on the proximate determinants for a representative sample of intervals started in, at most, the *three* to *four* years preceding the survey (for the later versions – used in Benin and Nigeria – however, detailed questions were asked for all births in the last *five* years). For the birth intervals themselves, not only is it possible to use a slightly longer period (complete data are available), it is also necessary to do so (since many interbirth intervals exceed three years): we have used *six* years.

Finally we should note that our analysis gives equal weight to each interval started in the period covered, rather than giving equal weight to each woman. Either approach could be used: the former is adopted here because it simplifies evaluation of the relative contribution made by each of the various determinants of fertility to overall fertility levels.

3.2 BIRTH INTERVAL LENGTHS

Table 12 and figure 4 summarize the results of a life-table analysis of all live-birth intervals started in the six years preceding the survey. For intervals among women currently aged under 35, it is estimated that over 90 per cent are closed by the arrival of another child in six years or less. Half the intervals among women aged less than 40 are closed in a little over two years. Probably only a few of the intervals that are not closed within six years are likely to be closed at higher durations: most will remain open. If we look just at the estimates for those closed within six years, we find an average duration of between two and two and a half years. As is to be expected, older women have a significantly lower proportion of intervals closed, and a slightly longer duration. The very youngest cohort also has slightly longer than average intervals: a few women who have a birth extremely young follow this with a very long interval. Table 13 suggests relatively small differences between the subgroups, with Coast recording the longest intervals among the provinces. City dwellers and Nairobi and Coast dwellers tend to have lower proportions closing the interval, particularly after the youngest age group, suggesting an earlier stopping pattern.

With an average birth interval of just over two years, Kenya has relatively short intervals by tropical African standards. Since the duration of gestation is everywhere fixed at approximately nine months, one or both of the other two components must be modest. We shall examine each, and its main determinants in turn.

Table 12 Length of live birth interval (in months),[a] by current age of mother

Current age of mother	All intervals						Closed in six years		N
	Quantiles[b]					Average (trimean)	Per cent closed	Mean duration	
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}				
15–19	16.8	21.5	29.3	46.9	65.0	31.8	93.2	29.8	645
20–24	15.3	20.9	26.6	35.8	53.3	27.5	93.5	26.4	2 244
25–29	14.7	20.6	26.2	35.9	51.1	27.2	95.5	26.4	3 148
30–34	15.3	21.7	27.9	39.6	64.9	29.3	90.5	27.2	2 014
35–39	15.8	22.1	29.6	44.2	–	31.4	85.0	27.5	1 565
40–44	17.3	23.1	36.4	–	–	–	74.6	29.8	808
45–49	17.7	24.9	50.6	–	–	–	56.8	28.2	493
All ages	15.3	21.4	28.0	41.5	–	29.7	88.3	27.0	10 495

[a]Estimated using life-table methods, using all intervals started in the six years preceding the survey.
[b]T_x indicates the estimated duration by which x per cent of the intervals have been closed.

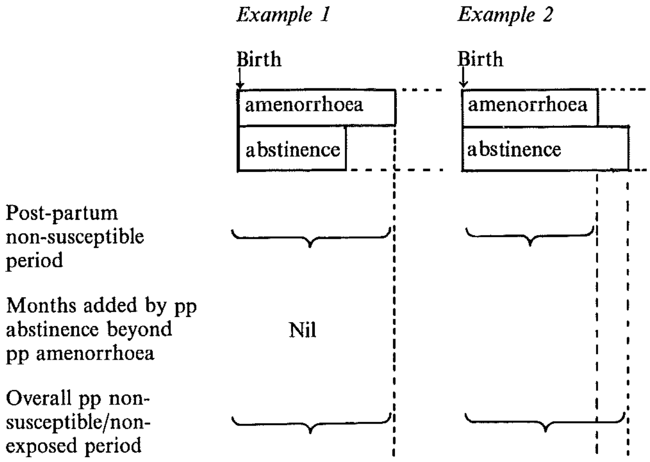
3.3 THE POST-PARTUM NON-SUSCEPTIBLE PERIOD AND ITS DETERMINANTS

Post-partum variables and the measurement of their duration

The post-partum non-susceptible period is usually measured by its proxy, the period of post-partum amenorrhoea. Its duration depends principally on the duration of frequent and intense breastfeeding and varies from about 1.5–2 months in the complete absence of breastfeeding to about 18 months or more where frequent and unsupplemented breastfeeding is prolonged.

In almost all populations abstinence is observed for at least a short period post-partum. Where this period is shorter than the period of amenorrhoea it has no separate impact on fertility. Where it can be longer, then it adds to the birth interval. Strictly speaking, since the woman is then susceptible, the additional months added should not be treated as part of the 'non-susceptible period'. However, it is often analytically more convenient to treat post-partum abstinence in the same way as post-partum amenorrhoea: both start at the moment of delivery, they cover partially overlapping time periods, and the data take the same basic form.

There is also a conceptual basis for treating post-partum abstinence and amenorrhoea in the same way, since not only do both start at delivery but they occur precisely *because* a birth has occurred: both their existence and their timing are the direct result of the birth. We shall, therefore, treat post-partum abstinence in exactly the same way as post-partum amenorrhoea here. We shall also define an overall post-partum non-susceptible/non-exposed period (nsp/nep) following each birth as whichever is longer – the period of post-partum amenorrhoea or the period of post-partum abstinence:



In all but the last two countries that used the FOTCAF module (Benin and Nigeria), detailed questions on the duration of breastfeeding, amenorrhoea and abstinence were asked only for the two most recent pregnancies for each woman. These do not form a representative sample of either births or pregnancies.[3] Current status data (ie whether or not the woman is still amenorrhoeic, still abstaining, still breastfeeding since the birth in question) are, however, available, either directly or by inference, for *all* births. We have therefore used current status data rather than the retrospectively reported durations and full life-table methods.[4] Details of the methods used are given in appendix A.

[3]Questions restricted to the two most recent births or to the two most recent pregnancies can provide a representative sample only of births for a short period immediately preceding the survey – a period sufficiently short for a woman not to have had any other birth in it, apart from the one or two births she was asked about. See Page, Ferry, Shah and Lesthaeghe (1980) and Page, Lesthaeghe and Shah (1982) for a discussion of the conventions used in WFS and of the potential selection biases.
[4]This has the additional potential advantage of avoiding use of retrospectively reported durations for the post-partum variables that may not be very reliably reported (see Ferry (1981) for an extended discussion). This is especially important for amenorrhoea, the duration of which many women find extremely hard to recall.

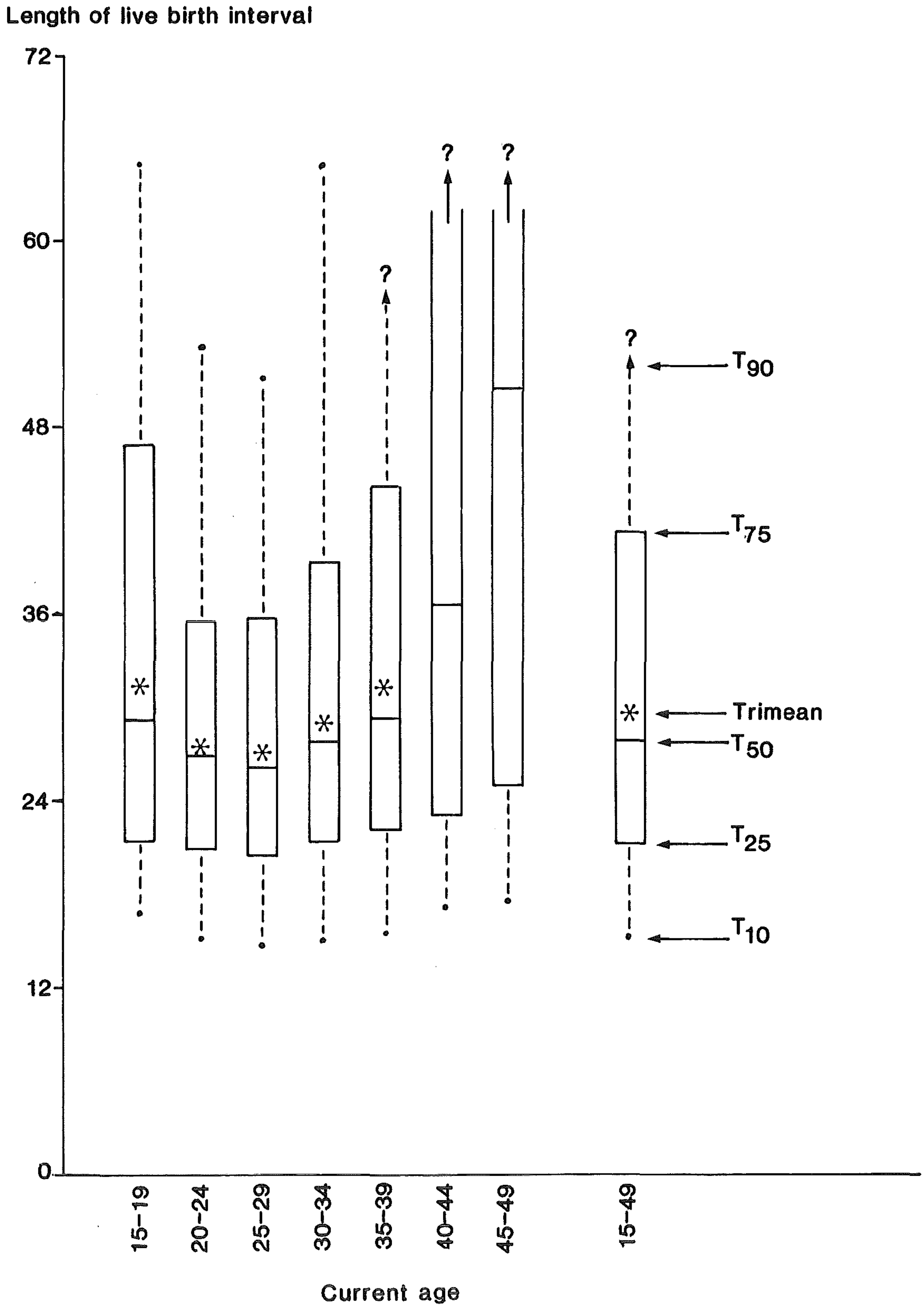


Figure 4 Length of live birth interval (in months), by current age of mother[a]

[a]See table 12.

At national level we have estimated not only the quantiles and trimean but also the arithmetic mean. For subgroups we have estimated only the arithmetic mean because sample fragmentation makes it extremely difficult to estimate the quantiles reliably. Two ways of estimating the mean are given at national level, for comparison. The 'survival mean' is defined as:

$$\bar{X} = 0.5\ E(0) + \sum_{d=1} p(d)$$

Table 13 Median length of live birth interval (in months) and percentages of intervals closed in six years,[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother											
	15–24			25–34			35–49			All ages		
	Median duration	Per cent closed	N	Median duration	Per cent closed	N	Median duration	Per cent closed	N	Median duration	Per cent closed	N
Residence												
Rural	26.9	94.1	2429	26.9	94.4	4561	32.5	76.7	2781	28.1	88.6	9771
Town	26.0	87.7	190	27.5	87.1	226	(38.4)	(64.6)	44	27.3	85.3	459
City	27.5	91.6	270	25.4	85.5	375	(34.8)	(69.3)	70	27.0	85.1	715
Education												
No schooling	27.4	94.4	967	28.0	92.9	2405	32.9	75.7	1942	29.3	86.4	5315
⩽3 years	26.2	94.1	309	28.0	96.2	546	32.0	77.0	453	28.7	89.8	1308
⩾4 years	26.8	91.8	1609	25.5	93.3	2207	32.2	77.5	497	26.4	90.4	4313
Province												
Nairobi	27.1	88.8	192	25.0	89.1	246	(32.9)	(67.4)	48	26.8	86.4	486
Central	26.0	91.1	314	27.0	94.7	804	31.0	77.2	567	28.1	87.7	1684
Coast	29.4	93.6	264	28.6	88.7	405	33.9	73.9	193	30.0	86.1	862
Nyanza	26.9	90.3	661	26.8	96.4	997	32.8	77.4	676	28.1	88.7	2334
Rift Valley	25.8	96.1	612	26.7	92.4	1131	32.3	76.2	497	27.1	89.0	2239
Western	26.6	96.4	452	26.7	94.0	708	36.3	77.0	317	27.6	90.3	1477
Eastern and Northeastern	29.1	93.5	380	27.0	94.2	837	32.9	75.3	596	28.9	87.3	1813

[a]Estimated using life-table methods, using all intervals started in the six years preceding the survey.
NOTE: Figures in parentheses are based on less than 100 births.

where:

p(d) is the proportion still in the post-partum condition for births that occurred d months ago; and

E(0) is the proportion that started out in this condition for the births concerned. This is assumed to be unity for amenorrhoea and abstinence (every woman has some post-partum amenorrhoea and abstinence, even if it is very short): for breastfeeding it is the proportion ever breastfed.

The 'prevalence–incidence' or 'stationarity' estimate of the mean is defined as:

$$\bar{X} = P/I$$

where:

P is the number of births for which the mother is still in the post-partum condition (regardless of when these births occurred); and

I is the average number of births per month. We have estimated I using both births in the last 12 months and births in the last 24 months. In a number of countries, including Kenya, the latter generally tends to give estimates that correspond slightly better with the survival mean, at least for breastfeeding (Ferry and Smith 1983), largely because of the larger sample size; but it may tend to overestimate durations for younger women and to underestimate them for older women.

It should be noted that the prevalence–incidence mean assumes a constant stream of births, an assumption that is not always warranted. We have used it in preference to the survival mean for the subgroup analyses, however, since the latter may be very sensitive to sample fragmentation.

Post-partum amenorrhoea and its relationship to breastfeeding

Most women know whether they have resumed menstruating since their last pregnancy, although one or two may be uncertain because of spotting or very irregular bleeding.[5] For the current open birth interval the actual question used was:

515 How many months after the birth of this child did your period come back?
____ months Period not back yet[6] [77]

[5]The only conceptual problem arises for women who have not resumed menstruating but who now seem to be menopausal, eg those who believe they are menopausal because their amenorrhoea has lasted much longer than usual, or those who have been amenorrhoeic an exceptionally long time (say more than three years). We have treated these women as no longer in *post-partum* amenorrhoea.

[6]For all the post-partum variables the woman was not actually asked directly whether she was still in the post-partum condition, eg still amenorrhoeic. Instead she was asked how many months had elapsed before it ended, with 'not yet ended' being an acceptable response.

The situation is more difficult with respect to breastfeeding. What exactly constitutes breastfeeding? What constitutes full breastfeeding? How does one classify an occasional suckle? As the questions show, respondents were largely left to interpret this themselves. We have to accept the data as they present themselves and not attach too much significance to small differences.

Questions on breastfeeding in the open pregnancy interval were:

510 Now I would like to ask you about several events in your life since the birth of ______ (Name of last child or 'Your most recent child who later died'). Did you breastfeed ______ (Name of last or your most recent child)?

Yes [1] No [2] (Skip to 514)

511 For how many months altogether did you breastfeed him/her?
Probe: How many months old was he/she when you completely stopped breastfeeding him/her?
______ Still breastfeeding [77] (Skip to 513) Until he/she died [97] (Skip to 513)

512 After ____ months had you completely stopped breastfeeding your child even once a day?
Yes [1] No [2] (Correct 511 as necessary then proceed to 513)

513 How many months old was the child when you began giving him/her any other food along with breastfeeding?
______ (Months) No additional food yet [77] Child died before given additional food [97]

Questions on breastfeeding in the last closed pregnancy interval were:

533 For how many months altogether did you breastfeed him/her?
Probe: How many months old was he/she when you completely stopped breastfeeding him/her?
______ (Months) Still breastfeeding despite current pregnancy [77] (Skip to 536) Until he/she died [97] (Skip to 536)

534 After ____ months had you completely stopped breastfeeding your child even once a day?
Yes [1] No [2] (Correct 533 as necessary and then proceed to 535)

535 Did you become pregnant again before or after you completely stopped breastfeeding?
Became pregnant before stopped breastfeeding [1] Became pregnant after stopped breastfeeding [2]

Table 14 Duration of post-partum amenorrhoea (in months), by current age of mother

Current age of mother	Estimates based on births in last three years							Prevalence–incidence estimate of mean duration
	Quantiles[a]					Average duration		
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
A All live births								
15–24	1.9	3.4	8.0[b]	13.2	19.5[b]	8.2	9.3	10.9
25–34	1.7	5.1	10.5	16.0	19.5[b]	10.6	10.8	11.5
35–49	2.1	5.5[b]	12.5	17.0	20.0[b]	11.9	12.1	14.4
15–49	1.8	4.2	10.7	15.4	19.6	10.3	10.6	11.9
B Children still surviving at time of survey								
15–24	2.1	3.6	8.6[b]	13.4	20.0[b]	8.6	9.7	–[c]
25–34	1.7	5.5	10.8	16.9	19.7[b]	11.0	11.3	–[c]
35–49	3.2	7.6[b]	12.2	17.2	20.3[b]	12.3	12.9	–[c]
15–49	2.1	5.8	11.1	15.9	19.8	10.9	11.1	–[c]

[a]T_x indicates the estimated duration by which x per cent of the women has resumed menstruation after the births in question, based on current status data.
[b]Final estimate obtained by graphical smoothing.
[c]Not estimated because the assumption of a constant stream of births is violated.

536 How many months old was the child when you began giving him/her any other food along with breastfeeding?
________ (Months) Child died before given additional food $\boxed{97}$

The estimates for amenorrhoea are summarized in table 14 and figure 5. Since it is sometimes difficult to estimate quantiles for the post-partum variables for five-year age groups of women (the p(d) sequences can be very irregular because of small sample sizes), we have presented all the results for three broader age groups only. The estimated average duration is moderate, the mean ranging from 11–12 months depending on exactly how it was estimated, and the trimean being estimated as 10 months. The average is shorter for births to younger women, the difference between births to women now aged 15–24 and those to women now aged 35–49 being about three months.[7]

Table 15 shows fairly marked differences between subgroups by residence and by education, with rural residents clearly differentiated from urban and city residents (amenorrhoea three months longer). Among the regions, Nairobi alone has a particularly short duration, Coast a particularly long one (even excluding the slightly suspect estimate for age group 35–49, Coast has the highest estimates) followed by Nyanza and Rift Valley.

The estimated duration of amenorrhoea is generally quite consistent with the information on breastfeeding. As table 16 and figure 6 show, virtually all children – 98 per cent – are breastfed (and most of those who are not are children who die shortly after birth), and the duration of breastfeeding is fairly long: the average duration is 16–17 months (about one month longer if we exclude children who died). As shown in table 17 and figure 7,

Table 15 Mean duration of amenorrhoea (in months),[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Residence				
Rural	11.4	11.9	14.9	12.4
Town	8.8	10.1	(8.4)	9.4
City	9.6	8.9	(14.1)	9.5
Education				
No schooling	13.3	13.5	15.0	13.9
⩽3 years	13.2	10.8	15.6	12.8
⩾4 years	9.1	9.7	13.1	9.7
Province				
Nairobi	9.9	8.7	(13.5)	9.6
Central	9.3	11.0	12.9	11.1
Coast	13.1	13.0	(27.7)	15.1
Nyanza	12.4	12.1	12.3	12.2
Rift Valley	11.6	11.9	17.8	12.8
Western	9.7	11.9	11.9	11.1
Eastern and Northeastern	9.7	11.2	15.9	12.1

[a]Estimated for births in the 24 months preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 live births in the period.

[7]The estimated difference would have been much higher (six months) if we had estimated the mean duration as P/I and had estimated I as the average number of births per month based on births in the last year rather than on births in the last two years.

Table 16 Duration of breastfeeding (in months), by current age of mother

Current age of mother	Per cent breastfed E	Estimates based on births in last three years							Prevalence–incidence estimate of mean duration
		Quantiles[a]					Average duration		
		T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
A All live births									
15–24	0.980	6.0	11.3	14.7	19.7	25.5	15.1	15.2	16.5
25–34	0.992	8.0[b]	11.4	15.8	19.5	24.0[b]	15.6	16.1	16.3
35–49	0.976	7.0[b]	12.8[b]	18.3	24.6	31.0[b]	18.5	18.2	19.4
15–49	0.975	6.0[b]	11.8	16.1	21.0	26.0	16.3	16.3	17.0
B Children still surviving at time of survey									
15–24	0.995	6.8	11.8	15.4	20.4	25.6	15.8	16.2	–[c]
25–34	0.934	9.0[b]	12.9	16.7	20.1	24.3	16.6	17.2	–[c]
35–49	0.995	10.0	14.4	19.0	25.2	31.5	19.4	19.6	–[c]
15–49	0.994	8.4	12.6	17.0	22.2	27.6	17.2	17.5	–[c]

[a] T_x indicates the estimated duration after the births in question by which x per cent of the women were not breastfeeding, based on current status data.
[b] Final estimates obtained by graphical interpolation.
[c] Not estimated because the assumption of a constant stream of births is violated.

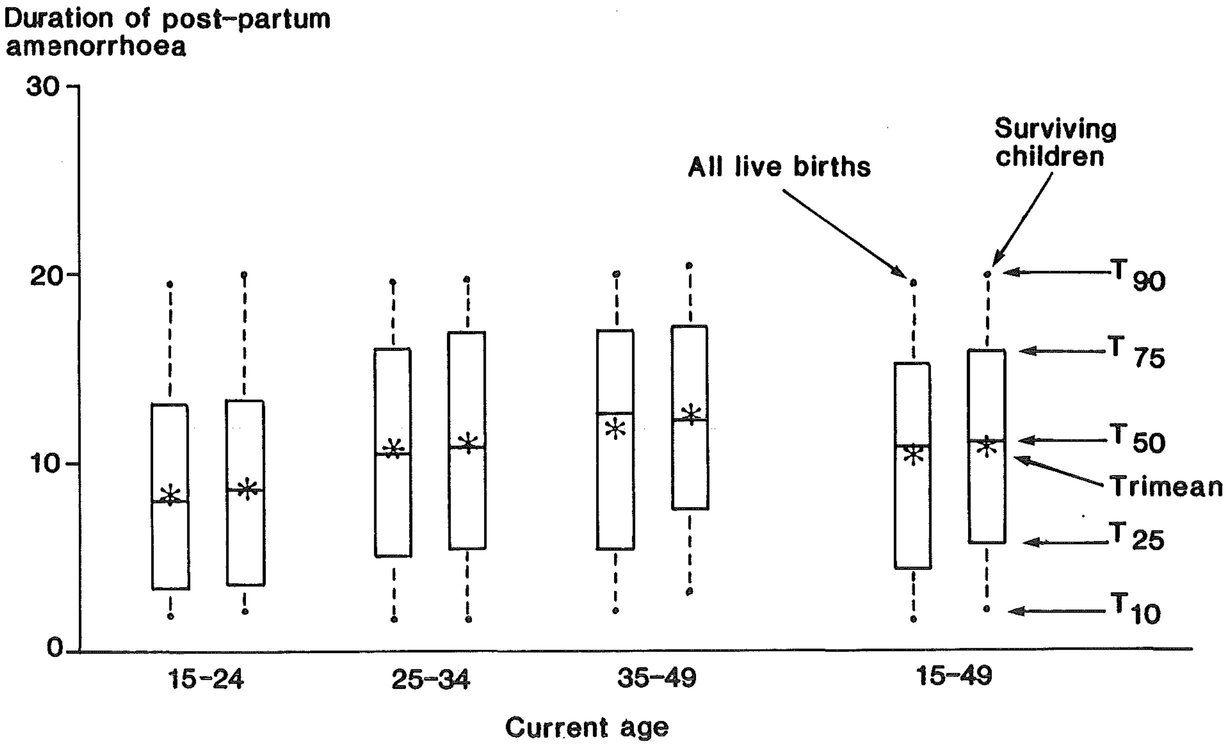


Figure 5 Duration of post-partum amenorrhoea (in months), by current age of mother[a]

[a] See table 14.

however, full breastfeeding is very short and averages only two months: less than 10 per cent of children are fully breastfed for more than five months. Tables 18 and 19 show essentially the same patterns of differentials between subgroups as table 15 indicated for amenorrhoea, with Coast here being unequivocally above the average.

The relationship between the data on breastfeeding and amenorrhoea corresponds quite closely with what is observed elsewhere. Figure 8 plots the mean duration of breastfeeding against that of amenorrhoea, together with a curve summarizing the average pattern of the relationship observed over a number of other countries

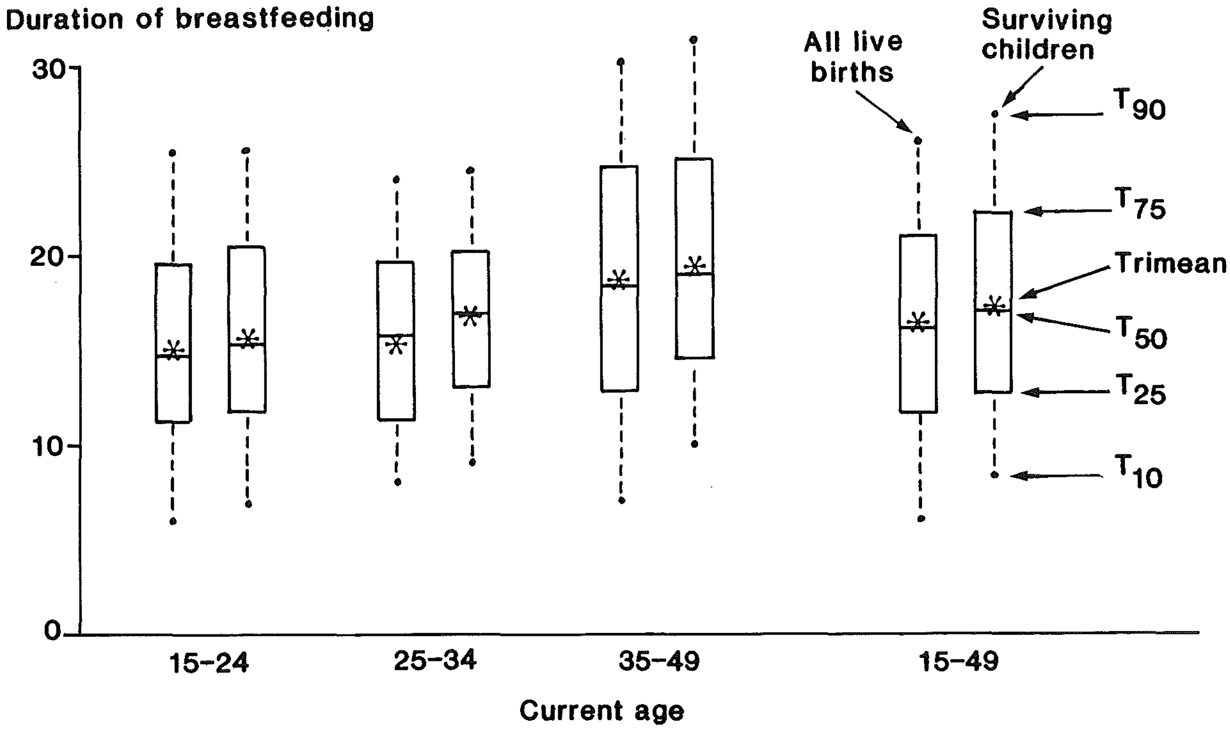


Figure 6 Duration of breastfeeding (in months), by current age of mother[a]

[a]See table 16.

Table 17 Duration of full breastfeeding (in months), by current age of mother

Current age of mother	Per cent breastfed E	Estimates based on births in last three years							Prevalence–incidence estimate of mean duration
		Quantiles[a]					Average duration		
		T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
A All live births									
15–24	0.980	0.2	0.7	1.5	2.6	4.1	1.6	1.9	2.5
25–34	0.992	0.3	0.8	1.8	2.8	4.4	1.8	2.2	2.2
35–39	0.976	0.3	1.0	1.9	3.6	5.5	2.1	2.4	2.1
15–49	0.975	0.3	0.8	1.7	2.8	4.6	1.8	2.1	2.3
B Children still surviving at time of survey									
15–24	0.995	0.3	0.7	1.5	2.7	4.3	1.6	2.0	–
25–34	0.934	0.3	0.9	1.8	2.8	4.3	1.8	2.2	–
35–49	0.995	0.4	1.1	2.1	3.8	5.6	2.3	2.5	–
15–49	0.994	0.3	0.8	1.7	2.9	4.7	1.8	2.2	–

[a]T_x indicates the estimated duration after the births in question by which x per cent of the women were not fully breastfeeding, based on current status data.

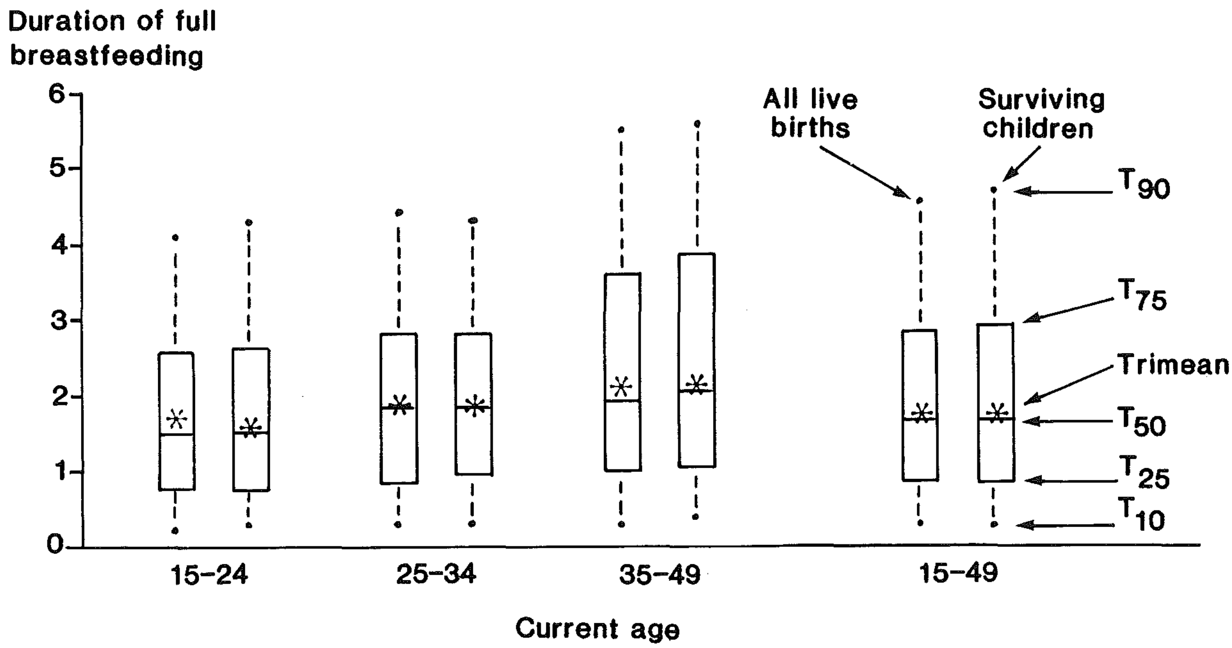


Figure 7 Duration of full breastfeeding (in months), by current age of mother[a]

[a]See table 17.

Table 18 Mean duration of breastfeeding (in months), [a]by current age of mother: differentials between subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Residence				
Rural	17.3	17.0	19.9	17.7
Town	14.2	13.2	(16.6)	13.9
City	14.8	12.9	(16.9)	14.0
Education				
No schooling	18.2	18.6	20.3	19.0
⩽3 years	16.4	16.5	20.5	17.5
⩾4 years	16.0	14.3	17.2	15.3
Province				
Nairobi	14.7	12.6	(16.5)	13.9
Central	15.2	14.3	16.5	15.1
Coast	20.1	18.6	(24.1)	20.0
Nyanza	17.1	17.6	18.0	17.6
Rift Valley	16.6	16.6	19.3	17.1
Western	17.0	16.6	22.3	17.7
Eastern and Northeastern	16.5	17.1	23.3	18.7

[a]Estimated from births in the 24 months period preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 live births in the period.

Table 19 Mean duration of full breastfeeding (in months),[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Residence				
Rural	2.5	2.2	2.2	2.3
Town	3.8	3.1	(0.8)	3.3
City	2.7	1.6	(0.7)	2.0
Education				
No schooling	2.8	2.7	2.5	2.7
⩽3 years	2.9	2.0	1.5	2.1
⩾4 years	2.4	1.8	1.4	2.0
Province				
Nairobi	2.7	1.8	(2.7)	2.2
Central	1.2	1.0	1.5	1.2
Coast	3.1	3.1	(5.8)	3.5
Nyanza	3.1	3.2	1.8	2.8
Rift Valley	2.7	2.0	3.3	2.5
Western	2.9	2.6	1.8	2.6
Eastern and Northeastern	1.5	1.7	1.7	1.6

[a]Estimated from births in the 24 months preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 live births in the period.

(Bongaarts 1983): the points lie very close to this curve. Figure 9 compares the proportion still amenorrhoeic by duration since the birth between (i) women who had not breastfed or were no longer breastfeeding at the survey, and (ii) those who were still breastfeeding, whether fully or partially. The dotted line refers to the subgroup who were still fully breastfeeding. Among women not breastfeeding at the time of the survey the proportion still amenorrhoeic is unity where the birth occurred less than

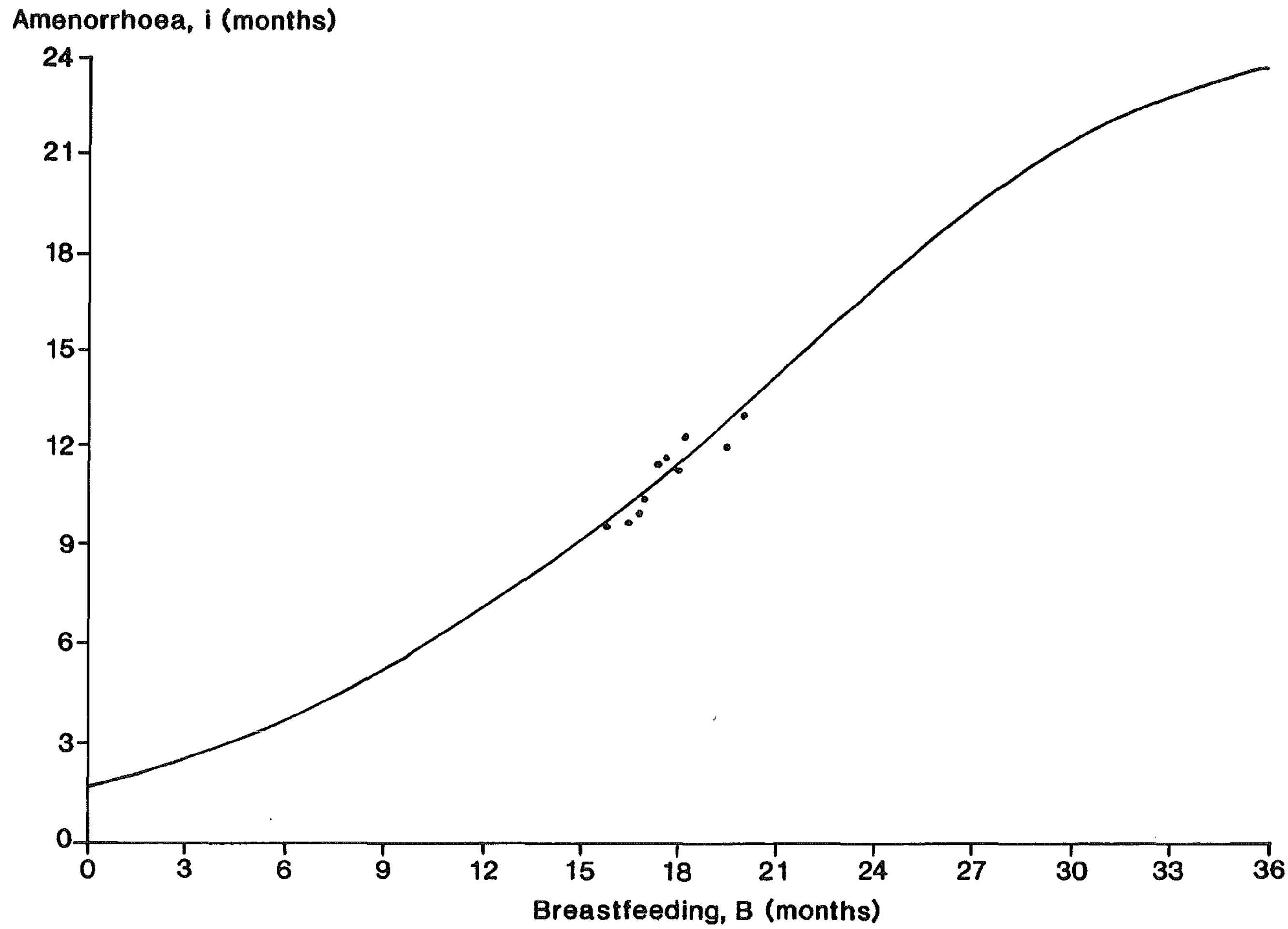


Figure 8 Relationship between estimated mean durations of breastfeeding and of post-partum amenorrhoea[a]

[a]The separate points refer to the subgroups in tables 15 and 18.
[b]Relationship estimated by Bongaarts (1983) based on data for a number of countries.

two months ago, but it drops sharply to only 20 per cent among women whose child was already two months old, then declines more slowly. For those still breastfeeding, the proportion declines much more slowly as we move from those with very recent births to those whose birth was longer ago, reflecting the role of breastfeeding in prolonging amenorrhoea beyond 1.5–2 months post-partum: among those whose birth was 12 months before the survey, 50 per cent are still amenorrhoeic and the figure of 20 per cent (which was reached at two months for the women who were not breastfeeding at the time of the survey) is reached for breastfeeding women only when we get to births that occurred about 20 months ago. For those still fully breastfeeding the child we can only look at births that occurred within the last six or seven months (only 10 women were still fully breastfeeding children born more than seven months before the survey), but in almost all the cases the woman was still amenorrhoeic, reflecting the predominant role of intensive breastfeeding in determining the duration of amenorrhoea.

We can conclude that our estimates of amenorrhoea durations are probably not far from reality. An average duration of 11–12 months would imply that breastfeeding was extending interbirth intervals by 9–10 months on average, since post-partum amenorrhoea would average about two months in the complete absence of breastfeeding.

Post-partum abstinence

The questions on post-partum abstinence took essentially the same form as those on amenorrhoea. For the current open pregnancy interval the question used was:

514 For how many months after the birth of this child did you go without sexual relations?
Probe: How many months old was the child when you resumed sexual relations?
____ Months   Not started yet[8] $\boxed{77}$

and for the last closed interval it was:

[8]Again, the woman was not asked directly whether she was still abstaining. In addition, the question does not distinguish between post-partum and terminal abstinence for those births where the mother will never resume sexual activity. For those reporting themselves as practising terminal abstinence elsewhere in the questionnaire, we have assumed that they are no longer in *post-partum* abstinence.

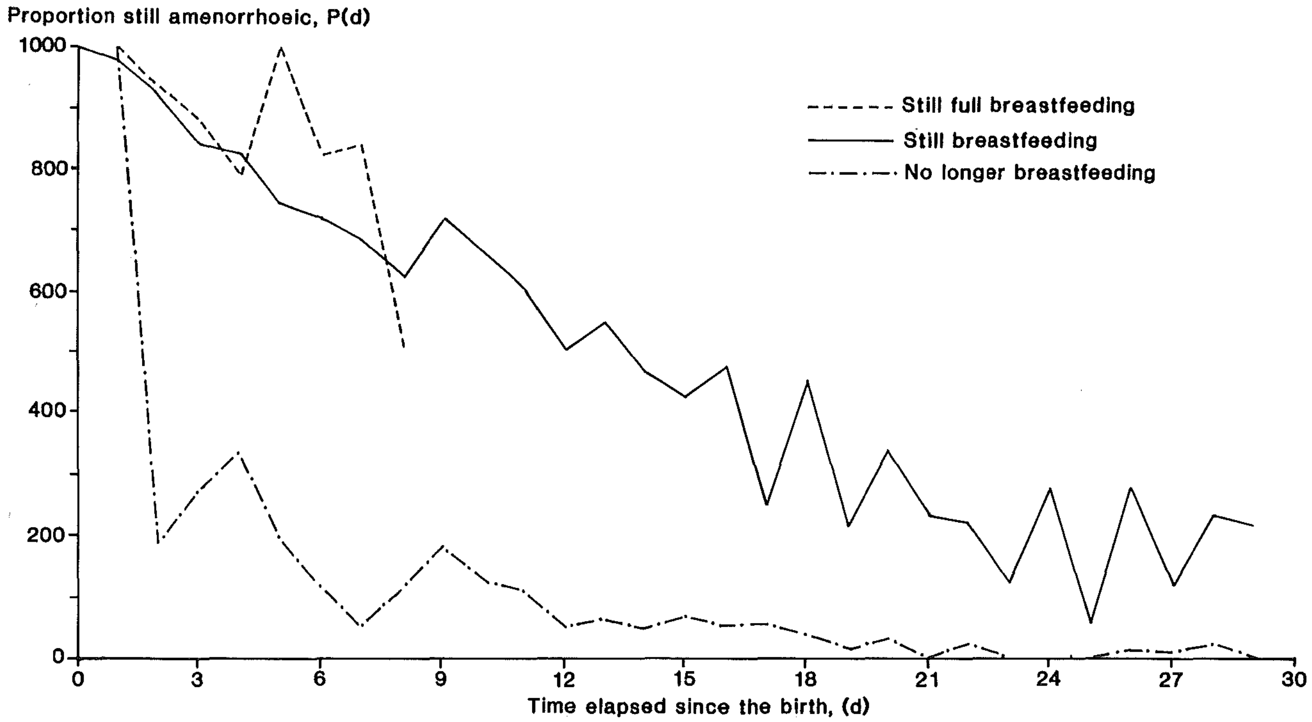


Figure 9 Proportion still amenorrhoeic by months elapsed since the birth, by breastfeeding status at the survey

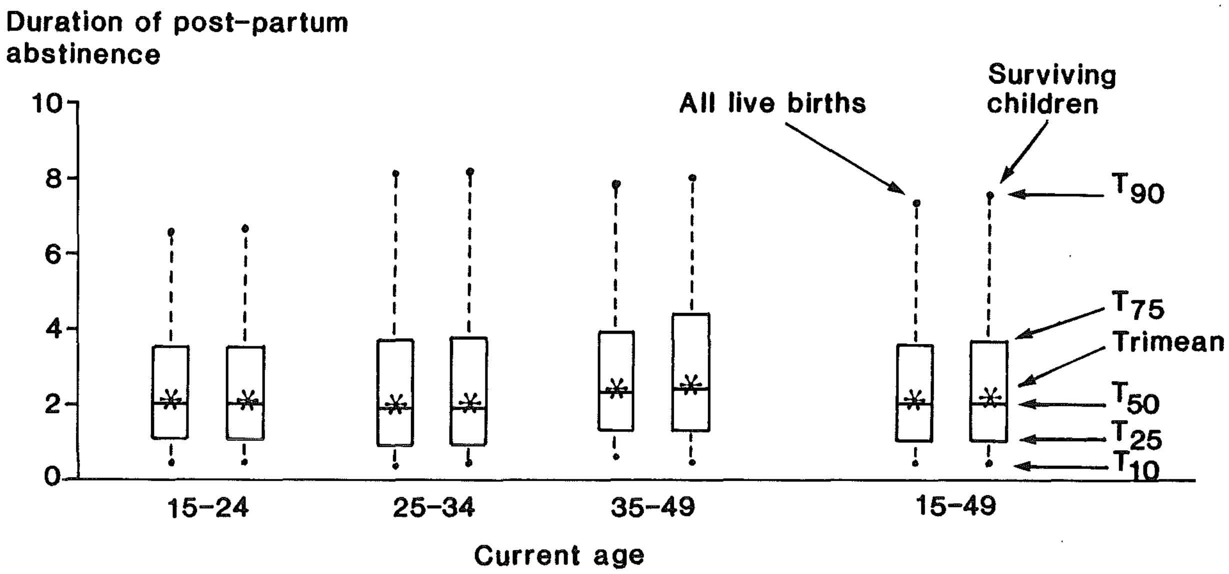


Figure 10 Duration of post-partum abstinence (in months), by current age of mother[a]

[a]See table 20.

537 For how many months after the birth of this child did you go without sexual relations?
Probe: How many months old was the child when you resumed sexual relations?
______ Months

In general, women can respond easily to this question. However, it is not clear how they interpreted it if there had been just a single isolated coitus some time before the resumption of regular sexual relations, as is prescribed, for example, in the traditions of some ethnic groups (Molnos 1973).

It has been known for some time that eastern African populations in general do not observe such extremely long periods of post-partum abstinence as some populations in western Africa,[9] although we cannot rule out the possibility that they may have done so in the past. Even by eastern African standards, however, recent post-partum abstinence in Kenya is very short. As table 20 and figure 10 show, the average is only 3–4 months. Even among the oldest age group, less than 10 per cent abstain for more than 7 months. The differentials be-

[9]See Schoenmaeckers, Shah, Lesthaeghe and Tambashe (1981), for a recent review of the anthropological literature.

Table 20 Duration of post-partum abstinence (in months), by current age of mother

Current age of mother	Estimates based on births in last three years: Quantiles[a] T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Average duration: Trimean	Mean	Prevalence–incidence estimate of mean duration
A All live births								
15–24	0.4	1.1	2.0	3.5	6.6	2.1	3.0	4.0
25–34	0.3	0.9	1.9	3.7	8.1	2.1	3.2	3.8
35–49	0.6	1.3	2.4	3.9	7.8	2.5	3.8	6.2
15–49	0.4	1.0	2.0	3.6	7.4	2.1	3.2	4.4
B Children still surviving at time of survey								
15–24	0.4	1.1	2.0	3.5	6.7	2.1	3.0	–[b]
25–34	0.4	0.9	1.9	3.8	8.2	2.1	3.2	–[b]
35–49	0.4	1.3	2.5	4.4	8.0	2.7	4.0	–[b]
15–49	0.4	1.0	2.0	3.7	7.6	2.2	3.8	–[b]

[a]T_x indicates the estimated duration by which x per cent of the women had resumed sexual relations after the birth in question, based on current status data.
[b]Not estimated because the assumption of a constant stream of births is violated.

tween the subgroups are generally modest (see table 21). There is a clear difference between educational subgroups for the central and oldest age groups, with the more educated abstaining less: within the youngest group, the three education groups are rather similar, with even the uneducated having rather short durations. Among the regions, interestingly, Nairobi does not have the lowest estimates (these are recorded for Western and Nyanza provinces), and Rift Valley appears to have the longest abstinence.

Figure 11 shows that for any group of births which occurred at the same time before the survey, the proportion still abstaining is much lower among those women who are no longer breastfeeding than among those who are still breastfeeding and this in turn is lower than the proportion still abstaining among those who are still fully breastfeeding. But we cannot tell from these data alone whether women are more likely to be abstaining *because* they are still (fully) breastfeeding the child, or whether the relationship is due to the impact of other variables on both breastfeeding and abstinence.

Table 21 Mean duration of post-partum abstinence (in months),[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother: 15–24	25–34	35–49	All ages
Residence				
Rural	4.0	3.8	6.8	4.5
Town	4.9	4.8	(6.8)	5.0
City	4.2	3.8	(4.4)	4.0
Education				
No schooling	4.4	4.9	7.5	5.5
⩽3 years	5.5	3.3	6.2	4.7
⩾4 years	3.6	2.8	4.1	3.3
Province				
Nairobi	4.7	3.6	(4.3)	4.2
Central	3.2	3.3	5.2	3.8
Coast	3.8	3.7	(5.9)	4.0
Nyanza	3.4	3.1	4.1	3.4
Rift Valley	5.8	6.0	12.8	7.0
Western	3.6	2.6	4.5	3.3
Eastern and Northeastern	3.5	3.7	8.3	4.9

[a]Estimated from births in the 24 months preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 live births in the period.

The combined impact of post-partum amenorrhoea and abstinence

Post-partum abstinence is too short to make a major contribution to the birth interval. For at least some intervals, however, post-partum abstinence does last longer than post-partum amenorrhoea. The duration of the overall non-susceptible/non-exposed period post-partum is, therefore, slightly longer than the duration of post-partum amenorrhoea alone. Table 22 and figure 12 show that the combined period averages 11–13 months, ie about one month longer than amenorrhoea alone. In other words, amenorrhoea and abstinence together add about 9–11 months to the average birth interval beyond the minimum possible average period of post-partum non-susceptibility; and most of this is added by lactation-related amenorrhoea.

The differentials by residence and by education are

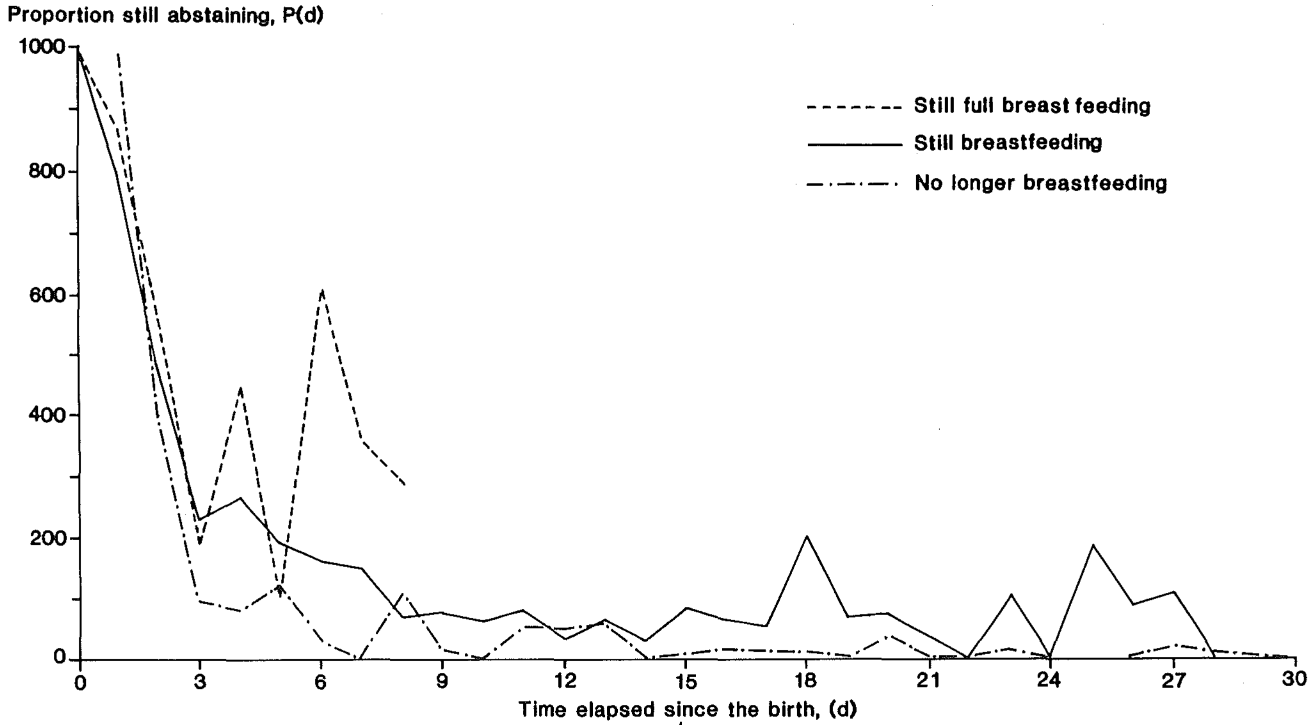


Figure 11 Proportion still abstaining by months elapsed since the birth, by breastfeeding status at the survey

Table 22 Combined effect of post-partum amenorrhoea and abstinence: duration of combined non-susceptible/non-exposed period (in months), by current age of mother

Current age of mother	Estimates based on births in last three years							Prevalence–incidence estimate of mean duration
	Quantiles[a]					Average duration		
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
A All live births								
15–24	2.2	3.8	7.7	13.4	20.0[b]	8.1	9.7	11.4
25–34	2.6	5.5	10.6	17.0	19.8[b]	11.0	11.5	12.2
35–49	2.5	6.5[b]	12.6	17.2	21.0[b]	12.2	13.1	16.7
15–49	2.4	4.8	10.8	15.9	19.8	10.6	11.3	12.9
B Children still surviving at time of survey								
15–24	2.4	4.1	10.3	13.6	20.0[b]	9.5	10.1	–[c]
25–34	3.3	6.1	10.9	17.3	20.0[b]	11.3	12.1	–[c]
35–49	3.5	8.2[b]	13.8	17.4	22.0[b]	13.3	14.0	–[c]
15–49	2.9	5.3	11.2	16.7	20.5[b]	11.1	11.9	–[c]

[a]T_x indicates the estimated duration by which x per cent of the women had resumed both menstruation and sexual relations after the births in question, based on current status data.
[b]Final estimates obtained by graphical smoothing.
[c]Not estimated because the assumption of a constant stream of births is violated.

significant (3–4 months) and in the expected direction (table 23). Among the provinces, Nairobi clearly has the lowest duration and Coast the highest (even excluding the oldest age group), its position as the province with the longest birth intervals clearly being due largely to its longer amenorrhoea and abstinence.

3.4 THE EXPOSURE INTERVAL AND ITS PROXIMATE DETERMINANTS

Estimation of the exposure interval

It is difficult to estimate the duration of exposure within the interval between successive live births from WFS data. In the first place, no direct questions were asked.

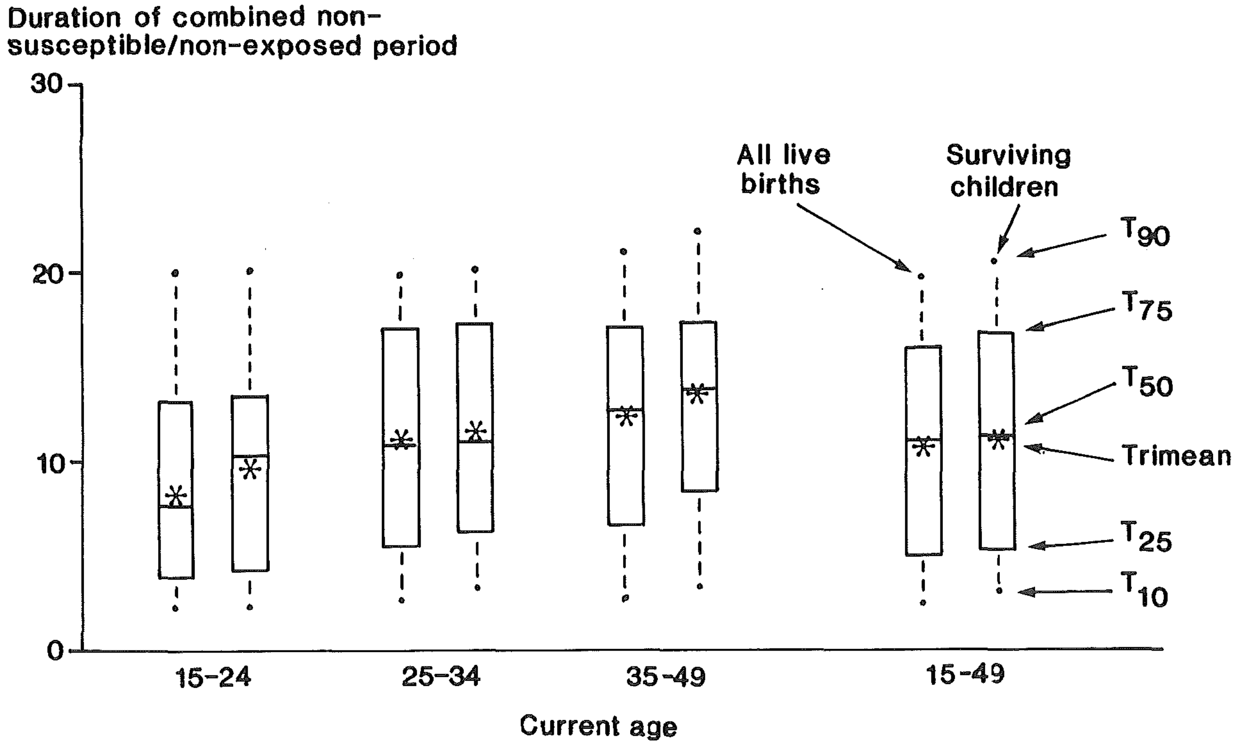


Figure 12 Combined effect of post-partum amenorrhoea and abstinence: duration of combined non-susceptible/non-exposed period (in months), by current age of mother[a]

[a]See table 22.

Table 23 Mean duration of combined non-susceptible/non-exposed period post-partum (in months),[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Residence				
Rural	11.9	12.6	17.4	13.5
Town	9.3	10.8	(13.5)	10.3
City	10.2	9.6	(16.5)	10.3
Education				
No schooling	13.5	14.4	17.8	15.2
⩽3 years	13.9	11.2	18.4	13.9
⩾4 years	9.8	10.3	14.9	10.5
Province				
Nairobi	10.5	9.1	(16.1)	10.2
Central	9.8	11.8	15.1	12.3
Coast	13.2	13.4	(28.5)	15.4
Nyanza	12.9	12.7	14.1	13.1
Rift Valley	12.3	12.8	21.8	14.1
Western	10.0	12.3	15.2	12.0
Eastern and Northeastern	10.6	12.1	18.5	13.5

[a]Estimated from births in the 24 months preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 live births in the period.

This means that we must usually estimate the exposure interval as a residual, as the period that is left unexplained by our other estimates. Secondly, as was the case with the birth intervals themselves, we can run into serious difficulties because our data refer largely to incomplete fertility histories. If we include in our analyses any currently open intervals, we have an unknown proportion of intervals that will never be closed: failure to exclude them can lead to a serious overestimate of our exposure interval, especially for older women.[10] On the other hand, if we were to restrict our analysis to closed birth intervals, then short birth intervals would be over-represented.

Two simple ways of making a very rough estimate of the exposure interval can be suggested here. One method, based on all intervals started in the recent past, makes use of the prevalence–incidence ratio estimation procedure already used for the post-partum variables. The mean duration is estimated as:

$$\bar{X} = P/I$$

where:
P is defined as the number of parous women currently in the exposure interval; and
I is the average number of women entering an exposure interval per month.

[10]The problems did not arise with the analysis of post-partum variables from data sets that include some open intervals because even if the birth interval concerned is never closed, the woman cannot remain indefinitely in the post-partum state.

Since no direct questions were asked on either P or I, they must both be estimated indirectly.

I can be estimated simply by taking the number of births per month, provided the stream of births is constant and there is no seasonality or other systematic variation over time in resumption of amenorrhoea and of sexual relations. As before, we have used births in a 26-month period to estimate I. P is estimated in a first stage as the number of women who have borne at least one child who are not currently in either of the other two components of the birth interval (ie women who are neither currently in post-partum amenorrhoea or abstinence nor currently pregnant). Excluded in addition should be all those who are never going to close their current birth interval. We can attempt to approximate the latter by excluding all those who report themselves as menopausal or otherwise infecund, as sterilized or as practising terminal abstinence.

P is likely to be overestimated for two reasons. First, the proportion reporting themselves as pregnant is usually too low, particularly for the first few months of pregnancy. Secondly, as will be discussed in chapter 4, the indicators from which we estimate the numbers who will never bear another child often lead to an underestimate of the number of intervals that will never be closed. The method is, therefore, likely to give slight overestimates of the exposure interval for younger women and rather marked overestimates for older women. The results, given in tables 24 and 25, suggest that this has indeed occurred in Kenya. The estimated exposure interval is 11–12 months for women under the age of 35. This is about 4–5 months higher than one might expect in a population with little evidence of widespread fecundity impairments or of unusually high foetal wastage (at least at national level), and with relatively little use of contraception. It is also about four months longer than the estimates obtained from marital fertility rates and a considerably more sophisticated estimation procedure (Mosley, Werner and Becker 1982). The figure for the 35–49 age group is clearly a bad estimate: as we shall see later, a far too small proportion of older women gave any indication that they were unlikely to have another birth at some time.

Table 24 Estimated duration of recent exposure intervals (in months), by current age of mother

Current age	All recent birth intervals (including current open intervals except those known to be likely to remain unclosed)[a]	Last closed birth interval per woman[b]
15–24	11.0	10.7
25–34	12.6	13.3
35–49	28.3	17.3
15–49	15.4	14.4

[a]Prevalence–incidence ratio, P/I with P estimated as the number of women currently married reported as currently neither pregnant nor in post-partum amenorrhoea or abstinence, and not reported as menopausal, having other fecundity impairments, sterilized or terminally abstaining.
[b](Closed birth interval) – (9) – (retrospectively reported duration for whichever was longer – post-partum abstinence or post-partum amenorrhoea).

Table 25 Mean duration of exposure interval (in months),[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Residence				
Rural	10.7	12.3	27.3	15.2
Town	13.2	12.8	(45.0)	15.2
City	13.8	18.8	(82.3)	20.1
Education				
No schooling	11.4	12.6	29.8	17.4
⩽3 years	6.4	13.4	25.5	14.6
⩾4 years	12.0	12.8	27.1	13.8
Province				
Nairobi	13.1	17.9	(65.6)	18.3
Central	13.1	14.5	26.8	17.6
Coast	13.2	18.5	(49.1)	20.6
Nyanza	11.0	13.3	28.6	16.2
Rift Valley	9.2	9.1	21.6	11.2
Western	10.6	11.7	35.2	15.3
Eastern and Northeastern	11.7	12.0	24.8	15.5

[a]Estimated for birth intervals started in the 24 months preceding the survey, as the prevalence–incidence ratio.
NOTE: Figures in parentheses are based on less than 30 birth intervals started in the period.

Interestingly enough, an estimated duration of the exposure interval obtained from the last closed birth or pregnancy interval (by subtracting from that interval both nine months for gestation and also the duration the woman reported for whichever was longer for this interval, post-partum amenorrhoea or post-partum abstinence) was rather similar, except for the older women (table 24). As stated above, the use of closed intervals might be expected to lead to a slight underestimation of the average exposure interval per woman. For the two younger age groups, however, the resulting figures correspond very well with those obtained from the prevalence–incidence estimate.

Since both sets of estimates (excluding the prevalence–incidence estimates for the older women) indicate slightly longer exposure intervals than *a priori* estimates suggested, it is particularly interesting to look at the information available on the proximate determinants of the exposure interval.

Information on the proximate determinants of the exposure interval

The main elements we want to examine here are, on the one hand, the waiting time to conception (determined largely by coital frequency in general and by any periods of separation of husband and wife in particular, and by the use of contraception) and, on the other hand, time

Table 26 Percentage of currently married women who 'had sexual relations these days'

Age group	All	Self-reported fecundity status					Exposure status								Detailed fecundity status				
		Fecund	Uncertain	Infecund	Menopausal	Sterilized	Preg. married	Ster. married	Infec. married	Terminal abst.	PP ameno	PP abst.	Husband away	Exposed	Prob. fec.	Prob. prim. infec.	Prob. sec. infec.	Infec.	Term. abst.
15–19	73	71	79	(100)	–	–	61	–	(100)	–	66	(37)	–	83	73	–	–	(100)	–
20–24	77	77	77	(84)	–	–	67	–	(78)	–	74	(84)	(33)	86	77	76	80	79	–
25–29	74	74	76	73	–	–	60	–	71	–	70	(24)	(8)	88	72	87	90	73	–
30–34	79	76	84	84	(87)	(87)	62	(87)	85	(0)	72	(23)	(100)	90	76	100	90	85	(0)
35–39	78	76	78	89	79	(100)	53	(100)	87	(0)	76	(50)	(52)	86	75	85	85	88	(0)
40–44	79	80	79	76	65	(100)	68	(100)	72	(0)	81	(53)	(65)	86	79	(82)	88	74	(0)
45–49	75	70	83	69	74	(100)	(59)	(100)	72	(0)	65	(77)	–	86	73	(77)	87	73	(0)
All	76	75	80	78	73	95	62	95	76	0	72	45	40	87	75	84	87	78	0
N	5708	3834	1248	355	221	50	936	50	577	39	1524	60	46	2477	4209	123	710	626	39

NOTE: Figures in parentheses are based on less than 20 cases.

lost as a result of foetal wastage. Unfortunately the information we can glean on these factors is both sparse and unreliable.

Fecundability: coital frequency, separations and use of contraception

Fecundability is usually estimated by examining the distribution of women by their waiting time to conception. The classic method is to compare the proportion who bear a child 9–11 months after marriage (most of whom have conceived the child within the first three months of marriage) with the proportion bearing their first child later than this. The ratio of the two proportions can be converted into an estimate of the average probability of conception per month.

Unfortunately the data for Kenya do not lend themselves easily to this type of calculation, largely because of the very large number of intervals for which the date of marriage or the date of first birth (or both these dates) were imputed. Moreover, the high level of premarital conceptions also raise doubts that those not pregnant at marriage may be a select group. We have not, therefore, attempted to use these data for estimating fecundability.

One of the determinants of fecundability is coital frequency (Barrett and Marshall 1969; Bongaarts 1979). Very little data on coital frequency exist and in Kenya no clear question was asked on this subject. The only question included was:

319 Are you having sexual relations with your husband these days?
If no

320 Do you expect to resume sexual relations with your husband sometime in the future?
If no

321 Why not?

It is not at all clear how the expression 'having sexual relations *these days*' was interpreted. Moreover, the question was asked only of currently married women although, as we have seen, sexual activity is in fact not restricted to these women. The percentages given (in table 26) lie generally in the range 75–90 per cent, but are difficult, if not impossible, to interpret. There are even some seeming contradictions, such as women who are recorded as being in post-partum abstinence or whose husband was away being also recorded as having sexual relations these days. At any rate, since we have no idea of what period the expression 'these days' implied for respondents, we cannot transform answers into useful measures of coital frequency.

Table 27 Average duration (in months) of temporary absences in last closed and open interval after resumption of sexual relations and menstruation, by age of the woman

Current age	Last closed interval		Open interval	
	$\bar{X}$ (months)	N	$\bar{X}$ (months)	N
15–24	0.3	1012	0.2	1034
25–34	0.3	2236	0.2	1713
35–49	0.4	2137	0.5	1738
All	0.4	5385	0.3	4486

Periods of separation of husband and wife can have a significant impact on the exposure interval if they are lengthy. Often, however, periods of separation overlap at least in part with pregnancy or with the period of post-partum non-susceptibility, so they have no independent impact.

In the WFS in general, separations exceeding three months were noted, but only for those that occurred within either the last closed interval or the current open interval. The exact questions asked in the KFS were:

Questions for the absences in the open interval

526 Since the birth of ________ (Name of last child or 'Since your last birth/pregnancy') have there been any times when you and your husband were apart for three months or more for any reason?
Probe: Was there any time when your husband was away from home working or looking for work for three months or more?

Yes $\boxed{1}$ No $\boxed{2}$
(Skip to 530)

527 How long after the birth of __________ (Name of last child or 'Your last birth/pregnancy') did the first such separation begin?

__________ (Years) + __________ (Months)

528(a) Since your last birth (or pregnancy) how many months were you and your husband apart for the (first, second) time?	**528(b)** During that time were you continuously apart without seeing each other?	**528(c)** Since your last birth (or pregnancy) were there any other times when you and your husband were apart for three months or more?
______ (Months)	Yes ☐ → No ☐ (Probe and correct)	Yes [1] (Repeat 528(a) 528(c)) No [2] (Skip to 529)
______ (Months)	Yes ☐ → No ☐ (Probe and correct)	No [1] (Repeat 528(a) 528(c)) No [2] (Skip to 529)

529 Did you and your husband get together after (last) separation?

Yes [1] No Still away [2]

Questions for the absences in the last closed interval

547 During the time between your last two pregnancies (between your last and current pregnancy) was there any time when you and your husband were apart for three months or more for any reason?
Probe: Has there been any time when your husband was away from home working or looking for work for three months or more?

Yes [1] ↓ No [2] (Skip to 553)

548 How long after your next to last (last) pregnancy did the first such separation begin?

__________ (Years) + __________ (Months)

549 Between your last two pregnancies (between your last and current pregnancy) how many months were you apart for the (first, second) time?	**550** During that time were you continuously apart without seeing each other?	**551** Were you pregnant when that absence began?	**552** Were there any other times during the interval between your last two pregnancies (between your last and current pregnancy) when you and your husband were apart for three months or more?
______ (Months)	Yes ☐ → No ☐ (Probe and correct)	Yes ☐ (Skip to 553) No ☐ →	Yes [1] (Repeat 549–552) No [2] (Skip to 553)
______ (Months)	Yes ☐ → No ☐ (Probe and correct)	Yes ☐ (Skip to 553) No ☐ →	Yes [1] (Repeat 549–552) No [2] (Skip to 553)

For Kenya, temporary separations appear to play only a very minor role in the exposure interval. After we exclude any period of separation that overlaps with post-partum amenorrhoea or abstinence, separations contribute less than one month on average to the birth interval (table 27). If any overlaps with pregnancy are also excluded, separations would appear to be, in general, of negligible importance. Of course this refers only to their role in determining the exposure interval: it is quite possible that at least in some populations

Table 28 Proportion of married women using contraception, by age

Current age	All currently married women			Apparently fecund and currently married women		
	Per cent using efficient method[a]	Per cent using inefficient method[b]	N	Per cent using efficient method[a]	Per cent using inefficient method[b]	N
15–19	1.4	1.4	477	1.8	1.8	366
20–24	3.2	2.6	982	4.2	3.3	765
25–29	4.2	1.9	1204	5.5	2.5	923
30–34	5.4	3.4	835	7.2	4.5	628
35–39	4.1	1.6	767	5.4	2.2	575
40–44	3.6	4.6	481	5.3	6.8	327
45–49	1.7	3.3	480	3.4	6.4	246
All ages	3.7	2.6	5238	5.0	3.5	3831

[a]Efficient is defined as all modern methods other than sterilization.
[b]Inefficient is defined as traditional methods other than post-partum abstinence.

separations serve as an institutional prop for post-partum abstinence.

Contraception is not yet widely used for spacing purposes. As table 28 shows, only a very small proportion of apparently fecund women use contraception for any purpose. For those few who do contracept, however, the exposure interval can be significantly increased.

Time lost through foetal wastage
As is common in nearly all surveys, foetal wastage rates appear to be very seriously under-reported. Of all pregnancies reported as occurring in the 12 months before the survey, less than 8 per cent were recorded as non-live births. The KFS clearly does not yield complete information on foetal wastage. There is, however, no indication from other sources that foetal wastage is unusually high, at least at national level.

Summary
Overall, this very brief overview of the meagre information available on the proximate determinants of the exposure interval gives no reason to believe that this component of the birth interval is exceptionally long, at least at national level. Our original estimates of the exposure interval suggest a moderate duration. From the available evidence on the determinants we can be fairly confident that it is not longer than our estimates; it may even be shorter.

3.5 CONCLUSIONS

The relatively short birth intervals observed in Kenya result from a combination of two factors. On the one hand both post-partum amenorrhoea and post-partum abstinence are relatively short by African standards. The traditional African spacing mechanisms are not widely followed in contemporary Kenya. On the other hand, they have not been replaced by widespread use of contraception for spacing purposes. This combination probably goes a long way towards explaining the high, and apparently increasing, level of fertility in Kenya. We need, however, to examine the stopping patterns before we attempt to integrate all the information.

4 The Pattern of Stopping Family Formation

4.1 INTRODUCTION

The key fertility variable to be estimated here is the timing of the last, or final, birth, defined in this analysis as the age at last birth.[11] The proximate determinants to consider are:

1 The age at which women cease to be fecund, either through natural causes or through sterilization. This usually occurs either through the definitive cessation of ovulation (in survey work often approximated by menopause which usually occurs some months later), but it can also occur through the development of secondary sterility for other reasons.
2 The age at which fecund women cease to engage in sexual intercourse either because of definitive termination of marriage (widowhood or divorce not followed by remarriage) or because of complete termination of sexual relations by still-married women (terminal abstinence).
3 The use of contraception and abortion in effect (even if not always in intention) to prevent any further births.

Our analysis of the stopping patterns is inevitably much narrower than any analysis of the starting or spacing patterns can be because it must be restricted largely to older women. It is, by definition, impossible to carry out a proper analysis of stopping patterns for women who have not yet completed their potential childbearing period; although we may be fairly certain that a small subgroup of women younger than this (for example, those who have had a sterilization) will never have another child, for the others we cannot be sure. Restriction of analysis to the oldest cohorts rules out the possibility of comparing the behaviour of older and younger cohorts. It also means that attention is focused on women whose reproductive careers were started in, and probably heavily conditioned by, circumstances prevailing about 30 years ago. In a period of change, such as Kenya has been experiencing, it is unlikely that the younger cohorts of today will reproduce the stopping patterns of their predecessors.

Our analysis of stopping patterns in WFS data sets must also rest on a much less secure base than the analyses of the starting and spacing patterns. The principal reason is quite simply that most WFS data sets do not include information for cohorts that have completed the childbearing period: the oldest age group included is usually 45–49. Although most of these women will, in fact, have no more children, a few will. Since their childbearing period is not completed we can only tread the borderland between analysis of facts and speculation with respect to their eventual stopping patterns. For some variables we are on quite solid analytical terrain. This is the case with clear-cut non-reversible events, such as sterilization in most cases or widowhood in some cultures. Here we can ask women whether they have experienced the event in question and use regular life-table or current status data procedures to make methodologically sound estimates. For status changes that are reversible, however, we must often rely on the women's own perception that she has reached the point of no return – for example that she is practising terminal abstinence. Or we can develop indirect indicators that suggest that she has passed the point of no return (for example, a woman of 45 who was widowed 12 years ago and has not remarried is unlikely to remarry in her remaining potentially fecund years; a woman who has not menstruated for two or three years although not breastfeeding is probably menopausal). Both approaches are risky in that they assume that the woman's circumstances will not subsequently change, and this assumption may be unwarranted.

Moreover, some of the characteristics we are interested in can be detected only a considerable time later. This is particularly the case when we are trying to identify the last in a series of events that are irregular or infrequent. For menopause, for example, menstruation often becomes increasingly irregular and infrequent before it ceases completely: the last menstrual period can then be identified only several months or even a year or more after its occurrence, when it has become apparent that no further menstrual periods will occur. Similarly, coital frequency may decline slowly and irregularly until it reaches zero. The problem of frequency is not unique to the stopping variables – it occurs also with some of the starting variables (entry into regular sexual relations, for example) and with some of the spacing variables (gradual weaning). It is, however, particularly common among the stopping variables, and it is exacerbated by the element of uncertainty and speculation introduced when even the oldest age group of women for whom we have information have not quite completed their potential childbearing period.

Our analysis is of necessity, therefore, essentially tentative. We have not made any attempt to evaluate variables that are extremely speculative in nature, such as stated intention to have no more children. This section focuses simply on the best estimates we can make, given the data available, on age at last birth, on indicators of ceasing to be fecund, and on age at ceasing to have sexual intercourse.

[11]The adjective 'last' is often used ambiguously, since it sometimes refers to the 'most recent' birth a woman has had at the time of the survey rather than to the last birth the woman will ever have. We use it here in the strict sense of the last birth a woman ever has.

The results are potentially very important, however, because both our existing knowledge of these characteristics and our experience with trying to measure them, are extremely limited or even, in some cases, almost non-existent.

4.2 AGE AT LAST LIVE BIRTH

Age at most recent birth was recorded for all women in the survey. For most women aged 45 or over, their most recent birth will in fact be their last birth: only a small minority will go on to have another child. For the very oldest women in this age group, this minority is so small as to be negligible. We can therefore assume that their frequency distribution by age at most recent birth corresponds to their frequency distribution by age at *last birth*, and we can use it to adjust the frequency distribution by age at *most recent birth* for the next youngest cohort in order to allow for the small proportion of this cohort who will go on to have another child. Each successively younger cohort within the age group can be adjusted on the basis of the reported or adjusted data for the cohorts above it that have more complete information (see appendix table A1). The results at national level are summarized in table 29. Estimates for the subgroups cannot easily be made because of sample fragmentation problems.

The mean age at last birth is estimated at close to 40 years. We can note that means recorded in pre-transitional European populations cluster close to 40, and the overall results obtained here are, therefore, consistent with the idea that the majority of women in the older cohorts continued childbearing as long as they were physically able to. As a cautionary note, however, we should point out that the proportions reporting a birth at very advanced ages are extremely high in the KFS compared with reliable data from other populations, and misreporting is the most probable cause. High fertility rates at advanced ages have been recorded in many Kenyan surveys and have usually been met with sceptism concerning either the reporting of fertility or the reporting of age.

Table 29 Age at last live birth, women currently 45+: recorded per cent distribution by age at most recent birth and estimated per cent distribution by age at last birth

Age at the birth	Most recent birth (recorded)	Last birth (estimated)
15–19	1.2	1.2
20–24	2.8	2.5
25–29	4.8	4.3
30–34	11.4	10.1
35–39	21.9	19.5
40–44	43.7	38.7
45–49	14.2	24.0
Mean	39.4	40.4
N	699	

It is sufficient to say that although the exact age at last birth cannot be estimated with much precision, the rather high value obtained suggests that few women end family formation before the natural processes of ageing terminate it. This is consistent with earlier information that few fecund women who are widowed or divorced fail to remarry fairly quickly and that very few women in the older cohorts use contraception or are sterilized. It also suggests that the tradition that a woman should refrain from further childbearing once her own children reach circumcision or marriage, which has been reported for several although not all ethnic groups in Kenya (Molnos 1973), is not having a major impact on stopping patterns, at least at national level. We can pursue each of the proximate determinants further.

4.3 INFORMATION ON THE PROXIMATE DETERMINANTS OF AGE AT LAST BIRTH

Age at ceasing to be fecund

Several questions were posed concerning each woman's current fecundity status. These included her own perception of whether she and her husband would be physically able to have a child in the future if they wanted to, and her own judgement of whether she was menopausal. Questions were also included to ascertain whether either she or her husband had had a sterilization. The exact questions asked in Kenya were:

For fecundity in general and menopause

556 Currently married [1]   Separated, divorced widowed [2] (Skip to 570)

557 Husband or wife sterilized [1] (Skip to 570)   Currently pregnant [2] (Skip to 561)   All others [3]

558 As far as you know, is it physically possible for you and your husband to have a child, supposing you wanted one?

Yes [1] (Skip to 560)   No [2]   D.K. [3] (Skip to 560)

559 Do you think you are at the menopause?
Yes [1] (Skip to 570)   No [2] (Skip to 570)

For sterilization

Female sterilization

415 Some women have an operation called sterilization, such as having their tubes tied, in order not to have any more children.
Have you ever heard of this method?
If Yes: If No, go to next method

416 Ever married [1]   Single [2] (Skip to next method)

417 Currently [1] Pregnant (Skip to next method)   Not currently [2] pregnant/D.K.

418 Have you had such an operation in order not to have any more children?

Yes [1]   No [2]

Male sterilization

419 Some men have an operation called vasectomy in order not to have more children.
Have you heard of this method?
If Yes: If No, go to next method

420 Currently married [1]   Single, separated [2] divorced, widowed (Skip to next method)

421 Has your husband had such an operation?
Yes [1]   No [2]
Go to next method

The questions on sterilization seem fairly clear. But since they were framed in the context of contraceptive sterilization, it may be that other forms of sterilization were slightly under-reported. Since sterilizations in general are not very widespread in Kenya, however, the reported proportions are probably not very much in error.

The responses elicited by the questions on menopause and on general fecundity status are harder to interpret. Women who are clearly pre-menopausal or clearly post-menopausal probably have little difficulty in categorizing themselves as such for the question on menopause, but it is not at all clear how women in the peri-menopausal period respond. The situation is even more difficult for self-reported fecundity status for two reasons. First, it is extremely hard for women to know their fecundity status because this requires knowledge of a large number of biological characteristics in addition to menstruation, many of which are not readily apparent and can be revealed only through detailed laboratory analyses. Secondly, it is impossible for anyone to know with certainty that a given couple is fecund since this requires advance knowledge about the outcome of a hypothetical situation involving a process spread out over several months or even years in the future. In other words the women are being asked to make a prediction about the future and, furthermore, to make their prediction on the basis of incomplete knowledge of the present. Clearly we need to know more about the relationship between actual and perceived fecundity status, but we have little information on this for any population, let alone about the relationship between actual status and the status reported to an interviewer. At the one extreme, women may tend to perceive/report themselves as fecund all the time the most obvious element of the reproductive function – menstruation – is present, even though their chances of conception and successful gestation may be very low or even zero (for example in the final years or months before menopause). At the other extreme they may use their awareness that few women do go on to bear children in these final years to perceive or report themselves as infecund as soon as they notice much irregularity in their menstrual cycle, even though a small chance remains.

The percentages reporting themselves as infecund for various reasons are tabulated by age in table 30. On the whole, we should probably greet the sizeable proportions 'uncertain' about their status (one in five of all

Table 30 Per cent distribution of currently married women according to self-reported fecundity status, by current age

Age	Fecund	Uncertain	Infecund, not menopausal	Infecund, menopausal	Sterilized	Total	Number of women	Reported per cent fecund among those reported as neither menopausal or sterilized
<20	85.0	13.6	1.3	0.0	0.1	100	745	85
20–24	83.4	14.6	1.9	0.2	0.0	100	804	84
25–29	76.9	19.2	3.4	0.1	0.3	100	1311	77
30–34	67.7	24.2	4.7	1.4	2.0	100	918	70
35–39	60.2	27.5	8.6	2.9	0.9	100	847	63
40	50.1	30.7	10.5	8.1	0.5	100	210	55
41	41.2	34.1	14.7	7.0	3.0	100	94	46
42	43.1	30.4	16.2	9.0	1.3	100	102	48
43	44.5	37.6	11.3	6.6	0.0	100	60	48
44	35.9	33.5	17.6	7.8	5.2	100	73	41
45	37.3	29.5	14.4	18.3	0.6	100	177	46
46	29.5	30.0	18.0	20.9	1.6	100	84	38
47	24.9	22.6	18.2	22.0	2.2	100	104	38
48	21.1	21.9	24.6	30.9	1.4	100	78	31
49	17.0	29.1	19.9	30.1	4.0	100	101	26
50	9.4	18.1	14.8	55.1	2.7	100	64	22
All	66.5	21.8	6.3	4.4	0.9	100	5771	

Source: Table 8.19, Kenya, Ministry of Economic Affairs and Development Planning (1980) women, one in three women in their early forties) with relief as an indication of realism in the responses rather than with the disappointment that usually greets uncertain responses.

We can, however, seriously question whether the proportions reported as fecund are realistic. The low figure of about 0.85 for women under 25 is presumably largely just a reflection of uncertainty among women who have not yet demonstrated their fecundity by actually bearing a child (probably coupled with a reluctance to tempt fate). Beyond age 25 the proportion declines with age as might be expected, but it declines suspiciously slowly. It seems very unlikely that 25 per cent of the couples where the woman is already 47 years old, 17 per cent of those where she is 49, and nearly 10 per cent where she is 50, are really capable of having another child. If they really are still fecund, their fecundity level is probably extremely low – so low as to be insignificant for the oldest women. It would appear that young women tend to err on the side of caution when reporting their fecundity status, while the oldest women tend to present an over-optimistic picture.

Failure to have a live birth in five years of continuous exposure suggests infecundity (or at least marked subfecundity) although some such women will go on to have a subsequent birth. In table 31 we have tabulated the proportions of women who have not had a live birth in the last five years among women who have been continuously married for this period. These proportions are, however, systematically quite markedly higher than the proportions reporting themselves as infecund for any reason.[12] There seems to be a fairly common reluctance to state that one is actually infecund in the absence of overwhelming indications to this effect, a reluctance that would be both socially and psychologically easy to explain.

Table 31 Proportion of non-contracepting women who have not had a live birth in the last five years despite having been married throughout the period

Current age	Women not using contraception	
	Proportion with no live birth in the five years	N
15–19	(5.6)	(24)
20–24	5.8	413
25–29	6.2	1008
30–34	12.3	778
35–39	21.4	758
40–44	31.5	462
45–49	58.0	487
(50)	(75.6)	(59)

NOTE: Figures in parentheses are based on less than 100 women.

To sum up, most of the problems with self-reported fecundity status seem to stem from two sources. First, a tendency for the women recorded in the older age groups to be over-optimistic in their reports, and secondly the essential uncertainty embodied in the question and the large proportions who, not surprisingly, state they are uncertain. The data look more plausible in general for those characteristics that are more concrete: the proportions sterilized, the proportions menopausal and the proportions with no birth in five years of continuous exposure are not implausible.[13]

We have attempted to combine the various indicators that a woman may have reached the end of her fecund life. Table 32 summarizes the indicators used – self-reported infecundity, sterilization, menopause and no birth in five years of exposure – together with the proportions with at least one or more of these characteristics. It is not unreasonable to assume that a woman with any one of these characteristics is probably infecund. Since acquisition of each of these characteristics is essentially non-reversible we can use the proportions with the characteristics to make a rough estimate of the mean age at becoming infecund using the usual current status procedures.[14] More specifically, the mean age $\bar{X}$ can be estimated from current status data as:

$$\bar{X} = \alpha + \frac{\sum_{x=\alpha}^{\beta-n} {}_nL_x - (\beta - \alpha)\cdot \ell_\beta}{(1 - \ell_\beta)}$$

where:

α and β represent the lower and upper ages at which the characteristic can be acquired;

ℓ_β is the proportion who have not acquired it by age β; and

${}_nL_x$ is estimated as the observed proportion without the characteristic among women between exact ages x and (x + n).

To make the calculations we have assumed that ℓ_β, the proportion without the characteristic in question, reaches zero at age 50 for infecundity and at age 55 for menopause and for 'no birth in five years of exposure'. We have set β at 50 for sterilization on the grounds that women beyond 50 are most probably already infecund. Note that like all current status methods applied to cross-sectional data, this stacks up the cumulated experience of various cohorts, and that the combination does not necessarily correspond with the actual experience of any cohort. For variables that may be changing rapidly

[12]Current users of contraception were excluded in order to have a clearer picture of the 'natural' level of these proportions, but since non-users are often selected for lower than average fecundity, this has the effect of giving proportions higher than would probably prevail in the entire population in the absence of contraception. The proportions contracepting in Kenya are low, however, so the impact of this is probably too small to account for the differences.

[13]The proportions menopausal correspond fairly well with the series given in Gray (1979) and Van Keep, Brand and Lehert (1979) for selected western, and more particularly southern, African populations; the proportions with no live birth in five years of exposure correspond quite closely with those calculated for pre-transitional France (Dupâquier 1979) and the Hutterites.

[14]It can only be rough, not only because of problems of data quality but because even with perfect reporting, one does not know the age at which a currently menopausal woman or a couple with no birth in five years of exposure did (or will) actually become infecund.

Table 32 Reported percentages with a characteristic suggesting that their fecund period is over, by age: all ever-married women

Current age	Self-reported infecundity	Menopausal	Sterilized	No birth in last five years[a]	Any one or more
15–19	1.8	0.0	0.0	5.6	2.0
20–24	1.6	0.1	0.0	5.8	3.4
25–29	3.6	0.1	0.3	6.2	7.4
30–34	6.3	1.5	2.0	12.3	14.4
35–39	11.5	2.9	1.1	21.4	24.5
40–44	21.6	8.0	1.3	31.5	33.0
45–49	44.1	25.8	1.9	58.0	53.9
(50)	(71.8)	(56.6)	(4.0)	(75.6)	(65.7)
Estimated mean age at acquiring the characteristic	45.5[b]	49.2[c]	40.8[b]	43.2[c]	43.1[b]
Observed or assumed percentage ever acquiring the characteristic	100.0	100.0	3.6	100.0	100.0

[a]Restricted to non-users of contraception who have been married throughout the five-year period.
[b]Assuming that no-one acquires the characteristic after age 50.
[c]Assuming that no-one acquires the characteristic after age 55, and assuming that those who acquire it after age 50 do so on average at age 51 (no birth in last five years) or at age 52.5 (menopause).

from one cohort to another (eg sterilization) the results may be misleading: for those that change only slowly, if at all, over time (eg menopause) there are no serious problems.

The resulting estimated mean ages are given at the foot of table 32. The mean age at menopause is estimated at just over 49 years, four years higher than the mean age at reporting oneself as infecund although not post-menopausal. It is nine years higher than the mean age at last birth estimated for the oldest cohort. A difference of nine years is quite plausible, corresponding closely to the differences observed in other populations (Parkes, Herbertson and Cole 1979). Moreover, the relationships between the other estimated means are also quite plausible. In other words, despite all the problems, the broad results suggest that the data are far from meaningless: they just need to be handled with great care.

We can conclude that there is no evidence in these variables that Kenyan women in general become unable to bear children at abnormally young ages, although our optimism on this score must be tempered by a realization that the mean ages estimated may well have been inflated by optimistic reporting or by overstatement of age. Indeed, other work on the KFS (Mosley, Werner and Becker 1982) has suggested non-negligible levels of infecundity.

Age at terminating sexual relations

If we are interested in using the WFS data to measure the impact of the age at which women cease to be in a marital union, we can use either the ages at last termination of union reported by women who are no longer married, or the proportions by age who are widowed or divorced. In either case we shall have to make some assumptions about the proportion that will ever remarry. For example, we might assume that women already over 45 years of age are unlikely to remarry and even if they do it is very unlikely it will have any impact on fertility since they will probably be infecund by then. Or we might assume that women who were divorced or widowed more than a certain minimum number of years ago and have not remarried since are women who are unlikely ever to remarry.

Widowhood and divorce do not have a great impact on the age pattern of stopping childbearing. Among women aged 45 and over, only 102 (15 per cent) reported themselves as widowed, divorced or separated (and their mean age at widowhood or divorce was 39 years). The small number, even more than the age, shows that marital dissolution plays a relatively minor role in the stopping pattern.

The practice of terminal abstinence within marriage is a particularly interesting issue in Kenya given the fact that the traditions of several ethnic groups frown on further childbearing once a woman has circumcised or married children. At a national level at least, terminal abstinence is certainly not widespread. For age groups 35–39 and 40–44 only 2–3 per cent of currently married women reported they were observing terminal abstinence: it is only for the women aged more than 45 that the figures reach 10 per cent, and by this time the fecundity of the women is already relatively low. Taking the percentage abstaining at ages 49 and 50, we estimate the proportion who ever observe terminal abstinence before 50 as 16 per cent, and the average age at which these 16 per cent start to do so as about 45 years. Overall, therefore, although terminal abstinence does exist, its impact on fertility is probably relatively small at the national level.

Table 33 shows significant differences between the subgroups with respect to the proportions not currently married and the proportions observing terminal abstinence among the older women. Town and city dwellers are markedly less likely to report they are observing terminal abstinence than are rural dwellers, but they are also less likely to be currently married. There are few systematic differentials by education, but there are by province. Women in Western, in Eastern and Northeastern provinces and also, to a lesser extent, in Nyanza, report relatively high proportions observing terminal abstinence, while the figures for Nairobi, Central, Rift Valley and, particularly, Coast province are relatively low. These regional differences tend, however, to be partially compensated for by the differentials in proportions married.

Risk reduction through contraception and abortion as proximate determinants of the stopping pattern

We have no means of determining from the available data whether contraception or abortion are being used in effect to stop family formation. For the sake of complet-

Table 33 Proportions reporting they are not currently married or are married but observing terminal abstinence, by age: differentials between subgroups

Subgroup	Current age								
	35–39			40–44			45–49		
	Not married	Abstaining	Not stated	Not married	Abstaining	Not stated	Not married	Abstaining	Not stated
Residence									
Rural	8.9	2.0	0.8	11.5	3.3	1.7	15.1	8.4	2.2
Urban	(18.4)	(0.0)	(0.0)	(24.0)	(8.0)	(0.0)	(25.0)	(5.0)	(0.0)
City	14.3	1.4	2.9	(15.6)	(0.0)	(0.0)	(35.3)	(2.9)	(0.0)
Education									
No schooling	10.6	2.4	1.4	12.5	2.9	1.7	17.2	8.2	1.7
⩽3 years	8.9	0.8	0.0	15.4	2.6	2.6	12.8	6.4	1.3
⩾4 years	7.5	1.1	0.0	9.4	4.7	0.0	16.1	8.9	5.4
Province									
Nairobi	(18.4)	(0.0)	(0.0)	(12.0)	(0.0)	(0.0)	(20.0)	(5.0)	(0.0)
Central	10.9	0.7	0.0	14.5	2.7	2.7	20.6	4.9	1.0
Coast	6.4	2.6	3.8	13.7	0.0	0.0	(17.9)	(2.6)	(5.1)
Nyanza	5.9	2.5	0.5	6.3	2.4	0.0	10.1	8.0	1.4
Rift Valley	14.7	2.8	0.7	16.5	2.9	4.9	18.9	5.6	1.1
Western	7.5	1.1	0.0	7.2	4.8	0.0	13.2	11.8	1.3
Eastern and Northeastern	9.4	2.2	1.7	17.4	6.5	1.1	16.8	11.7	3.6

NOTE: Figures in parentheses are based on less than 50 women.

Table 34 Reported percentage of women using contraception other than sterilization or terminal abstinence

Current age	All women			Currently married women		
	Traditional methods	Modern methods	N	Traditional methods	Modern methods	N
15–19	0.4	0.3	1907	1.3	1.3	498
20–24	1.8	2.2	1436	2.5	3.1	1050
25–29	1.7	3.5	1479	1.9	3.9	1311
30–34	2.8	4.5	1011	3.1	4.9	918
35–39	1.6	3.6	925	1.8	4.0	846
40–44	3.6	2.8	614	4.1	3.2	539
45–49	2.3	1.5	643	2.7	1.7	544
Total	1.7	2.4	8018	2.4	3.4	5707

eness, however, we present in table 34 what data are available, namely the proportions currently using modern and traditional forms of contraception (other than sterilization and terminal abstinence, which have already been discussed). The reported proportions are very low for both types. For older women at least only a small group is trying to keep down its fertility at later ages by these means.

4.4 CONCLUSIONS

Despite all the problems resulting from incomplete histories, conceptual ambiguities and misreporting, it is evident that the majority of Kenyan women are able to continue childbearing up to quite advanced ages; and, for the oldest cohorts at least, the majority have made full use of the last years of their fecund life. Not only are these older women able to continue childbearing, most of them take few steps to stop family formation earlier than the natural processes of ageing oblige them to. Their continuation of active childbearing into high ages has combined with the short interbirth intervals of the younger women to produce Kenya's extremely high period level of fertility. The next 10–20 years will tell whether these younger women will also continue childbearing into late ages or whether they will adopt an early stopping pattern.

5 Contribution of the Main Intermediate Fertility Variables to Overall Fertility Levels and Differentials

5.1 INTRODUCTION

Having attempted a systematic description of the role played by the proximate determinants at each stage in a woman's reproductive lifetime, we now try to relate these pieces of information to overall fertility levels. In other words, we attempt here to uncover the mechanisms that are at play in producing current overall levels of fertility and to assess the relative role of each of the main intermediate fertility variables to overall fertility levels. For this purpose, we have chosen to use the Bongaarts model (1978; 1982) which expresses the impact of each of the four main intermediate fertility variables in terms of the extent to which it inhibits overall fertility.

The original Bongaarts formulation is:

$$\mathrm{TFR} = \mathrm{TF} \times C_m \times C_c \times C_a \times C_i \quad (1)$$

where:

TFR is the total fertility rate, equal to the number of births a woman would have at the end of the reproductive span if she were to bear children at prevailing age-specific fertility rates while living throughout the reproductive period;

TF is the total potential fertility ('total fecundity'), or the level of total fertility one might expect if all women were married throughout the reproductive age range, if there was no use of contraception and abortion, and if the post-partum period was not extended by lactation and abstinence;

C_m is an index of the impact of marriage, reflecting the relative loss of potential fertility due to the fact that most women are not continuously married between the ages of 15 and 50 years;

C_c is an index of the impact of contraception, reflecting the relative loss of potential fertility within marriage due to contraceptive use;

C_a is an index of the impact of abortion, reflecting the relative loss of potential fertility due to induced abortions; and

C_i reflects the relative loss of potential fertility due to extension of the post-partum non-susceptible period by lactation-related amenorrhoea and by abstinence.

Each of the four C indices can take values between 0 and 1.0. The greater the fertility-inhibiting effect of a given variable the lower the value: 0 would indicate total suppression of fertility by the variable concerned, 1.0 no inhibition at all.

The model refers essentially to a synthetic cohort. Both the total fertility rate and the total fecundity are standardized on a uniform age structure. Ideally all the other indices should, therefore, also be calculated in such a way that they refer to a synthetic cohort.

5.2 APPLICATION OF THE BONGAARTS FRAMEWORK TO THE KFS DATA

Because of the lack of reliable data, no attempt has been made here to estimate C_a, the index of induced abortion. Our model is thus:

$$\mathrm{TFR} = \mathrm{TF}' \times C_m \times C_c \times C_i$$

with TF′ defined as the total fecundity if all women were continuously married, if there was no contraception and no extension of the post-partum period.

The inputs used consist of:

TFR is the total fertility rate calculated from age-specific fertility rates of women then aged 15–49, for the five years preceding the survey;

TMFR is the total marital fertility rate calculated from age-specific fertility rates of women both married (marriage defined to include all types of

Table 35 Estimates of indices of the intermediate fertility variables (Bongaarts model)

Age group	TFR[b]	TMFR[b]	u	$\bar{e}$[c]	i′	C_m	C_c	C_i
15–24	2.62	4.05	0.047	0.760	11.6	0.647	0.961	0.664
25–34	3.27	3.39	0.077	0.797	12.3	0.965	0.934	0.649
35–39	2.37	2.50	0.073	0.771	17.3	0.948	0.939	0.559
15–49 unstandardized	8.26	9.94	0.068	0.780	13.1	0.831	0.943	0.633
15–49 standardized[a]	8.26	9.94	0.067	0.775	14.2	0.831	0.944	0.612

[a]Standardized on a uniform age structure.
[b]Partial TFR and TMFR in the case of the separate age groups.
[c]Weighted average effectiveness taking into account the mix of methods used.

Table 36 Indices of the proximate determinants and of their impact on fertility (Bongaarts model): differentials between subgroups

Subgroup	Age group 15–24								Age group 25–34							
	TFR[a]	TMFR[a]	u	$\bar{e}$[b]	i′	C_m	C_c	C_i	TFR[a]	TMFR[a]	u	$\bar{e}$[b]	i′	C_m	C_c	C_i
Residence																
Rural	2.68	4.06	0.041	0.733	11.9	0.660	0.968	0.658	3.34	3.44	0.064	0.791	12.6	0.971	0.945	0.643
Town	2.44	4.03	0.058	0.782	9.3	0.605	0.951	0.719	2.79	3.17	0.145	0.845	10.8	0.880	0.868	0.683
City	2.24	3.97	0.087	0.843	10.2	0.564	0.921	0.697	2.56	2.86	0.188	0.858	9.6	0.895	0.826	0.712
Education																
No schooling	2.87	3.69	0.022	0.618	13.5	0.778	0.985	0.625	3.09	3.20	0.041	0.795	14.4	0.854	0.965	0.608
⩽3 years	2.92	4.05	0.004	0.600	13.9	0.721	0.997	0.617	3.42	3.61	0.064	0.760	11.2	0.947	0.947	0.673
⩾4 years	2.52	4.37	0.073	0.770	9.8	0.577	0.939	0.707	3.48	3.62	0.125	0.812	10.3	0.961	0.890	0.694
Province																
Nairobi	2.20	4.20	0.089	0.828	10.5	0.524	0.920	0.690	2.89	3.25	0.250	0.868	9.1	0.889	0.766	0.725
Central	2.47	4.55	0.092	0.778	9.8	0.543	0.923	0.707	3.49	3.60	0.099	0.805	11.8	0.969	0.914	0.660
Coast	2.53	3.37	0.032	0.791	13.2	0.751	0.973	0.631	2.75	2.82	0.061	0.815	13.4	0.975	0.946	0.627
Nyanza	2.73	3.97	0.029	0.662	12.9	0.688	0.979	0.637	3.19	3.28	0.068	0.701	12.7	0.973	0.949	0.641
Rift Valley	2.87	4.15	0.045	0.649	12.3	0.692	0.968	0.649	3.38	3.50	0.076	0.777	12.8	0.966	0.936	0.639
Western	2.83	4.23	0.032	0.806	10.0	0.669	0.972	0.702	3.43	3.61	0.013	0.792	12.3	0.950	0.989	0.649
Eastern and Northeastern	2.37	4.01	0.062	0.847	10.6	0.591	0.943	0.687	3.25	3.40	0.086	0.840	12.1	0.956	0.922	0.654

Subgroup	Age group 35–49								All ages						Unstandardized		Standardized[c]	
	TFR[a]	TMFR[a]	u	$\bar{e}$[b]	i′	C_m	C_c	C_i	TFR[a]	TMFR[a]	u	$\bar{e}$[b]	i′	C_m	C_c	C_i	C_c	C_i
Residence																		
Rural	2.45	2.58	0.071	0.777	17.4	0.950	0.940	0.557	8.53	10.08	0.061	0.740	13.5	0.846	0.951	0.625	0.951	0.615
Town	1.52	1.71	0.070	0.834	(13.5)	0.889	0.937	(0.625)	6.84	8.91	0.097	0.823	10.3	0.768	0.914	0.694	0.923	0.673
City	0.80	0.91	0.123	0.818	(16.5)	0.879	0.891	(0.571)	5.64	7.74	0.135	0.840	10.3	0.729	0.878	0.694	0.879	0.654
Education																		
No schooling	2.31	2.42	0.051	0.768	17.8	0.955	0.958	0.551	8.49	9.31	0.042	0.776	15.2	0.912	0.965	0.593	0.970	0.594
⩽3 years	2.87	3.08	0.082	0.705	18.4	0.932	0.938	0.542	9.30	10.74	0.057	0.711	13.9	0.866	0.956	0.617	0.963	0.606
⩾4 years	2.11	2.27	0.160	0.805	14.9	0.930	0.861	0.599	8.13	10.26	0.109	0.794	10.5	0.792	0.907	0.690	0.902	0.662
Province																		
Nairobi	0.80	0.86	0.179	0.794	(16.1)	0.930	0.847	(0.578)	5.96	8.31	0.165	0.847	10.2	0.717	0.849	0.697	0.845	0.658
Central	2.75	3.04	0.117	0.771	15.1	0.905	0.903	0.595	8.73	11.19	0.105	0.793	12.3	0.780	0.910	0.649	0.913	0.658
Coast	1.64	1.84	0.039	0.851	(28.5)	0.891	0.964	(0.426)	7.01	8.03	0.045	0.798	15.4	0.873	0.961	0.590	0.961	0.542
Nyanza	2.23	2.22	0.040	0.663	14.1	0.996	0.971	0.613	8.21	9.47	0.046	0.699	13.1	0.847	0.965	0.633	0.966	0.631
Rift Valley	2.50	2.72	0.077	0.778	21.8	0.919	0.935	0.496	8.82	10.37	0.067	0.750	14.1	0.851	0.946	0.613	0.948	0.587
Western	2.08	2.15	0.069	0.799	15.2	0.967	0.940	0.593	8.40	9.99	0.036	0.801	12.0	0.841	0.969	0.656	0.967	0.645
Eastern and Northeastern	2.74	2.89	0.084	0.788	18.5	0.948	0.929	0.541	8.41	10.30	0.081	0.809	13.5	0.817	0.929	0.625	0.931	0.621

[a]Partial TFR and TMFR in the case of the separate age groups.
[b]Weighted average effectiveness taking into account the mix of methods used.
[c]Estimates are standardized on a uniform age structure.

unions) and then aged 15–49, for the five years preceding the survey;

u is the proportion of married women currently using contraception;

$\bar{e}$ is the estimated average contraceptive effectiveness (weighted average of the effectiveness of the different methods used); and

i' is the estimated mean duration of the post-partum non-susceptible, non-exposed period (ie the mean duration of the period during which women are in post-partum amenorrhoea or post-partum abstinence) for all births, regardless of the survival status of the child. Here we have used the prevalence–incidence estimates based on births in the last two years.

Table 35 presents the inputs at the national level. The three indices are estimated from the equations:

$$C_m = TFR/TMFR;$$
$$C_c = 1 - 1.08\ (u \times \bar{e});\ \text{and}$$
$$C_i = 20/(18.5 + i').$$

Since TFR and TMFR are standardized on a uniform age structure we have likewise attempted to standardize u, $\bar{e}$ and i'. At the national level this is not too difficult, but makes little difference to the results. For subgroups with a strong concentration in a given age range it can make more difference, but the results are then subject to greater sampling variability because of the additional fragmentation into age groups: the estimates of i' and of C_i for subgroups broken down by age are particularly sensitive because of the small number of births on which they are based, and they require cautious interpretation.

The main fertility-inhibiting variable is seen to be the post-partum period ($C_i = 0.62$), followed by the marriage pattern ($C_m = 0.73$). Contraception has only a very minor impact ($C_c = 0.94$). The same basic pattern recurs in each of the separate age groups, except that nearly all the impact of marriage patterns is seen to be restricted to the youngest age group, indicating that delay of entry into marriage has a much greater impact than either non-marriage or marital dissolution. As is to be expected, the impact of contraception is slightly greater for older than for younger women, but only marginally so, while the impact of the post-partum period is greatest among the older, more traditional, women. If we take the combined effect of C_i – the traditional fertility-inhibiting mechanism – and C_c – the more modern one – and calculate their product $C_c \times C_i$, then younger women have systematically higher values (ie less fertility inhibition) than older women: the product is 0.64 for the age group 15–24, 0.61 for women 25–34 and 0.53 for women 35–49. Clearly the younger women are not yet adopting contraception in sufficient numbers to counterbalance their lesser observance of prolonged lactation and abstinence.

Table 36 presents the estimates by subgroup. The differentials in C_i tend to be greatest for the central age group: for the youngest women nearly all the groups are moving towards a relatively short post-partum period, whereas for women 25–34 only some are. The

Table 37 The combined impact on fertility of the main proximate determinants

Subgroup	Indices affecting marital fertility $C_c \times C_i$					Indices affecting overall fertility $C_m \times C_x \times C_i$				
	Age group					Age group				
	15–24	25–34	35–49	All ages (a)	All ages (b)	15–24	25–34	35–49	All ages (a)	All ages (b)
Residence										
Rural	0.637	0.608	0.524	0.594	0.585	0.420	0.590	0.497	0.503	0.495
Town	0.684	0.593	(0.586)	0.634	0.621	0.414	0.522	(0.521)	0.487	0.477
City	0.642	0.588	(0.509)	0.609	0.575	0.362	0.526	(0.447)	0.444	0.419
Education										
No schooling	0.616	0.587	0.528	0.572	0.576	0.479	0.501	0.504	0.522	0.525
⩽3 years	0.615	0.637	0.508	0.590	0.584	0.444	0.604	0.474	0.511	0.505
⩾4 years	0.664	0.618	0.516	0.626	0.597	0.383	0.594	0.480	0.496	0.473
Province										
Nairobi	0.635	0.555	(0.490)	0.592	0.556	0.333	0.494	(0.455)	0.424	0.399
Central	0.653	0.603	0.537	0.590	0.601	0.354	0.584	0.486	0.461	0.469
Coast	0.614	0.593	(0.411)	0.567	0.521	0.461	0.578	(0.366)	0.495	0.455
Nyanza	0.624	0.608	0.595	0.611	0.610	0.429	0.592	0.593	0.530	0.528
Rift Valley	0.628	0.598	0.456	0.580	0.556	0.435	0.578	0.419	0.493	0.474
Western	0.682	0.642	0.557	0.637	0.624	0.456	0.610	0.539	0.535	0.525
Eastern and Northeastern	0.648	0.603	0.502	0.581	0.578	0.383	0.596	0.476	0.474	0.472

[a] C_c and C_i not standardized for age.
[b] C_c and C_i standardized for age.

Table 38 Indices of the proximate determinants of fertility and of their impact on fertility (extended model)

Age group	TFR	TEMFR	TMFR	u_{ster}	u_{tab}	u_{oth}	$\bar{e}_{oth}$	i	j	C_{em}	C_{diss}	C_{ster}	C_{tab}	C_{oth}	C_{ppamen}	C_{ppab}
15–24	2.62	3.96	4.05	0.001	0.001	0.041	0.724	11.0	0.6	0.661	0.978	0.999	0.999	0.968	0.678	0.980
25–34	3.27	3.31	3.39	0.010	0.005	0.056	0.750	11.6	0.7	0.988	0.976	0.989	0.995	0.954	0.664	0.977
35–49	2.37	2.37	2.50	0.014	0.021	0.059	0.714	14.8	2.5	1.000	0.948	0.985	0.977	0.953	0.601	0.930
All ages (unstandardized)	8.26	9.64	9.94	0.009	0.007	0.053	0.729	12.1	1.0	0.856	0.970	0.990	0.992	0.958	0.653	0.968
All ages (standardized)	8.26	9.64	9.94	0.009	0.011	0.053	0.727	12.8	1.4	0.856	0.970	0.990	0.988	0.957	0.639	0.957

differentials in C_c are larger among older women, but even here contraception has a significant impact only for Nairobi province, for city dwellers in general and for women with four or more years of schooling.

Table 37 shows the effects of different combinations of variables at subgroup level. For all ages, we see that the combined effects of the post-partum period and of contraception (left-hand panel) are slightly smaller for women in the highest education category than for less educated women ($C_c \times C_i = 0.60$, compared with 0.58), despite their greater use of contraception. The same is true for town dwellers relative to residents of rural areas. The pattern is the same but more striking for the youngest age group. The tendency of town dwellers and of women with more than three years education not to observe prolonged lactation and amenorrhoea is not (yet) fully compensated by their greater use of contraception. This is not true, however, for city dwellers who, relative to their peers, do compensate through contraception. For the central age group the pattern is similar for the residence categories, but here it is the women with just a few years schooling who have the smallest combined impact (0.64): women with four or more years are beginning to compensate.

Coast has the greatest combined fertility-reducing impact for these two variables (0.52), greater than that of Nairobi and Rift Valley (0.56). Coast achieves this, like Rift Valley, mainly through a particularly long post-partum period, whereas Nairobi does it also through its significantly greater use of contraception. The differences are much smaller among younger than among older women though, again reflecting the fact that what little contraception is used seems to be being adopted more for stopping childbearing than for spacing births.

When C_m is included in addition to C_c and C_i (right-hand panel of table 37), then the combined impact is clearly stronger for city dwellers and those who live in Nairobi, with relatively small differentials otherwise.

5.3 AN EXTENDED VERSION OF THE FRAMEWORK

The original Bongaarts model:

$$TFR = TF \times C_m \times C_c \times C_a \times C_i \qquad (1)$$

can easily be extended to:

$$TFR = TF \times (C_{em} \times C_{diss}) \times (C_{ster} \times C_{tab} \times C_{oth}) \times C_a \times (C_{ppam} \times C_{ppab}) \qquad (5)$$

The new model uses a much more detailed decomposition of total fecundity and more specification in the calculation of the indices. In this model:

C_m is split into two indices:
- C_{em} reflects the effect of delayed entry into marriage and of proportions never married; and
- C_{diss} reflects the effect of marital dissolution.

C_c is split into three distinct elements:
- C_{ster} reflects the effect of sterilization;
- C_{tab} reflects the effect of terminal abstinence; and
- C_{oth} reflects the effect of other forms of contraception.

C_i is split into two indices:
- C_{ppamen} reflects the effect of lactational amenorrhoea; and
- C_{ppab} reflects the additional effect of post-partum abstinence beyond amenorrhoea (Adegbola and Page 1981).

As in the previous calculations we have not attempted to estimate C_a.

Tables 38 and 39 present the results at national level and for subgroups respectively. Because of sample fragmentation problems we have not attempted to make the estimates for subgroups also age specific.

Table 38 confirms that the impact of marriage is restricted almost entirely to delay in entry into marriage, and that abstinence beyond the period of amenorrhoea plays a significant role only among the oldest, most traditional women. More interesting, perhaps, are the differences between subgroups (table 39). The traditional methods of limiting marital fertility – post-partum and terminal abstinence – are marginally more important in Eastern and Northeastern provinces than in the other provinces, but even here they play only a very small role. Sterilization also has almost no impact, even in Nairobi. Among the provinces only for Nairobi do the other forms of contraception have a significant impact: they also have a clear impact among urban dwellers in general and among the more educated. At provincial level, the pattern of differentials is dominated by differences in lactation-related amenorrhoea (with the exception of Nairobi). For the urban–rural and edu-

Table 39 Indices of the fertility impact of the proximate determinants of marital fertility (extended model): differentials between subgroups

Subgroup	C_{ster}	C_{tab}	C_{oth}	C_{ppamen}	C_{ppab}
Residence					
Rural	0.992	0.978	0.980	0.647	0.966
Town	0.990	0.990	0.933	0.717	0.969
City	0.979	0.998	0.899	0.714	0.972
Education					
No schooling	0.992	0.973	1.000	0.617	0.961
⩽3 years	0.996	0.987	0.940	0.639	0.966
⩾4 years	0.987	0.989	0.929	0.709	0.972
Province					
Nairobi	0.974	0.996	0.873	0.712	0.979
Central	0.999	0.983	0.927	0.676	0.961
Coast	0.990	0.991	0.980	0.595	0.991
Nyanza	0.997	0.977	0.991	0.651	0.972
Rift Valley	0.986	0.987	0.972	0.639	0.960
Western	0.994	0.980	0.995	0.676	0.970
Eastern and Northeastern	0.986	0.962	0.979	0.654	0.956

cation categories, the pattern is dominated by a combination of this and reversible methods of contraception.

5.4 SUMMARY

Overall, we get a strong impression of the dominating role still played by lactational amenorrhoea, followed by the marriage pattern. Contraception, especially non-reversible forms, has only a limited impact in a few subgroups. There is a clear indication of a two-stage fertility transition here, with declines in lactation and abstinence not yet being compensated by contraceptive use except among the highest socio-economic groups and among some of the oldest women.

6 Summary and Conclusions

Kenya's level of fertility is currently one of the highest in the world and it is almost certain that it has increased over the last 20 years. The constituents of this are quite simple. First, childlessness is very rare: most Kenyan women both can and do bear children. Secondly, the starting pattern of fertility is quite young. Kenyan women bear their first children at age 19 on average, but 10 per cent of them start as early as 14 or 15 years. The first birth occurs on average some four to five years after menarche and in most cases quite soon after the first regular sexual union. The more educated and the more urbanized younger women do have a slightly later starting pattern, but the differences are small: these women have their first birth on average about one year later than their rural uneducated counterparts.

Thirdly, birth intervals in Kenya are relatively short (two years or so on average). On the one hand, the traditional birth-spacing mechanisms are not very strong in contemporary Kenya: breastfeeding, post-partum amenorrhoea and, particularly, post-partum abstinence are relatively short by African standards. On the other hand, the use of modern contraception to space births has not (yet) been widely adopted.

Fourthly, the cohorts who are currently in the later years of childbearing have shown little tendency to stop childbearing earlier than they are physically obliged to. Moreover, the proportion who become unable to bear more children at an early age is, at least at national level, not abnormally high. In other words, most women in these cohorts both have been able to continue childbearing for quite a long time, and have indeed done so. Whether or not the following cohorts, who are still in the early or central years of childbearing, will also have a late stopping pattern remains to be seen: it is quite possible that they will shift to a different stopping pattern, given other changes in their behaviour.

Clearly we cannot hope to understand what is occurring, nor make good predictions about what may occur in the coming years, simply by studying overall fertility rates. It is only by examination of changes in the proximate determinants and of their determinants that we can begin to understand what is occurring as both the traditional fertility ideals and the traditional mechanisms regulating fertility adapt under the pressure of institutional change. The potential for conflicting effects on fertility of changes in the various proximate determinants – sometimes with the fertility-enhancing changes and sometimes with the fertility-reducing changes dominating, sometimes with a rough balance between them – is clear. These conflicting effects can occur either within a population at a given point in time, or within a cohort over its lifetime. There is no doubt that in order to understand and make useful projections of the course of fertility, we need to study not only fertility ideals, but also the way in which the proximate determinants both individually and as a set respond to social and economic pressures.

Whether their major concerns are health, education, community development, the status of women, or any other population-related subject, those responsible for population policies and programmes will find a rich field in reflections on the proximate determinants of fertility.

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Appendix A – Methodology

The objective of the text was to provide an illustration of the possibilities for a basic analysis of the FOTCAF module and related variables predicated on simple methods of analysis and estimation. The appendix is intended to summarize the methodological background to the practical computations employed.

A.1 REQUIRED COMPUTER PROGRAMS AND DATA FILES

Programs

We have endeavoured to keep the procedures as simple as possible. In particular, all the material necessary for the analyses can be produced using a single statistical package, the widely available SPSS. In fact, nearly all of it can be produced using just two procedures within SPSS – Crosstabs for basic cross-tabulations and Survival for classic life-table methods. In some cases, the summary statistics presented in tabular form in this report can be extracted directly from the SPSS output; in others, they are derived from it via simple computations that can, if necessary, be carried out with pencil, paper and a pocket calculator.

Only two exceptions to the use of SPSS are suggested. Age-specific fertility rates, and age-specific marital fertility rates can, if desired, be derived from SPSS tables: they can be obtained with less effort, however, from the WFS program Fertrate. Similarly, life-table analysis of birth intervals can be carried out within SPSS, but may be easier with the special programs for analysing these particular data developed at WFS.

Data files

All the analyses can be carried out using a standard recode file based on the individual questionnaire (ie a data file in which the units are women). This is true even for the analysis of birth intervals and their components, where the units of analysis are births rather than women (for example, if using SPSS through use of the Do Repeat facility). Many analysts, however, may prefer to create a second file in which births are the units, including for each birth in the six years preceding the interview the relevant characteristics of the mother (age at survey, education, residence, etc) as well as the characteristics of that birth and the associated birth interval.

A.2 ANALYSIS AND ESTIMATION FOR DURATION VARIABLES

Some of the characteristics estimated are proportions, which pose no problems at all but duration variables – the number of years or months before a particular event occurs – do. This is simply because of the effects of truncation and censoring that result from use of incomplete histories. For all but the oldest women some of the individuals who will ultimately be exposed to the 'risk' of experiencing the event have not yet become exposed. Others are exposed but have not yet experienced the event in question – all we know is that they have not experienced it so far, we do not know when they will do so.

Analysis of non-renewable events: classic life-table methods

The classic strategy for coping with censoring is to apply conventional life-table procedures. The strategy is appropriate when the data set includes for all cases information on the time elapsed to event for those who have experienced it and the time elapsed to observation for those who have not yet experienced it (but will ultimately do so). It is used here, therefore, for age at first birth; age at menarche; age at first union; and length of the birth interval.

The risk of experiencing the event between exact durations x and (x + n) is simply estimated as:

$$ {}_nq_x = \frac{{}_nE_x}{N_x - {}_nC_x} \qquad \text{(A1)} $$

where:
${}_nq_x$ is the risk in question;
${}_nE_x$ is the number known to have experienced the event between durations x and (x + n);
N_x is the number reported as having reached exact age x without experiencing the event; and
${}_nC_x$ is the number of cases for whom observation ceases between exact durations x and (x + n).

Strictly speaking, just as the denominator excludes all cases for whom information stops somewhere between durations x and (x + n) because that is when they were interviewed, so too should the numerator exclude such cases (Rodríguez and Hobcraft 1980; Smith 1980). In other words:

$$ {}_nE_x = {}_nE'_x - {}_ne_x \qquad \text{(A2)} $$

where:
${}_nE'_x$ is the total number of cases known to have experienced the event between exact durations x and (x + n); and
${}_ne_x$ is the subgroup of those cases among ${}_nE_x$ that were between durations x and (x + n) at the time of the interview.

From the ${}_nq_x$ estimates, all functions of the life table can immediately be estimated, including the frequency distribution of events by time elapsed (the ${}_nd_x$ function in mortality analysis) and the 'survival' function (l_x).

The SPSS Survival procedure provides an extremely simple way of generating functions of the life-table type for any such variable. A careful check should be made before its application, however, that there are no negative durations to event in the data, whether false ones resulting from miscoding or 'genuine' ones (eg premarital births where the variable under study is the interval from marriage to first birth). The reasons are both theoretical and practical. In the first place, life-table analysis assumes that all durations are positive by definition (one cannot experience an event before being exposed to it): 'genuine' negative intervals, therefore, call its application into question. On the practical level, some versions of the Survival routine (eg the current CDC version) are set up in such a way that if one feeds in a negative duration to event, the case is treated not as a case that had already experienced the event, but as one that had *not* experienced it (and the duration to event is interpreted as duration to observation).[15]

Non-renewable events and the use of current status data

For some variables, full life-table methods cannot be used but current status data (a simple dichotomy indicating for each case whether or not the event in question has already occurred) can. This situation can arise quite simply as a result of a question asking whether or not the event has occurred, but no question on when it occurred for those who have experienced it. This happens not infrequently in survey design either because it is believed that retrospectively reported durations to event are not sufficiently reliable, or because the current status question was included more for use in other types of analysis than for estimation of durations. Retrospectively reported durations of breast-feeding, amenorrhoea or abstinence, for example, have sometimes been regarded as suspect because of their very strong heaping on multiples of six months (Ferry 1980; Lesthaeghe and Page 1980; Page, Lesthaeghe and Shah 1982). An example from the WFS of the latter is menopause: women were asked whether they were menopausal, but they were not asked when they reached menopause.

The situation can also arise if a question on duration to event is included in the questionnaire but is restricted to a non-representative subsample of cases. This is precisely what occurred in WFS with the post-partum variables – breastfeeding, amenorrhoea and abstinence – for example. Indeed, questions about all the components of the birth interval were usually restricted to, at most, the two most recent births (or the two most recent pregnancies) for each woman. It is known that neither of these (nor their combination) provides an unbiased sample of women's intervals, long intervals being over-represented in the current open interval and under-represented in the closed interval. Nor do they form an unbiased sample of all intervals started in any given period, except for a period so short that no woman could have had more than the one or two pregnancies she was asked to report on. It is, however, possible to use them in combination with the dates of all births in the two to four years before the survey to derive current status estimates. The reason is simply that we do not actually need a question on current status for the earlier births since the information can be inferred. If a woman has had another birth since the birth in question, it is certain that she has stopped abstaining, for example; it is highly probable, although not certain, that she had resumed menstruation, for she must have resumed ovulation; and since few women breastfeed a child right through the next pregnancy it is almost certain that she had stopped breastfeeding the child in question.

Estimating a frequency distribution from current status data

After defining the current status for each case, it is simple to group the cases by time elapsed, (d), and to calculate the proportions who have not yet experienced the event for each category of (d), eg proportion not yet married by age, proportion still amenorrhoeic by months elapsed since the birth, proportion not yet menopausal by age. We shall use the symbol P(d) to indicate the proportions when durations are assumed to be measured in completed units of time, for example the proportions not yet menopausal by age. We shall use p(d) when d refers to a rounded duration or to a group of cases whose durations are centred on exact duration (d), for example months elapsed since birth measured by the difference between two century months.

Provided the cases on which a given proportion is based are representative of all those that started out d months or years ago, then p(d) can be taken as corresponding to 1_x for that cohort in standard life-table notation and P(d) to ${}_1L_x$ (from which the survivor function 1_x can be estimated directly). Quartiles, trimean, etc can be derived immediately from the 1_x function.

A practical problem arises, however, in that each of the estimates of p(d) or P(d) within a series is independent of the others, since each is derived from a separate cohort. There is no guarantee that the proportions reported as not having experienced the event will decline monotonically as d increases, the way they must do with a real cohort. They may even increase because of real differences between cohorts or because of sampling variability.[16] Even at national level, the p(d) or P(d) sequence can exhibit an extremely irregular sequence with numerous reversals of the generally downward trend, because of the small number of cases with a given value of d. Figure A1 (solid line) illustrates the irregularity that can occur, even at national level, using the post-partum variables.

If one is to estimate medians or other quantiles, some procedure to constrain the estimates to decline mono-

[15] The two types of duration are entered, for practical convenience, as a single variable in Survival (duration to event for those who have already experienced it, duration to observation for all others). The distinction between the two is made in the current CDC version by appending a negative sign to cases where the duration entered refers to duration to observation.

[16] Increases are impossible when classic life-table methods are used, even if there are real differences between cohorts and strong sampling variations, because each ℓ_x value is estimated cumulatively from the preceding value ℓ_{x-1}:

$$\ell_x = \ell_0 \prod_{i=0}^{x-1} (1 - {}_1q_i)$$

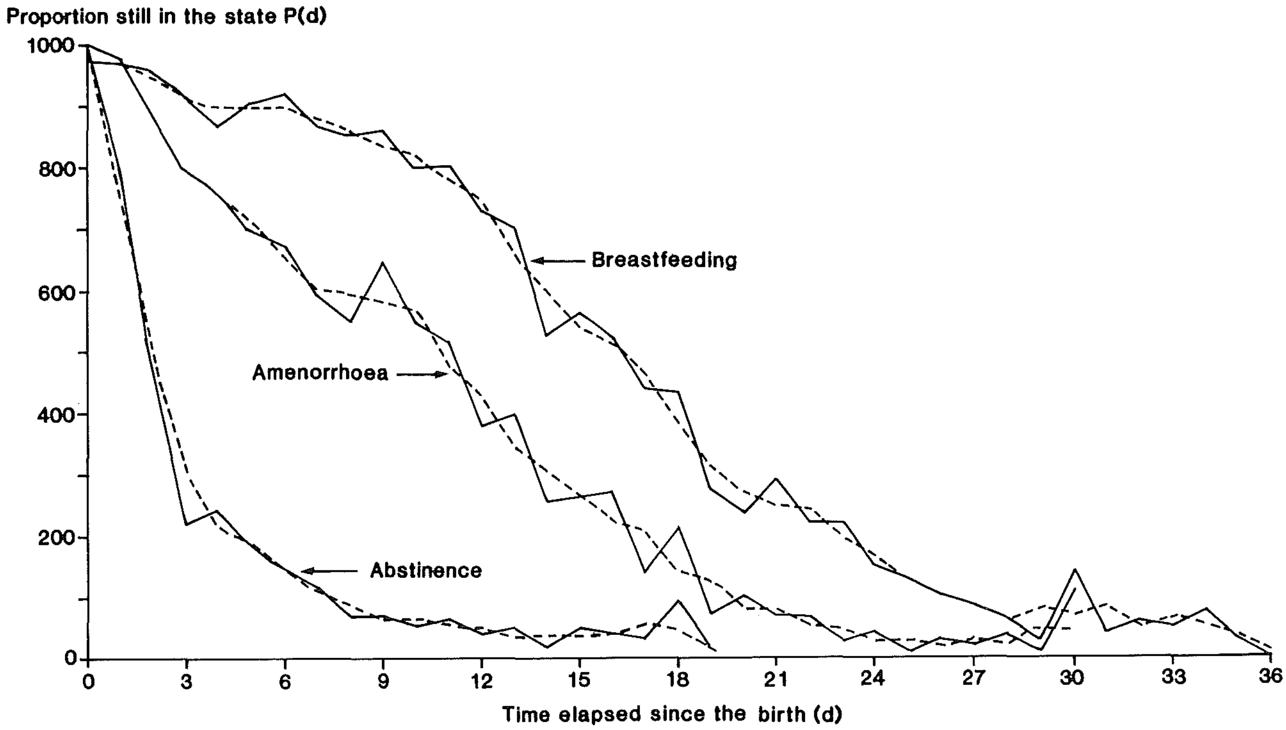

Figure A1 Reported and smoothed proportions breastfeeding, amenorrhoeic and abstaining, by months elapsed since the birth

tonically is required. A number of procedures are available, some of which make few assumptions about the underlying form of the frequency distribution but which often leave a rather irregularly declining sequence, others – based on model schedules – which produce a very smoothly declining sequence but require assumptions about the underlying distribution (Page, Lesthaeghe and Shah 1982). Here we have used a much simpler, though admittedly *ad hoc* procedure; we have first smoothed the data lightly by taking three-month moving averages (figure A1, broken line) and then estimated the quantiles from the smoothed curve, removing any remaining reversals near the quantiles that are to be estimated by graphical interpolation. At national level this is usually fairly simple and adequate for estimating the quartiles, but it is less satisfactory for subgroups because of the greater irregularity in the data. Fortunately we can often make estimates of the mean duration even where it is impossible to make adequate estimates of the whole frequency distribution or of selected quantiles.

Estimating the mean

Given a series of l_x or ${}_nL_x$ values for a real or for a synthetic cohort the mean is derived directly as:

$$e_0^\circ = \sum_{x=0}^{\omega-1} {}_1L_x \tag{A3}$$

or estimated as:

$$e_0^\circ = l_0/2 + \sum_{x=1}^{\infty-1} l_x \tag{A4}$$

assuming $l_0 = 1.0$ in both cases.

The corresponding equations for our observed proportions are:

$$\bar{X} = \sum_{d=0}^{\infty-1} P(d) \tag{A5}$$

or

$$\bar{X} = 0.5 + \sum_{d=1}^{\infty-1} p(d). \tag{A6}$$

Whatever the notation used, these equations are valid only for a particular subclass of non-renewable events. More specifically, they refer only to those phenomena that are, like mortality, universal and for which events can occur at any point in time between duration 0 and extinction of the cohort at duration ∞.

The more general form, of which the above equations are merely a special case, allows for phenomena that occur only within a more limited range of durations (usually denoted by α and β for the lower and upper limits respectively), and for phenomena that are not universal (with l_β indicating the proportion that ultimately experiences the event). The general form is:

$$\bar{X} = \alpha + \frac{\sum_{x=\alpha}^{\beta-1} {}_1L_x - (\beta-\alpha) l_\beta}{(1 - l_\beta)}$$

or

$$\alpha + \frac{\sum_{d=\alpha}^{\beta-1} P(d) - (\beta-\alpha) p(\beta)}{1 - p(\beta)} \tag{A7}$$

The formula is well known for its use in estimating the singulate mean age at marriage from reported proportions not (yet) married tabulated by age: α and β are usually then taken to be ages 15 and 50 respectively, P(d) as the reported proportion single among those between exact ages d and d+1, and $p(\beta)$ as the estimated proportion still single at age 50.

We have used this form in estimating the age at acquiring various proximate determinants of the age at stopping childbearing, some of which are non-universal and for all of which the practical bounds α and β do not coincide with durations 0 and ∞.

The post-partum variables, on the other hand, refer to events that are universal once a birth has occurred and the lower bound α corresponds to exact duration 0, β to ∞. Breastfeeding cannot be continued for ever and both post-partum amenorrhoea and post-partum abstinence must cease at some point (usually as a result of the resumption of menstruation and sexual relations, though sometimes as a result of the onset of menopause or terminal abstinence). The simpler form of the equation can thus be used. There is, however, a slight complication in the case of breastfeeding. Life tables assume, by definition, that everyone who starts is exposed to the risk of experiencing the event. For breastfeeding we are often interested not only in the average duration of breastfeeding among those children who are breastfed, but also in the average duration of breastfeeding including those who are never breastfed. Moreover, our observed proportions include those who were never breastfed. Either we must estimate the proportion never breastfed and adjust our observed p(d):

$$p'(d) = p(d)/(1-n(d)) \tag{A8}$$

where n(d) is the estimated proportion never breastfed among those at duration d. From this we can estimate the mean duration of breastfeeding for breastfed children as:

$$\bar{X}' = 0.5 + \sum_{d=1}^{\infty-1} p'(d) \tag{A9}$$

(the constant 0.5 is unchanged since this in fact refers to $0.5*l_0$ and $l_0 = 1.0$). Or we can simply estimate the mean duration of breastfeeding for all children by making both terms on the right-hand side include children who were never breastfed:

$$\bar{X}'' = 0.5\,E(0) + \sum_{d=1}^{\infty-1} p(d) \tag{A10}$$

where E(0) is the estimated proportion who were ever breastfed. We have adopted the latter procedure, and reported both $\bar{X}''$ and the proportion ever breastfed. A comparable problem does not arise with the other post-partum variables because every woman can be assumed to have had some period of post-partum amenorrhoea and abstinence, even if it was extremely short.

This method of estimating the mean duration is sometimes referred to as the 'survivor' mean, because it is essentially estimated by summing estimates of the survivor function in life-table terminology. As stated above, it can be calculated even when the p(d) or P(d) sequence does not decline monotonically. It may, however, suffer from quite severe sampling variability and thus requires very careful use when applied to subgroups. An alternative to the survivor mean is the 'stationarity' mean also known as the prevalence–incidence mean, which is thought to be less sensitive. This is simply the special case of the survivor mean that occurs under a stationary condition, ie when not only the phenomenon under study does not change from one cohort to the next, but also cohort size is stationary. Then equation (A5) reduces to:

$$\bar{X} = P/N \tag{A11}$$

where:
P is the number of cases who have not yet experienced the event (regardless of their duration (d)); and
N is the number of cases in each category (d) (assumed constant).

The classic example is the expectation of life in a stationary population:

$$e_0^\circ = \frac{\text{Population size}}{\text{Births per year}} \quad \left[= \frac{\text{reciprocal of the}}{\text{crude birth rate}}\right] \tag{A12}$$

or

$$e_0^\circ = \frac{\text{No of persons who have not yet died}}{\text{No of persons in a cohort}}$$

The name prevalence–incidence mean refers to the fact that its use is well known in epidemiology for estimating the mean duration of a condition as:

mean duration = prevalence/incidence

We have used this for estimating the mean duration of the post-partum variables, particularly for the subgroups, in the form:

$$\bar{X} = P/I \tag{A13}$$

where:
$\bar{X}$ is the mean duration of the variable in months;
P is the number of births for which the mother is still in the post-partum condition (regardless of when those births occurred); and
I is the average number of births per month.

I is usually estimated from the number of births in the last one, two or three years. Two years seems to provide the most robust estimates in a number of countries, although one year is better in some cases. We have used two years for the KFS, though it was not entirely clear that this always yielded the best results. Note that because of the way dates are coded in WFS and because of heaping on multiples of 12, half the births for whom the time elapsed since birth was recorded as 24 months were treated as having occurred within the last two years. In other words:

$$I = \frac{\text{all births coded as occurring 0–23 months before survey} + \text{1/2 births coded as occurring 24 months before survey}}{24}$$

If it is reasonable to assume that not only the stream of births but also the stream of women entering the exposure interval has been constant over time, then one can attempt to use the same method to estimate the exposure interval as:

$\bar{X} = P/I$

where:
P is now the number of parous women who are apparently in the exposure interval between two births; and
I is the average number of women entering the exposure interval.

Estimation of P is notoriously difficult, however (see section 3.4).

Age at last birth

Estimation of age at the final experience of a renewable event from incomplete histories raises particular difficulties. Not only do we have censoring – some women have not yet had their final birth – but we have the additional problem that we cannot identify which cases have already experienced it and which have not. Life-table and related procedures can cope with the former but they cannot cope with the latter.

We have based our estimates on the distribution of older women by their reported age at most recent birth, attempting to adjust this for those who will in fact have another birth. The basic adjustment procedure we have used is straightforward, and is illustrated in table A1. We take first the oldest single-year cohorts (here the cohort reported as aged 50 at interview), and assume they will never have another live birth. We calculate the proportion of them that had their final birth at age 49 (7.4 per cent – the proportions who reported birth at very advanced ages are implausibly high in Kenya). We assume that the cohort now aged 49, 2.1 per cent of whom report having had a birth at 49, will ultimately exhibit the same proportion as the cohort now aged 50. We therefore adjust their reported proportion with births at age 49 upwards to 7.4 per cent and reduce all the other proportions accordingly. Since we estimate that 5.3 per cent (7.4 − 2.1) out of the 97.9 per cent who reported their most recent birth as having occurred at younger ages will go on to have another birth, the adjustment is achieved simply by multiplying all the other proportions by (97.9 − 5.3)/(97.9) = 0.946. The adjusted figures are shown in italics. We now have two cohorts for whom we have complete data (cohort now aged 50) or suitably adjusted data (cohort now aged 49) for the proportion who have their last birth at age 48. The weighted average of the two proportions is 1.3 per cent (2.2 × 114 + 0.0 × 72)/(114 + 72). We then adjust the incomplete data for women now aged 48, assuming that they will ultimately exhibit the same proportions experiencing their last birth at ages 48 and 49 as the preceding cohorts. The estimation continues down through the successive cohorts until all the cohorts included have been adjusted. Finally we can combine the single-year cohorts into five-year cohorts. The results are given at the foot of table A1.

Use of single-year cohorts is very time-consuming and can occasionally lead to deadlocks (for example, if the estimated proportion ultimately having a birth at a given age is higher than the proportion currently at that age who reported they had already had a birth at that age). Collapsing of categories is then advisable.

Table A1 Estimation of age at last birth: adjustment of the per cent distribution of older women by age at most recent birth

Current age	N	Per cent within the given current age group who reported age at last birth as																	
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
45	189	0.0	0.0	0.5	0.0	0.0	0.7	0.9	0.0	0.7	1.0	0.5	2.3	3.1	1.8	1.6	1.9	1.8	2.5
		0.0	*0.0*	*0.4*	*0.0*	*0.0*	*0.6*	*0.7*	*0.0*	*0.6*	*0.8*	*0.4*	*1.8*	*2.5*	*1.4*	*1.3*	*1.5*	*1.4*	*2.0*
46	98	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	1.1	1.0	1.6	4.1
		0.0	*0.0*	*0.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*1.0*	*0.9*	*1.4*	*3.6*
47	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	0.8	0.9	0.0	0.0	0.0	0.6	1.1	0.0	0.7
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.9*	*1.4*	*0.8*	*0.8*	*0.0*	*0.0*	*0.0*	*0.6*	*1.0*	*0.0*	*0.7*
48	108	0.0	1.0	0.0	1.1	0.0	0.0	1.0	0.0	1.0	0.7	1.2	0.0	0.5	0.0	0.7	0.0	1.4	0.0
		0.0	*0.9*	*0.0*	*1.0*	*0.0*	*0.0*	*0.9*	*0.0*	*0.9*	*0.6*	*1.1*	*0.0*	*0.5*	*0.0*	*0.6*	*0.0*	*1.3*	*0.0*
49	114	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	2.2	0.0	2.4	1.1	3.0	0.0	1.3	1.0	3.4	0.0
		0.0	*0.0*	*0.9*	*0.0*	*0.0*	*0.0*	*0.9*	*0.0*	*2.1*	*0.0*	*2.3*	*1.0*	*2.8*	*0.0*	*1.2*	*0.9*	*3.2*	*0.0*
50	72	1.7	0.0	0.0	2.0	0.0	0.0	0.0	2.1	0.0	0.0	0.9	0.0	0.0	0.0	1.0	0.0	1.9	0.8
		1.7	*0.0*	*0.0*	*2.0*	*0.0*	*0.0*	*0.0*	*2.1*	*0.0*	*0.0*	*0.9*	*0.0*	*0.0*	*0.0*	*1.0*	*0.0*	*1.9*	*0.8*
45–50	699	0.2	0.2	0.4	0.4	0.0	0.2	0.6	0.4	1.1	0.5	1.0	0.8	1.4	0.5	1.1	1.0	1.7	1.5
		0.2	*0.1*	*0.3*	*0.4*	*0.0*	*0.2*	*0.5*	*0.4*	*1.1*	*0.4*	*0.9*	*0.6*	*1.2*	*0.4*	*1.0*	*0.8*	*1.5*	*1.2*

[a]The column check serves as a check on the adjustment calculation. The individual percentage figures for a given cohort should sum to 100 per cent except for small rounding errors.

A.3 ESTIMATING THE IMPACT OF THE MAIN INTERMEDIATE FERTILITY VARIABLES ON OVERALL FERTILITY LEVELS

Basic Bongaarts framework

In the decomposition:

$$\mathrm{TFR} = \mathrm{TF} \times C_m \times C_c \times C_a \times C_i \qquad \text{(A14)}$$

TFR and TF are the total fertility rate and total fecundity respectively, and C_m, C_c, C_a and C_i measure the fertility-inhibiting effect of the four main intermediate fertility variables: marriage, contraception, abortion and the post-partum period.

C_m is intended to measure the extent to which the total fertility rate is lower than it would be if all women were continuously married between ages 15 and 50, and experienced throughout this age range the observed age-specific marital fertility rates. This is often calculated as:

$$C_m = \frac{\Sigma\, g(a)\, m(a)}{\Sigma\, g(a)} \qquad \text{(A15)}$$

where:
g(a) is the observed age-specific marital fertility rate for age group (a); and
m(a) is the proportion currently married among women in age group (a).

It can also be calculated as the ratio of the observed total fertility rate to the observed total marital fertility rate.

$$C'_m = \frac{\mathrm{TFR}}{\mathrm{TMFR}} \quad \text{or} \quad \frac{\Sigma\, f(a)}{\Sigma\, g(a)} \qquad \text{(A16)}$$

where f(a) is the age-specific fertility rate for all women in age group a (including births to non-married women) and the other terms are as before.

The original Bongaarts formulation assumed that the two were equal, ie that the number of births outside marriage was negligible. In countries with a non-negligible number of births outside marriage (however the term marriage was defined in the survey) there may be significant differences between the two, however. We have elected to use the second expression here because fertility outside reported marriages is not negligible in Kenya and because under these circumstances use of the first definition of C_m (A15) would destroy the relationships in the basic framework (A13).

The TFR and TMFR values can be readily calculated, especially if the Fertrate computer program is available. We chose to take the rates for the five-year period preceding the survey:

$$f(a) = \frac{\text{no of births in this period to women in age group (a) at the birth}}{\text{no of women-years lived in age group (a) during this period}}$$

and

$$g(a) = \frac{\text{no of births in this period to women both married and in age group (a) at the birth}}{\text{no of years women lived in marriage in age group (a) during this period}}$$

The index of contraception is derived as:

$$C_c = 1 - 1.08\, u\bar{e} \qquad \text{(A17)}$$

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Check[a]
2.8	4.5	1.4	2.7	3.8	4.4	5.4	6.7	11.8	7.3	9.4	16.5	(3.9)	–	–	–	–	–	
2.2	*3.6*	*1.1*	*2.1*	*3.0*	*3.5*	*4.3*	*5.3*	*9.3*	*5.8*	*7.4*	*13.1*	*7.1*	*5.8*	*2.4*	*1.3*	*7.4*	*0.0*	Σ = 100.1%
1.1	5.4	4.2	3.5	7.4	4.6	4.0	3.9	11.5	9.6	12.8	9.1	8.8	(4.1)	–	–	–	–	
1.0	*4.7*	*3.6*	*3.0*	*6.4*	*4.0*	*3.5*	*3.4*	*10.0*	*8.3*	*11.1*	*7.9*	*7.6*	*5.8*	*2.4*	*1.3*	*7.4*	*0.0*	Σ = 99.6%
2.3	2.5	0.3	2.2	3.7	6.2	10.3	8.8	11.3	10.4	7.2	5.6	7.9	9.3	(5.3)	–	–	–	
2.2	*2.3*	*0.3*	*2.1*	*3.5*	*5.8*	*9.7*	*8.3*	*10.6*	*9.8*	*6.8*	*5.3*	*7.4*	*8.7*	*2.4*	*1.3*	*7.4*	*0.0*	Σ = 100.1%
4.5	2.9	3.8	5.3	3.7	7.1	3.0	6.2	12.2	5.0	8.1	12.3	8.8	5.7	2.6	(0.3)	–	–	
4.1	*2.7*	*3.5*	*4.9*	*3.4*	*6.5*	*2.7*	*5.7*	*11.2*	*4.6*	*7.4*	*11.3*	*8.1*	*5.2*	*2.4*	*1.3*	*7.4*	*0.0*	Σ = 100.1%
5.1	4.5	5.4	3.7	7.9	5.9	2.9	4.7	10.2	7.3	4.4	5.5	7.9	3.6	0.4	2.2	(2.1)	–	
4.8	*4.2*	*5.1*	*3.5*	*7.5*	*5.6*	*2.7*	*4.4*	*9.6*	*6.9*	*4.2*	*5.2*	*7.5*	*3.4*	*0.4*	*2.0*	*7.4*	*0.0*	Σ = 99.7%
3.2	3.7	1.5	7.0	2.3	6.9	5.0	8.8	11.3	5.0	4.0	8.9	3.5	5.6	5.4	0.0	7.4	(0.0)	
3.2	*3.7*	*1.5*	*7.0*	*2.3*	*6.9*	*5.0*	*8.8*	*11.3*	*5.0*	*4.0*	*8.9*	*3.5*	*5.6*	*5.4*	*0.0*	*7.4*	*0.0*	Σ = 99.9%
3.2	4.0	2.6	3.7	4.8	5.6	5.2	6.5	11.4	7.5	7.9	7.3	(6.6)	(4.2)	(1.9)	(0.4)	(1.1)	(0.0)	
2.8	*3.5*	*2.4*	*3.4*	*4.3*	*5.1*	*4.6*	*5.8*	*10.2*	*6.7*	*6.9*	*9.0*	*7.1*	*5.8*	*2.4*	*1.3*	*7.4*	*0.0*	Σ = 99.9%

NOTES: (i) Percentages given in the first row (roman) are the reported percentages, and those in the second row (italics) are the adjusted percentages.
(ii) A dash indicates no experience yet.
(iii) Figures in parentheses indicate the experience is not yet complete.

where:
u is the proportion of currently married women using contraception; and
$\bar{e}$ the average effectiveness of the methods used.
More specifically:

$$\bar{e} = \Sigma[u(m)e(m)]/\Sigma u(m) \tag{A18}$$

and

$$C_c = 1 - 1.08\Sigma[u(m)e(m)]$$

where:
u(m) is the proportion of currently married women using contraceptive method (m); and
e(m) is the average effectiveness of method m.

We assumed the following levels of effectiveness:

1.0 for sterilization and the pill,
0.9 IUDs,
0.8 for condoms, and
0.5 for all other methods.

The index of post-partum amenorrhoea and abstinence is estimated as:

$$C_i = \frac{20}{18.5 + i'} \tag{A19}$$

where i′ is the mean duration (in months) of the period during which the woman is in post-partum amenorrhoea or post-partum abstinence, based on a sample of births.

More specifically we took here the prevalence–incidence estimate of the mean duration of the post-partum period, estimating incidence from all births in the preceding two years. Expression (A19) assumes that the mean birth interval would be 20 months in the absence of any extension of the post-partum period by lactation or abstinence, and that 1.5 of these would be contributed on average by the post-partum period that would be experienced even in the absence of lactation and abstinence.

Ideally since TFR, TF, TMFR and C_m are standardized by age (on a uniform age distribution) u, $\bar{e}$ and i′ should also be standardized before the calculation of C_c and C_i. However, sampling fragmentation can be a problem when standardizing, especially for i′ because of the small number of births on which i is often based. Use of three broad age groups rather than seven five-year age groups is suggested as a possible solution.

Extended version of the model

In our extended version of the Bongaarts framework we have:

$$\text{TFR} = \text{TF} \times (C_{em} \times C_{diss}) \times (C_{ster} \times C_{tab} \times C_{oth}) \times (C_{ppamen} \times C_{ppab}) \tag{A20}$$

where:
C_{em} and C_{diss} measure the fertility impact of delayed entry into marriage and that of marital dissolution respectively;
C_{ster}, C_{tab} and C_{oth} measure respectively the impact of sterilization, of terminal abstinence, and of other forms of contraception; and
C_{ppamen} and C_{ppab} measure respectively the effect of extended (lactation-related) post-partum amenorrhoea and the effect of post-partum abstinence beyond the period of post-partum amenorrhoea.

The product $(C_{em} \times C_{diss})$ is a decomposition of the original C_m, $(C_{ster} \times C_{tab} \times C_{om})$ a decomposition of the C_c, and $(C_{ppamen} \times C_{ppab})$ a decomposition of C_i.

The two indices of marriage are estimated simply by:

$$C_{em} = \text{TFR/TEMFR} \tag{A21}$$

where:
TFR is the total fertility rate; and
TEMFR is the total ever-married fertility rate based on the age-specific fertility rates of ever-married women.

$$C_{diss} = \frac{\text{TEMFR}}{\text{TMFR}} \tag{A22}$$

The indices of contraception can be estimated as:

$$C_{ster} = 1 - 1.08\ u_{ster} \tag{A23}$$

where:
u_{ster} is the proportion of currently married women with a sterilization (assumed to be 100 per cent effective);

$$C_{tab} = 1 - (1.08\ u_{tab}/C_{ster}) \tag{A24}$$

where:
u_{tab} is the proportion of currently married women who are practising terminal abstinence (also assumed to be 100 per cent effective); and

$$C_{oth} = 1 - 1.08\,\frac{\Sigma[u(m)e(m)]}{C_{ster} \times C_{tab}} \tag{A25}$$

where:
u(m) and e(m) are respectively the proportions using other methods of contraception and the average effectiveness of each group of methods.

For the post-partum period, we have:

$$C_{ppamen} = \frac{20}{18.5 + i} \tag{A26}$$

where:
i is the mean duration of post-partum amenorrhoea, measured in months, for a sample of births; and

$$C_{ppab} = \frac{18.5 + i}{18.5 + i + j} \tag{A27}$$

where:
j is the average number of months by which the combined post-partum period (amenorrhoea or abstinence) exceeds the period of post-partum amenorrhoea.