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The Proximate Determinants of Fertility in North Sudan

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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

One of the major objectives of the World Fertility Survey programme is to assist the participating countries in reaching a better understanding of their levels of fertility. To this end, a number of countries included as part of their fertility questionnaires a module designed to gather information on the proximate determinants of fertility. This module, called Factors other than Contraception Affecting Fertility (FOTCAF), asked questions pertaining to the onset, patterns and termination of childbearing, elucidating such matters as menarche, menopause, breastfeeding, abstinence and sterility.

A number of countries have made a particular point of analysing these data. North Sudan was among them, and the present document reports on the findings of the Sudan Fertility Survey of 1978–9.

I should like to congratulate Ibrahim Abbas who, in collaboration with Ishmael Kalule-Sabiti, undertook this valuable piece of analysis, and to thank Samir Farid for his assistance and co-operation in the production of this report.

HALVOR GILLE
Project Director

1 Introduction

1.1 THE PROXIMATE DETERMINANTS OF FERTILITY

The Sudan Fertility Survey (SUDFS), was the first large-scale attempt to measure fertility and its socio-economic and socio-cultural determinants in the history of the country. The questionnaire included among other things, questions on 'Factors Other Than Contraception Affecting Fertility' (FOTCAF) and their proximate determinants. There are strong reasons for a close study of the FOTCAF variables and their proximate determinants in a country like North Sudan. First, these intermediate variables are the focus of the institutional arrangements through which societies restrict their reproductive capacity. As Davis and Blake (1956) observed, cultural, social and economic settings do not affect fertility directly but indirectly through the 'intermediate fertility variables', that is, through a series of biological and behavioural factors that determine exposure to sexual intercourse and hence to childbearing. The relative importance of each differs from one society to another. For a long time demographers tended to focus their attention on just three variables: age at entry into first marriage, contraception and abortion. Although these three variables have a powerful inhibiting check on fertility, almost exclusive focus on them has led to a somewhat lopsided view of fertility in general and its social context in particular. Other variables might be as, or even more, important for different societies.

Secondly, in a period of change like the one Sudan is undergoing, the various proximate determinants may react to the same general set of factors but their reactions may differ in magnitude and direction. Not all the proximate determinants, for example, necessarily shift in the direction of lower fertility in the process of modernization through education, urbanization and industrialization. On the contrary, the changes that occur in some, especially early in the process, may tend to push fertility up. The best examples of this trend are reductions in breastfeeding and in the observance of any traditions of prolonged postpartum abstinence.

Thus it is intended that the present study, in addition to providing a better insight into fertility changes and giving a better explanation of the observed fertility levels in Sudan, will provide a basis for more reliable predictions of future fertility patterns and trends in Sudan.

The main focus of the report will be to estimate the proximate determinants and their impact on fertility levels and differentials. Results will be presented for the population as a whole and, whenever possible, for major subgroups, by literacy and type of place of residence. No attempt will be made to consider other details or subgroups, due to time constraints and to problems of sample size.

Our strategy of the analysis is a dynamic approach to fertility based on the process of family formation. Thus we analyse in turn:

(i) The starting pattern of family formation (presented as age at first live birth).
(ii) The spacing pattern (presented as birth intervals).
(iii) The stopping pattern (presented as age at last birth).

In each case we will examine first the pattern itself (age at first birth, birth intervals and age at last birth) and then the proximate determinants of each pattern. Finally we will examine the relative contribution of each of the major proximate determinants to the total fertility and fertility differentials.

1.2 THE SUDAN FERTILITY SURVEY (SUDFS)

The data presented in this report are drawn from the Sudan Fertility Survey (SUDFS) conducted in 1978–9 as part of the World Fertility Survey programme (WFS). Two questionnaires were used in the survey: the household schedule and the individual questionnaire. The individual questionnaire was administered to ever-married women, aged 50 years or less who had spent the night before the survey in the selected household (ie, the de facto population). Of the 3923 households selected for the individual questionnaire from the household survey (12 028 households were covered by the household survey), only 3204 women were found to be eligible and only 3115 individual questionnaires were successfully completed. Data from the household survey will be used whenever necessary to supplement the results. For more details concerning sample design and survey methodology, and the final survey results see Ministry of National Planning (1981).

1.3 METHODS OF ANALYSIS AND PRESENTATION OF RESULTS

Almost all the intermediate fertility variables that we will examine are duration variables, measured in terms of the time elapsed before a particular event occurred. Age at first marriage, for example, is measured as the time elapsed between a woman's date of birth and the date of her entry into first union. Similarly, length of birth interval and length of breastfeeding are measures of duration. Since, however, on the day of the interview for some respondents insufficient time had elapsed for them to have experienced the events in question (closing the birth interval concerned, weaning), the information on duration is censored by the interview. For censored data

sets, classic life-table methods and use of current status data are more appropriate and they will thus be employed for our analysis.

To summarize the detailed distributions estimated for a duration variable we shall present a series of quantiles, T_x, which is defined as the time elapsed before x per cent of the persons concerned have experienced the given event. Thus we give T_{10}, T_{25}, T_{50}, T_{75} and T_{90}, as the time elapsed before 10, 25, 50, 75, and 90 per cent of the respondents experienced an event. As an overall measure of central tendency we use the trimean, a weighted average of the quantiles (T_x) that gives twice as much weight to the median as to the other two quartiles, $(T_{25}+2T_{50}+T_{75})/4$; in other cases we shall use the arithmetic mean. The methods of analysis are discussed in detail in Ferry and Page (1982).

Finally one major limitation on the analysis – especially concerning the starting patterns of family formation – will be due to the fact that information obtained from the SUDFS individual questionnaire was obtained only for the ever-married women. Necessary adjustments were made whenever it was possible; in other cases it was impossible to do so without making unwarranted assumptions.

2 Starting Patterns of Family Formation

2.1 INTRODUCTION

In considering the starting patterns of family formation, the main fertility variable to be examined is age at first birth for those who do bear children, and its main proximate determinants: age at menarche, age at first marriage (union), interval from first union to first birth, and the incidence of primary sterility, contraception to delay conception and foetal wastage. Since voluntary childlessness is uncommon and the use of contraception to delay the first birth almost non-existent, primary sterility can be measured by the proportion remaining childless after five years of continuous marriage.

The information in the SUDFS individual questionnaire refers only to ever-married women. This will certainly introduce biases in some of the results, as women who marry later are clearly under-represented. For some variables, in particular age at first birth and age at first marriage, it has been possible to attempt adjustment by combining the information for ever-married women obtained from the individual questionnaire with the age structure of the never-married women obtained from the household questionnaire. For other variables, such as age at menarche and interval from marriage to first birth, adjustment was not possible and the data have been presented in the unadjusted form for the ever-married women.

2.2 AGE AT FIRST LIVE BIRTH

A Sudanese woman bears her first child at an average age of about 21 years, (table 1 and figure 1). This compares with 21 for Lesotho, 20 for Ghana, 19 for Kenya and 21.6 for Syria. By the age of 17, 25 per cent of all women have already had their first child, 10 per cent are mothers by the age of 15 and 90 per cent are mothers by the age of 34. The distributions show a slight increase in age at first birth for the younger cohorts – those aged 15–19, 20–24 and 25–29. The increase, however, is not steady and since premarital births are not common in the northern provinces of the Sudan, biases in the estimates are probably minimal. The biases in the estimates for the oldest age group (45–49) may reflect possible misdating and omission of first births (see Rizgalla 1985).

2.3 THE PROXIMATE DETERMINANTS OF AGE AT FIRST BIRTH

Age at menarche

One of the most important and necessary conditions for the process of childbearing is for a woman to start ovulation. The onset of ovulation defines the starting point of a woman's fecund life, but since the woman herself cannot easily tell when the event exactly took place we are usually restricted in survey work to information on the onset of menstruation, even though it sometimes precedes ovulation by several months. Menstruation has the advantage that it is an easily recognizable sign that a girl is now undergoing physical, as well as social, changes. Its disadvantage is that it is not related perfectly to the process of ovulation.

Table 2 and figure 2 show that the average age at menstruation is 13.6 for ever-married women in the Sudan. Ten per cent of the women have experienced their first menstruation by age 12. Half the women have experienced it by their 14th birthday and 90 per cent before reaching the age of 16. The distributions show no difference across age groups, indicating that Sudanese women have not experienced any changes in age at menarche. The results for the younger cohorts (15–19 and 20–24) may be biased downwards since they are derived from an ever-married sample only, and menarche usually precedes marriage.

Table 1 Age at first live birth by current age, all women

Current age	Quantiles					Trimean	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	17.6	–	–	–	–	–	232
20–24	14.8	17.5	21.0	–	–	–	515
25–29	15.0	16.8	19.3	23.8	–	19.8	715
30–34	14.3	15.9	18.8	22.3	30.0	18.9	501
35–39	14.5	16.6	19.8	24.5	31.4	20.2	589
40–44	14.4	16.3	20.2	24.9	33.5	20.4	303
45–49	15.3	17.6	21.6	26.7	39.1	21.8	259
15–49	15.2	17.2	20.3	25.0	33.9	20.7	3114

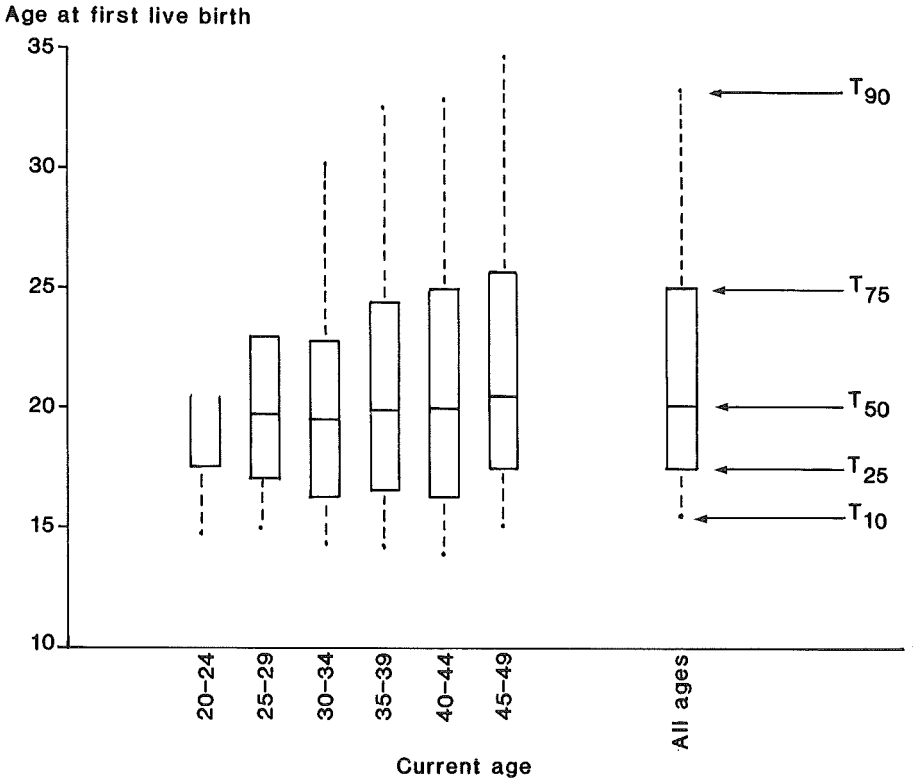

Figure 1 Age at first live birth by current age, all women

Age at first marriage

Although menarche indicates in most cases that a woman is about to become able to have children, the start of actual childbearing depends on subsequent exposure to sexual intercourse. In many societies this is approximated by marriage, and in North Sudan, Islamic culture forbids premarital sex. Marriage itself is a somewhat long process which starts with engagement and passes through many other defined steps before actual cohabitation takes place. During the survey the interviewers were instructed to ask for the date of consummation of marriage, locally known as zifaf.

The results in table 3 (and figure 3) show that the average age at marriage is 18 years in the Sudan (compared with 19.3 in Syria and 19 in Lesotho). Ten per cent of all women are married by the age of 13, 50 per cent by the age of 18 and 90 per cent by the age of 28.

It seems that age at first marriage has been rising for the younger cohorts (those currently aged less than 30). The median ages for the age groups 30–34, 35–39, 40–44, 45–49 are 15.7, 16.2, 15.9 and 16.2 respectively, while the comparable figures for those aged 20–24 and 25–29 are 18.6 and 17.0 respectively. The rise is however slow and less apparent by the comparable trimean.

Interval between first marriage and first birth

Table 4 shows the interval in months between first marriage and first birth. Of the total of 3114 ever-married women interviewed, 50 per cent had had their first birth within 20 months of the date of their first marriage, while 10 per cent of the women had their first birth eight months after first marriage. Overall, a Sudanese woman bears her first child within two years of her first marriage. The oldest women (those currently aged over 35) experienced a longer first birth interval than their younger counterparts; this probably reflects either physiological impairment due to very young ages at first marriage among older cohorts or differential misreport-

Table 2 Age at menarche by current age, ever-married women

Current age	Quantiles					Trimean	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	12.1	12.6	13.5	14.8	15.8	13.6	216
20–24	12.1	12.5	13.3	14.7	15.8	13.5	482
25–29	12.2	12.6	13.5	14.6	15.6	13.5	677
30–34	12.1	12.6	13.5	14.6	15.6	13.5	454
35–39	12.1	12.7	13.6	14.7	15.7	13.6	530
40–44	12.1	12.5	13.5	14.6	15.7	13.5	284
45–49	12.1	12.6	13.7	14.8	15.8	13.7	240
15–49	12.1	12.6	13.5	14.7	15.7	13.6	2884

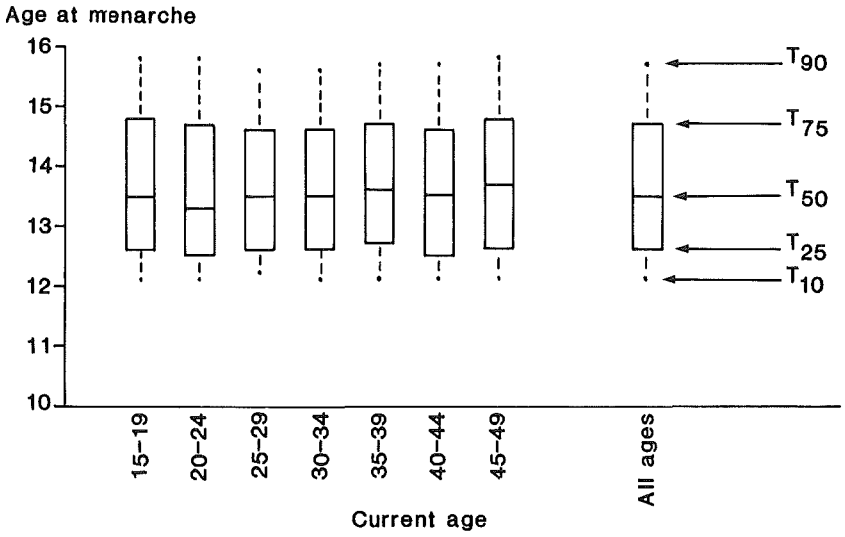

Figure 2 Age at menarche by current age, ever-married women

Table 3 Age at first marriage by current age, all women

Current age	Quantiles					Trimean	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	15.8	17.9	–	–	–	–	232
20–24	12.5	14.9	18.6	–	–	–	515
25–29	12.6	14.4	17.0	20.4	–	17.1	715
30–34	12.0	13.9	15.7	18.1	22.7	15.5	501
35–39	11.8	13.8	16.2	19.6	24.3	16.4	589
40–44	11.7	13.4	15.9	19.7	23.7	16.1	303
45–49	12.5	14.3	16.2	20.0	25.2	16.5	259
15–49	12.9	14.9	17.8	22.1	28.3	18.1	3114

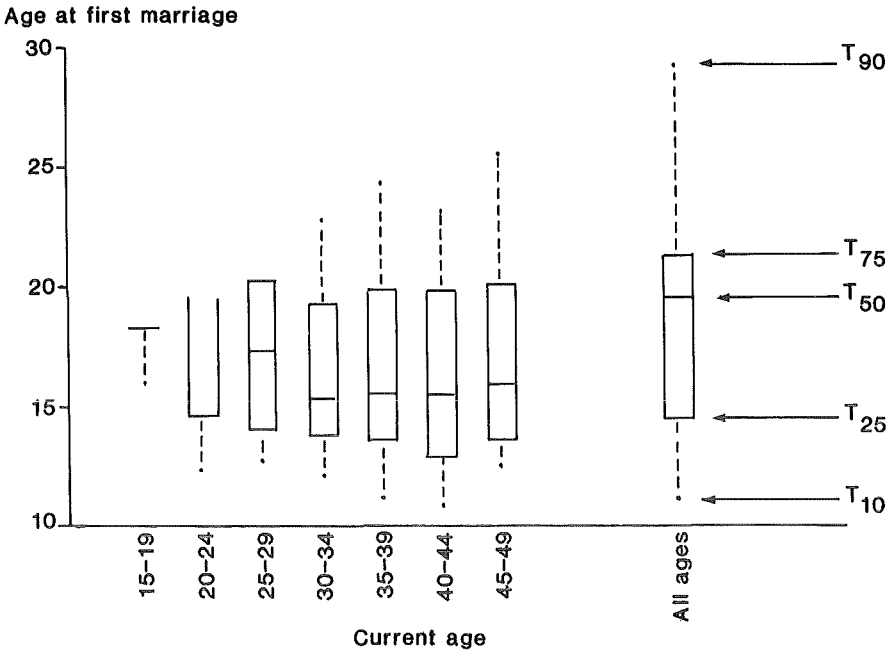

Figure 3 Age at first marriage by current age, all women

Table 4 Interval from first marriage to first birth (in months by age at survey), ever-married women: national

Current age	Quantiles					Trimean	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
15–19	9.3	12.6	20.9	35.7	72.3	22.5	232
20–24	7.9	10.3	18.1	36.6	57.6	20.8	515
25–29	8.4	11.4	18.5	34.1	62.9	20.6	715
30–34	8.1	11.6	18.5	40.1	81.7	22.2	501
35–39	8.0	13.0	22.0	55.9	108.8	28.2	589
40–44	9.2	14.8	26.5	54.9	112.7	30.7	303
45–49	10.2	15.5	31.7	58.6	116.8	34.4	259
15–49	8.4	12.1	20.2	42.7	99.4	23.8	3114

Table 5 Interval from first union to first birth (in months), for literacy and type of place of residence subgroups

Subgroup	Quantiles					Trimean	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}		
Literate	8.0	10.4	17.6	28.0	57.2	18.4	568
Illiterate	8.5	12.8	21.4	46.8	104.8	25.6	2546
Urban	8.2	11.5	18.3	34.7	83.3	20.7	842
Rural	8.5	12.4	21.1	46.0	101.6	25.1	2272

Table 6 Percentage never having had a live birth and percentage never having had a pregnancy, by current age

Current age	Ever-married women			Women married at least 1–5 years		
	No live birth	No pregnancy	N	No live birth	No pregnancy	N
15–19	52.2	34.4	232	16.7	14.3	27
20–24	14.4	9.9	515	4.7	4.7	327
25–29	7.5	6.3	715	5.1	4.6	647
30–34	5.4	4.6	501	5.1	4.2	488
35–39	5.3	4.0	589	5.1	3.8	583
40–44	6.5	5.7	303	6.1	5.3	302
45–49	8.6	7.1	259	8.6	7.5	259
15–49	11.2	8.3	3114	5.6	4.7	2631

ing of dates. Ten per cent of the women had not had a birth after eight years of marriage.

Major variations emerge from the tabulations by subgroups (table 5). Women with no education and those who live in rural areas have longer intervals to first birth than those with some education and those who are urban dwellers. Overall, women with some education do not have their first birth until after 18 months of marriage and those who live in urban areas after 20 months, compared with 25 months for illiterate women and those residing in rural areas.

Primary sterility

Since marriage is almost universal and there is almost no deliberate control to prevent a first birth, childlessness or failure to conceive among married women may be taken as an indication of either sterility or subfecundity.

Of the 3114 ever-married women, 11.2 per cent had had no live birth and 8.3 per cent had had no pregnancy. Of the 2631 women who had been married for at least five years, only 5.6 per cent stated that they had not had a live birth and 4.7 had had no pregnancy, with little variation between age groups (table 6).

2.4 CONCLUSIONS

We have seen from the data that the vast majority of the Sudanese women are capable of bearing children and give birth to their first child at an average age of about 21 years. Fifty per cent of all women are mothers by the age of 20.

There is a gap of about six to seven years between the onset of menstruation and the birth of the first child. This difference may, in part, be attributed to the delay in the onset of ovulation following menarche and, in part, to the delay between entry into marriage and consummation of marriage.

On the average, Sudanese women first marry when they are 18. There seems to have been a slight change in this age, especially among the young cohorts. The interval between first marriage and first birth is about two years and there is little evidence of widespread primary sterility.

3 Birth-Spacing Patterns

3.1 INTRODUCTION

Biologically a woman's fecund life extends from the time of ovulation to the time of her menopause, which is the time when ovulation stops. The length of time between these two events is, on average, about 30–35 years. The number of children that a woman would bear in this period will depend, among other things, on the length of the intervals between successive births.

In traditional societies, birth-spacing has been probably the most effective means of regulating reproductive capacity. However, among those subgroups of the population which have been influenced by modernization, many of the institutionalized supports that helped the traditional methods of spacing (breastfeeding, for example, or post-partum abstinence) tend to be eroded without being replaced by new ones, such as contraception.

In this chapter we examine data from the SUDFS on birth-spacing. We will analyse intervals between successive live births and their proximate determinants namely:

(i) The post-partum non-suspectible period, during which the woman is not susceptible to conception since she is not ovulating (this period is measured by the closely correlated period of post-partum amenorrhoea).

(ii) The exposure interval, which is the period between the return of susceptibility (ovulation) 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, which starts with a conception which leads to a live birth.

A better approach to the analysis of the birth intervals and their components would have been a study of the intervals between successive pregnancies, and not just live births. However, for the purposes of this report, the analysis will be based on live-birth intervals for the simple reason that the pregnancies that did not end in a live birth were probably seriously under-reported in the SUDFS. It is clear that a large proportion of these pregnancies tend to be undetected, forgotten, or simply not reported (see Rizgalla 1985).

Lastly the analysis will be restricted to live-birth intervals that started a few years before the survey (six years) even though the data was collected on all birth intervals of the women interviewed. The reason for this restriction is because detailed questioning on the proximate determinants of the intervals was done only for the last two births of each respondent.

3.2 BIRTH INTERVALS

Table 7 and figure 4 summarize the results of a life-table analysis of live-birth intervals for ever-married women, started in the six years preceding the survey. The table also shows the proportion of the intervals that were closed within the six-year period. An interval is closed if the live birth that started it is followed by another live birth before the date of the interview. It can be seen from the table that the median birth interval is about $2\frac{1}{2}$ years. Ten per cent of the live births are followed by another live birth within 14 months and 25 per cent within 21 months. At the other end of the continuum, 10 per cent of the intervals remain unclosed after $5\frac{1}{2}$ years. Overall, 91 per

Table 7 Length of live birth interval (in months),[a] by current age of mother

Current age of mother	All intervals						Closed in six years	
	Quantiles[b]					Average	Per cent closed	N
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}			
15–19	13.9	20.7	30.8	35.8	–	29.5	89.2	160
20–24	12.1	18.5	25.9	36.0	48.4	26.6	98.3	894
25–29	13.9	21.0	28.5	37.8	48.7	21.8	95.5	1356
30–34	13.6	20.9	29.8	43.5	62.2	31.0	91.8	880
35–39	14.4	22.5	33.3	55.0	69.3	36.0	90.2	861
40–44	15.7	24.4	42.0	–	–	–	61.1	238
45–49	13.5	20.8	32.0	–	–	–	63.5	137
15–49	13.6	21.1	29.9	42.0	66.4	30.7	90.7	4526

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

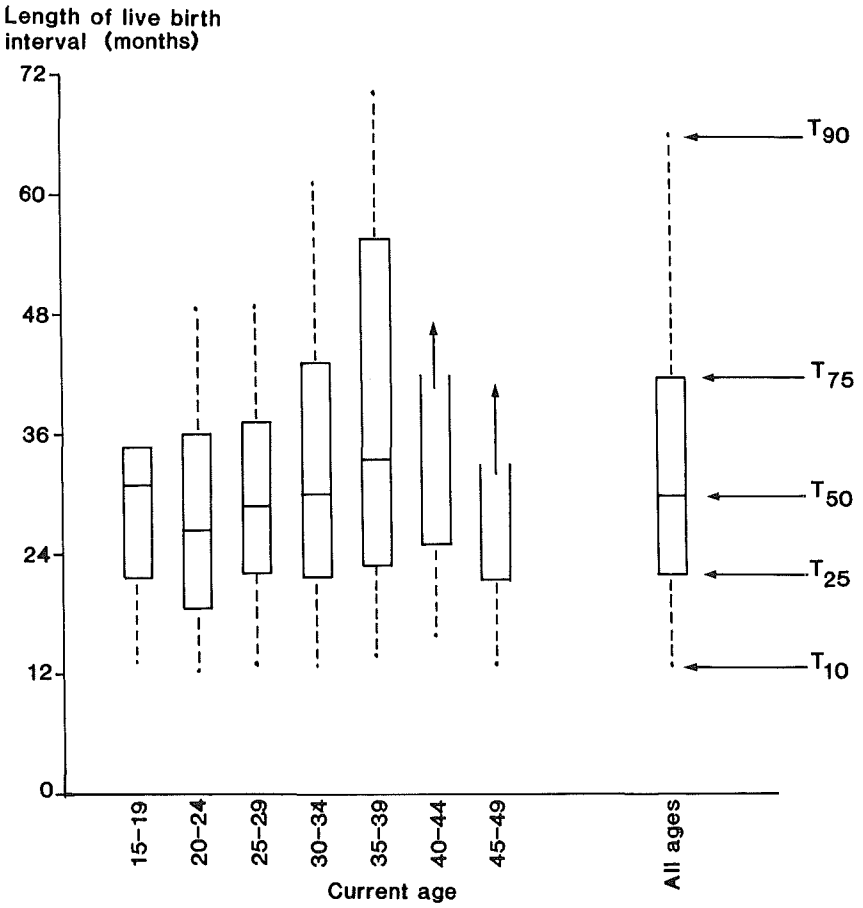

Figure 4 Length of live birth interval (in months), by current age of mother

Table 8 Median length of live birth interval (in months) and per cent of intervals closed in six years,[a] by current age of mother: differentials between subgroups

Subgroup	Current age of mother					
	15–24			25–34		
	Median duration	Per cent closed	N	Median duration	Per cent closed	N
Literate	26.5	96.7	288	27.5	92.3	487
Illiterate	25.4	96.3	766	28.2	94.6	1749
Urban	25.1	92.0	280	28.3	90.3	602
Rural	25.6	97.3	773	28.0	95.3	1634
	35–49			15–49 (all ages)		
	Median duration	Per cent closed	N	Median duration	Per cent closed	N
Literate	35.4	85.7	101	29.9	90.2	876
Illiterate	33.0	81.7	1135	29.2	90.5	3651
Urban	36.2	78.5	283	29.5	87.9	1165
Rural	32.5	81.8	954	28.7	91.5	3362

[a]Estimated using life-table methods, using all intervals started in the six years preceding the survey.

cent of all intervals were closed within the six years preceding the survey.

Classifying the data according to age groups shows younger women (those aged between 20 and 29 years) experiencing shorter birth intervals. Also, a higher percentage of their intervals are closed in the six-year period. Among the older women (those aged over 40), it is probable that few of the intervals that are not closed within the six years are ever going to be closed. It is quite likely that most will remain open as the women near the end of their fecund life, and become menopausal.

When the data are considered by subgroups (ie literacy and type of place of residence) and by broader age groups (table 8), some differences are observed. They do not, however, appear significant. As expected, literate and urban women show consistently shorter birth intervals than their illiterate and rural counterparts. Interval length also increases with advancing age.

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

Post-partum variables and measurements of their duration

The post-partum non-susceptible period is usually measured by the period of post-partum amenorrhoea. Its duration depends principally on the duration of frequent and intense breastfeeding and varies from $1\frac{1}{2}$–2 months on average where breastfeeding is not prolonged, to 18 months or more where breastfeeding is frequent and unsupplemented.

In most societies, resumption of sexual activity is not immediate after a birth; there is usually some period of abstinence. If the duration of abstinence is longer than the duration of amenorrhoea it adds to the length of a birth interval and thus affects fertility. It has no effect if it is shorter than the period of amenorrhoea. Strictly speaking, the months added by post-partum abstinence after the end of amenorrhoea should not be regarded as part of the non-susceptible period, since the woman is then susceptible. For the convenience of this analysis, however, amenorrhoea and abstinence will be treated in the same way because both start at the moment of delivery, and they cover partially overlapping time periods. In this analysis, we will estimate the overall post-partum non-susceptible/non-exposed period (nsp/nep) which is defined for each birth as whichever is longer – the period of post-partum abstinence or post-partum amenorrhoea.

In the survey, detailed questions were asked on the post-partum variables for the two most recent pregnancies. In this section, estimates are derived using the current status data (ie whether or not the woman is still amenorrhoeic, still breastfeeding, still abstaining since the birth in question). The current status data can be derived or can be inferred for all births, and the use of current status data makes the computation of mean durations and quantiles possible if the proportion in the state (pd) is regarded as corresponding to the survivor function (1x) of a life table.

At national level we have estimated not only the quantiles and trimeans but also the arithmetic mean and the prevalence/incidence ratio. For the subgroups we have estimated only the prevalence/incidence ratio since small sample sizes make it difficult to estimate reliably the quantiles and the other measures.

The arithmetic mean (or survival mean) is defined as:

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

where:

p(d) is the proportion still in the post-partum condition for the birth that occurred d months ago; and
E(o) is the proportion that started out in this condition for the births concerned. This is unity for amenorrhoea and abstinence. For breastfeeding it is the proportion ever breastfed.

The prevalence/incidence 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.

In our analysis, births occurring in the last 24 months were used. It should be noted that the prevalence/incidence mean assumes a constant stream of births, an assumption that is not always warranted. (For details of the methodology, see Ferry and Page 1985.)

Post-partum amenorrhoea

Most women know whether they have resumed menstruation since their last pregnancy although a few may be uncertain because of spotting or irregular bleeding. Information on amenorrhoea in the open interval is derived from question **513** (see Ministry of National Planning 1981, for the questionnaire). Table 9 and figure 5 give data on post-partum amenorrhoea for broad age groups. We used broad, rather than the five-year, age groups because the monthly occurrence of births to sample women is quite small and the proportions of women in a post-partum state by month would be subject to pronounced fluctuations. We also present the subgroup results as prevalence/incidence ratios. The estimated median duration of amenorrhoea is fairly short, about nine months. The comparable trimean, mean and prevalence/incidence ratio are 9, 11 and 12 months respectively. The median duration is shorter for births to younger women (aged 15–24) than for the older age groups (25–34 and 35–49). When only those children who are still surviving at the time of the interview are considered (second panel of table 9), the estimates are higher. This is to be expected since women who gave up breastfeeding following the death of the child are excluded. The median duration of amenorrhoea when only surviving births are considered is 3.4 months higher than for all births.

Table 9 Duration of post-partum amenorrhoea (in months), by current age of mother

Current age of mother	Estimates based on births in last three years							
	Quantiles[a]					Average duration		Prevalence/ incidence estimate of mean duration
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
I All live births								
15–24	1.2	2.6	8.6	14.2	19.7	8.5	9.6	10.8
25–34	1.0	3.1	13.0	17.3	19.3	11.6	11.7	12.5
35–49	0.5	2.1	13.4	15.3	21.6	11.1	10.4	11.2
15–49	0.8	2.6	8.8	16.1	19.9	9.1	10.8	11.7
II Children still surviving at time of survey								
15–24	1.0	2.8	8.8	14.7	21.7	8.8	10.3	[b]
25–34	0.7	3.6	15.2	17.4	23.9	12.8	12.2	[b]
35–49	0.5	2.3	13.9	15.6	21.7	11.4	11.1	[b]
15–49	0.7	3.1	13.2	16.4	23.4	11.5	11.5	[b]

[a] T_x indicates the estimated duration by which x per cent of the women have resumed menstruation after the births in question, based on current status data.
[b] Not estimated because the assumption of a constant stream of births is violated.
NOTE: All T_x values obtained after the data was smoothed by three-month moving average.

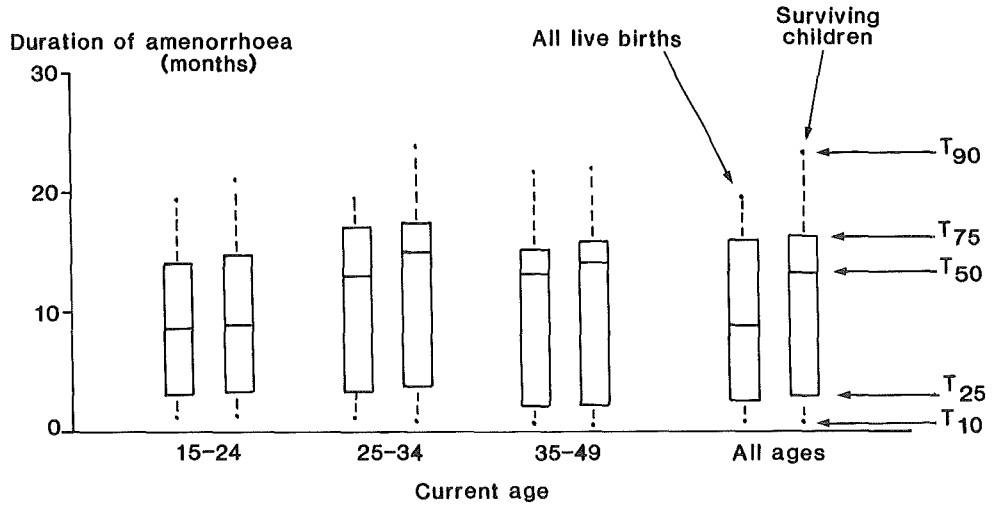

Figure 5 Duration of post-partum amenorrhoea (in months), by current age of mother

Looking at the data for subgroups (table 10), we see marked differences, with literate and urban women having consistently shorter durations than their illiterate and rural counterparts. This is not surprising since illiterate and rural women are more likely to uphold traditional methods like prolonged breastfeeding (which influences amenorrhoea) than the literate and urban residents.

Breastfeeding

The duration of amenorrhoea depends largely on the extent and duration of full breastfeeding. Full breastfeeding here is taken to mean that breastmilk is the sole form of food a child receives; partial breastfeeding is used to indicate that the breast milk is supplemented by other foods. However, in the survey, the questions on breastfeeding were vague and it was up to the respon-

Table 10 Mean duration of amenorrhoea (in months),[a] by current age of mother: selected subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Literate	9.2	8.6	(7.1)	8.7
Illiterate	11.2	13.2	11.5	12.2
Urban	8.8	9.5	(7.1)	8.8
Rural	11.3	13.2	12.3	12.4

[a] Estimated for births in the 24 months preceding the survey as the prevalence/incidence ratio.
NOTE: Figures in parentheses indicate fewer than 30 live births in the period.

dents to make their own decisions on the meaning of the questions:

507 Now I would like to ask you about the period since the birth of _____ (Name of last child, or 'Your most recent child who later died'). Did you breastfeed _____(Name of last child, or 'Your most recent child')?

Yes [1] No [2]
(Skip to 511)

508 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 [86] (Skip to 510) Until he/she died [87] (Skip to 510)

509 After _____ months had you completely stopped breastfeeding your child even once a day?

Yes [1] No [2]
(Correct 508 as necessary then proceed to 510)

510 How many months old was the child when you began giving him/her additional food along with breastfeeding?

_____ (Months) No additional food given yet [86] Child died before given other food [87]

The questions on breastfeeding in the last closed pregnancy interval were:

537 Now I would like to ask you about the period after the birth of _____ (Name of next-to-last child, or 'Your next-to-last child'). Did you breastfeed _____ (Name of next-to-last child, or 'Your child born before your last child')?

Yes [1] No [2]

538 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 [86] (Skip to 540) Until he/she died [87] (Skip to 540)

539 After _____ months had you completely stopped breastfeeding your child even once a day?

Yes [1] No [2]
(Correct 538 as necessary then proceed to 540)

540 How many months was the child when you began giving him/her additional food along with breastfeeding?

_____ (Months) No additional food given yet [86] Child died before given other foods [87]

Table 11 and figure 6 present estimates for partial breastfeeding by broader age groups. Overall, about 92 per cent of all live births, and nearly 100 per cent of all surviving births, were breastfed. Fifty per cent of all live births are weaned after 17 months, the same age as for surviving births. Half of all live births are not given supplementary food until after 4.5 months (table 12 and figure 7) and 5.0 months for children still surviving at the time of the survey (see medians or T_{50}). Less than 10 per cent of all live births and of still surviving births were fully breastfed longer than 11 and 15 months respectively.

Tables 13 and 14 summarize the estimates for partial

Table 11 Duration of breastfeeding (in months), by current age of mother

Current age of mother	Per cent breastfed	Estimates based on births in last three years							
		Quantiles[a]					Average duration		Prevalence/ incidence estimate of mean duration
		T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
I All live births									
15–24	0.920	7.3	11.6	14.3	18.7	24.5	14.7	16.3	16.3
25–34	0.942	7.1	12.5	17.4	19.0	23.8	16.6	17.1	17.3
35–49	0.876	7.0	9.3	17.3	24.6	25.7	17.1	18.6	17.1
15–49	0.919	7.2	11.9	16.7	19.2	25.2	16.1	17.2	16.9
II Children still surviving at time of survey									
15–24	0.997	7.6	12.2	14.8	19.1	24.7	15.2	16.4	[b]
25–34	0.994	8.5	13.6	17.6	19.4	23.9	17.1	17.1	[b]
35–49	0.995	7.3	13.2	18.2	24.7	25.9	18.6	17.8	[b]
15–49	0.995	7.9	13.0	17.2	19.6	25.4	16.7	17.1	[b]

[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] Not estimated because the assumption of a constant stream of births is violated.
NOTE: All T_x values obtained after the data was smoothed by three-month moving average.

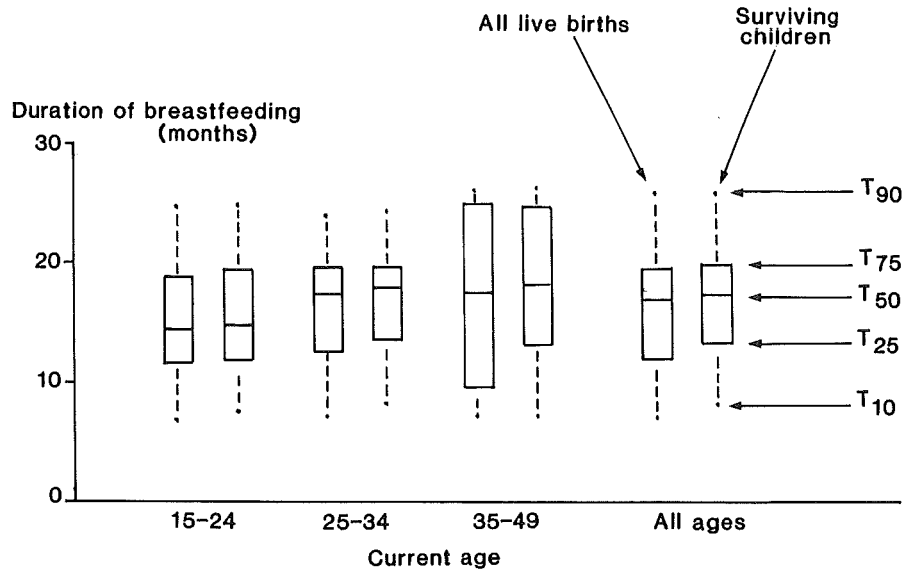

Figure 6 Duration of breastfeeding (in months), by current age of mother

Table 12 Duration of full breastfeeding (in months), by current age of mother

Current age of mother	Per cent breastfed	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	
I All live births									
15–24	0.920	1.2	3.0	4.2	5.3	7.0	4.2	5.4	6.5
25–34	0.942	1.1	3.0	4.8	8.9	15.3	5.4	6.4	6.6
35–49	0.876	0.8	2.4	4.4	7.4	8.7	4.7	6.4	6.1
15–49	0.919	1.0	2.9	4.5	7.4	10.9	4.8	6.2	6.5
II Children still surviving at time of survey									
15–24	0.997	2.3	3.3	4.3	5.5	10.6	4.4	5.4	[b]
25–34	0.994	1.2	3.1	5.1	9.0	15.4	5.6	6.4	[b]
35–49	0.995	1.4	2.6	4.5	7.4	8.8	4.8	6.1	[b]
15–49	0.995	1.5	3.1	4.9	7.6	14.8	5.1	6.1	[b]

[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.
[b] Not estimated because the assumption of a constant stream of births is violated.
NOTE: All T_x values obtained after the data was smoothed by three-month moving average.

and full breastfeding by literacy and type of place of residence subgroups. Both partial and full breastfeeding are shorter among the literate and urban women. The difference, however, is not marked.

Post-partum abstinence

The questions on post-partum abstinence in the open interval took essentially the same form as those on amenorrhoea. They were as follows:

511 For how many months after the birth of this child did you go without sexual relations?

____ (Days) ____ (Months) Not started ☐86☐ (Skip to 513) 40 Days ☐87☐ (Skip to 513)

512 Try to remember whether the interval without sexual relations was exactly 40 days or less or more?

____ (Days) ____ (Months) 40 Days ☐87☐
(Probe well and record interval)

The questions in closed interval were:

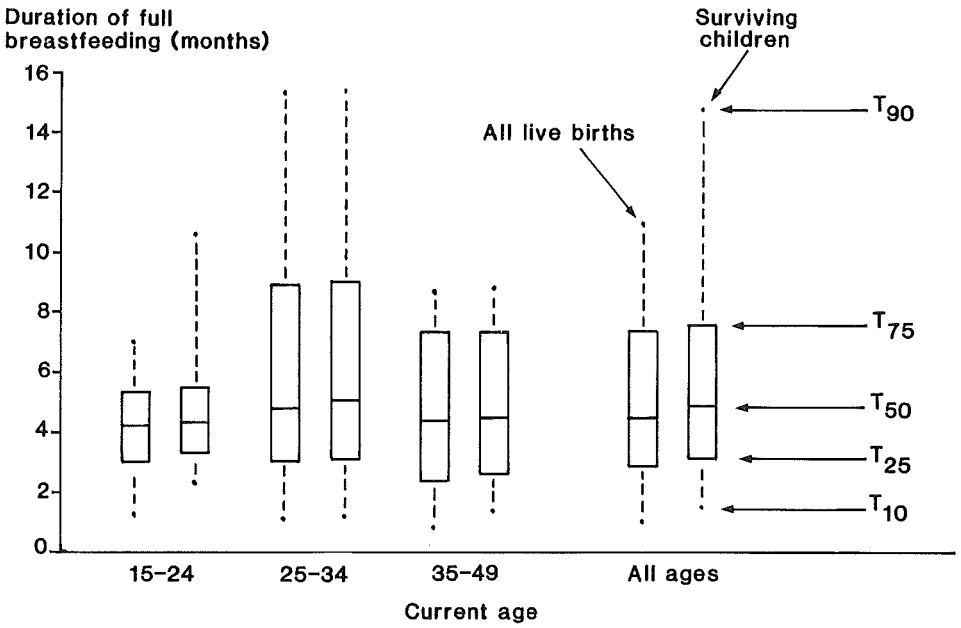

Figure 7 Duration of full breastfeeding (in months), by current age of mother

Table 13 Mean duration of breastfeeding (in months),[a] by current age of mother: selected subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Literate	15.6	16.7	(16.3)	16.1
Illiterate	16.6	17.3	17.4	17.2
Urban	15.5	15.3	17.5	17.0
Rural	16.5	17.8	17.4	17.3

[a]Estimated for births in the 24 months preceding the survey, as the prevalence/incidence ratio.
NOTE: Figures in parentheses indicate fewer than 30 live births in the period.

Table 14 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
Literate	5.5	4.6	(4.1)	5.0
Illiterate	7.0	7.1	6.3	6.9
Urban	(5.9)	5.8	(6.1)	5.9
Rural	6.7	6.8	5.4	6.7

[a]Estimated for births in the 24 months preceding the survey, as the prevalence/incidence ratio.
NOTE: Figures in parentheses indicate fewer than 30 live births in the period.

Table 15 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]					Average duration		Prevalence/ incidence estimate of mean duration
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
I All live births								
15–24	0.3	0.8	1.5	2.5	4.6	1.6	2.5	3.3
25–34	0.3	0.7	1.4	2.6	5.5	1.5	2.6	2.8
35–49	0.3	0.7	1.4	2.3	8.4	1.5	2.8	3.2
15–49	0.3	0.7	1.4	2.4	5.7	1.5	2.1	3.1
II Children still surviving at time of survey								
15–24	0.3	0.7	1.6	2.5	5.0	1.6	2.4	[b]
25–34	0.3	0.7	1.4	2.6	5.7	1.5	2.7	[b]
35–49	0.3	0.6	1.3	2.1	8.5	1.3	2.9	[b]
15–49	0.3	0.7	1.4	2.4	6.0	1.5	2.7	[b]

[a]T_x indicates the estimated duration by which x per cent of women have resumed sexual relations after the births in question, based on current status data.
[b]Not estimated because the assumption of a constant stream of births is violated.
NOTE: All T_x values obtained after the data was smoothed by three-month moving average.

541 For how long 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?

____ _____
(Days) (Months)

542 Try to remember whether the interval without sexual relations was exactly 40 days or less or more?

____ _____ 40 Days [87]
(Days) (Months)

It is generally accepted that Muslim populations do not observe long periods of post-partum abstinence. Islamic doctrine anticipates that bleeding after childbirth stops after 40 days and that sexual activity can be resumed after that. The results of the estimates of post-partum abstinence summarized in table 15 and figure 8 are not at variance with this view. Fifty per cent of the respondents stated that sexual activity resumed 1.4 months after childbirth (see median or T_{50}) and the duration was the same when dead children were excluded. Fewer than 10 per cent of the women stated they resumed sexual relations six months or more after childbirth. There is very little variation across age groups.

The combined impact of post-partum amenorrhoea and abstinence

We have seen that the period of post-partum abstinence is much shorter than the duration of post-partum amenorrhoea so that its overall contribution to the birth interval is small. Table 16 summarizes the combined effects of post-partum amenorrhoea and abstinence. Fifty per cent of the respondents resumed both menstruation and sexual relations after 10 months for all live births and 13 months for still surviving births. Ten per cent resumed both within one month and fewer than 10 per cent after 20 and 24 months for all live and still surviving births respectively. In all cases younger women (in the age group 15–24) resumed menstruation and sexual intercourse earlier than older women (aged 25 and over).

Table 17 gives data for subgroups. As with amenorrhoea, literate and urban residents experience shorter durations of nsp/nep periods than their illiterate and rural counterparts.

3.4 THE EXPOSURE INTERVAL AND ITS DETERMINANTS

Estimation of the exposure interval

The duration of exposure within the interval between successive live births is hard to estimate from our data, because no direct questions were included in the questionnaire. We therefore have to estimate the exposure interval as the period which is left unexplained by our other estimates. Another difficulty is that if we include any currently open intervals to the exposure interval we would be adding an unknown proportion of intervals that will never be closed, which would lead to a serious overestimate of our exposure interval. On the other hand, if we were to restrict our analysis to closed birth intervals alone, then short birth intervals would be overrepresented and hence result in a downward bias. This problem did not arise in the analysis of the post-partum variables because even for the intervals that will never close the women cannot remain indefinitely in the post-partum state.

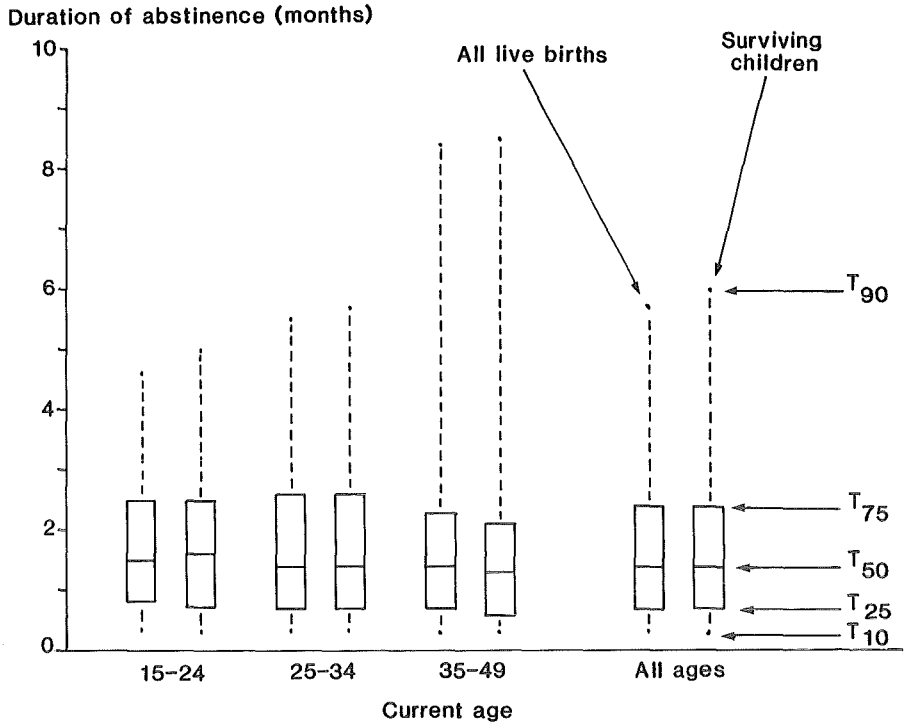

Figure 8 Duration of post-partum abstinence (in months), by current age of mother

Table 16 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							
	Quantiles[a]					Average duration		Prevalence/ incidence estimate of mean duration
	T_{10}	T_{25}	T_{50}	T_{75}	T_{90}	Trimean	Mean	
I All live births								
15–24	1.2	2.8	8.8	14.5	19.8	8.7	9.8	11.1
25–34	1.1	3.6	13.0	17.7	19.4	11.8	12.3	13.1
35–49	0.6	2.8	13.6	15.5	23.5	11.4	11.2	11.9
15–49	1.0	3.2	9.6	16.5	19.9	9.5	11.3	12.2
II Children still surviving at time of survey								
15–24	1.3	3.2	8.9	14.8	23.4	9.0	10.4	[b]
25–34	1.1	4.4	15.3	17.8	24.6	13.2	12.8	[b]
35–49	0.6	5.8	14.0	15.7	23.5	12.4	11.9	[b]
15–49	1.0	3.9	13.3	16.8	23.6	11.8	11.9	[b]

[a] T_x indicates the estimated duration by which x per cent of the women have resumed both menstruation and sexual relations after the births in question, based on current status data.
[b] Not estimated because the assumption of a constant stream of births is violated.
NOTE: All T_x values obtained after the data was smoothed by three-month moving average.

Table 17 Mean duration of combined non-susceptible/non-exposed period (in months),[a] by current age of mother: selected subgroups

Subgroup	Current age of mother			
	15–24	25–34	35–49	All ages
Literate	10.0	9.2	(9.2)	9.4
Illiterate	11.5	13.8	12.1	12.7
Urban	9.2	9.9	(8.2)	9.4
Rural	11.6	13.9	12.9	13.0

[a] Estimated for births in the 24 months preceding the survey, as the prevalence/incidence ratio.
NOTE: Figures in parentheses indicate fewer than 30 live births in the period.

Two ways of estimating the exposure interval can be attempted. The first method is based on intervals started in the recent past and makes use of the prevalence/incidence estimate procedures which we have already used for the post-partum variables.

The mean duration of the exposure interval is estimated as:

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

where:

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

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

If there has been a constant stream of births it is reasonable to assume that the number of mothers who become exposed again by reaching the end of post-partum amenorrhoea and abstinence is roughly constant. In this case the number of births per month can be assumed to approximate I in the equation.

P is estimated as the number of women who have had at least one child, who are neither currently in post-partum amenorrhoea or abstinence nor currently pregnant. It excludes those who are never going to close their current birth interval – namely those who reported themselves as menopausal, or infecund, sterilized or those practising terminal abstinence. P is likely to be overestimated for two reasons. First, the proportion reporting themselves as currently pregnant is usually too low, particularly for the first few months of pregnancy. Secondly, the indicators available from which we estimate the numbers who will never bear another child, lead to an underestimate of the number of intervals that will never be closed. The results are presented in tables 18 and 19. The overall estimated exposure interval is 17.4 months with younger women (aged 15–24) having a shorter exposure interval than the 25–34 age group. This is about 4–5 months higher than one might expect in a population with no evidence of widespread fecundity impairment or of unusually high foetal wastage and with very little use of contraception. The figure for 35–49 age group is clearly unrealistic and faulty and yields a biased overall mean.

The second method estimates the duration of exposure interval simply by taking the last closed birth or pregnancy interval for each woman and subtracting from the length of that interval nine months for gestation and the

Table 18 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	11.2	12.0
25–34	14.5	16.3
35–49	32.9	16.8
15–49	17.4	15.4

[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 or having other fecundity impairment, sterilized or terminally abstaining.
[b](Closed birth interval) – (9) – (retrospectively reported durations for whichever was longer, post-partum amenorrhoea or post-partum abstinence).

Table 19 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
Literate	11.3	20.0	44.9	18.2
Illiterate	11.1	13.0	32.2	17.2
Urban	13.2	19.5	46.8	22.4
Rural	10.4	12.6	29.7	15.7

[a]Estimated for birth intervals started in the 24 months preceding the survey.

duration the woman reported for whichever was longer – post-partum amenorrhoea or post-partum abstinence. The results in the second column of table 18 show that this method consistently overestimates the durations of exposure intervals.

Information on the proximate determinants of exposure interval

The period of exposure was defined as the total length of time between the beginning of the interval and the date of the next conception, minus the period of non-exposure. This will include the waiting time to conception and any time lost as a result of foetal wastage. The former depends on both fecundability – defined as the probability of conception in one menstrual cycle – and on exposure to the risk of conception. The waiting time to conception will depend not only on fecundability but also on temporary separations of couples, and on the use of contraception to prevent pregnancy. This, however, depends on the effectiveness of the method used.

One of the determinants of fecundability is frequency of sexual intercourse. In the SUDFS, however, no question was asked on this subject. Contraceptive use in North Sudan, as we saw earlier, is generally of little significance on the tempo of women's fertility and the proportion of women who used contraception before the first pregnancy is very small. Long periods of separation of couples may have a significant impact on the exposure interval. However, such separations may, in part, overlap with the periods of pregnancy and post-partum status. In the SUDFS about 96 per cent of the women were continuously married throughout the last closed pregnancy interval so that this factor can be disregarded as a possible influence on Sudanese fertility.

3.5 CONCLUSIONS

Birth intervals in the Sudan average about 2.5 years in length. Older women have larger intervals than the younger ones. The major factor influencing the length of birth intervals is breastfeeding which averages about 17 months and results in an amenorrhoeic non-exposed period of about 11 months. Urban and literate women have shorter durations of breastfeeding and consequently shorter durations of post-partum amenorrhoea. Post-partum abstinence plays a very minor role in influencing the length of the non-susceptible period as do contraception and temporary marital disruptions.

4 Patterns of Stopping Family Formation

4.1 INTRODUCTION

This section is concerned with the timing of the final birth. We will examine the proximate determinants of age at which women have their final birth, which is determined by the age at which they become infecund (either through menopause, secondary sterility or sterilization); the age at which they stop having sexual relations (either through terminal abstinence within marriage or definitive widowhood, divorce or separation); the use of contraception to prevent any more births; and the prevalence of abortion.

The analysis will be restricted to older women in the age range 45–49 who have gone through most of their reproductive experience. This restriction to older women only is due to the fact that most younger women will not have acquired the characteristics that signal the end of their childbearing, although a few younger women may have been sterilized. Even among the older cohort (45–49), there are constraints. Not all the women in the cohort will have stopped childbearing completely; a few, especially the younger ones, will have another child before reaching their 50th birthday. In such circumstances, therefore, we cannot be certain about any of the proximate determinants marking the end of a woman's childbearing. We could probably be certain if a woman was sterilized, but data for the SUDFS show that only 0.3 per cent of the currently married women reported themselves as sterilized, so that the impact of this factor on the end of childbearing is negligible. Widowhood/divorce/separation accounts for only 3.7 per cent of women. Moreover, union dissolution through widowhood, divorce or separation does not necessarily prevent a woman's continued sexual activity or remove the risk of childbearing permanently. This will largely depend on her fecundity status (ie if she is too old to have another child). For the other stopping variables – menopause and terminal abstinence – we have to rely on the information provided by the woman based on her own perception that she has reached the end of her reproductive period (for instance, that she is practising terminal abstinence or convinced she is post-menopausal).

4.2 AGE AT LAST LIVE BIRTH

Age at most recent birth was recorded for all ever-married women in the SUDFS. For most of the women in the oldest age group (45–49), their recorded most recent birth will also be their last birth, although the younger women in the cohort may go on to have another child. In order to allow for the continued childbearing of these younger women until around age 49 or 50, using the distribution of the oldest age, we adjust the distribution by age at most recent birth for the youngest cohort. This method is described in detail elsewhere (see Ferry and Page 1985).

Table 20 presents data for the most recent birth (recorded) and last birth (estimated). With a recorded

Table 20 Age at last birth (women aged 45–49), 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)
11	0.3	0.3
12	0.6	0.5
13	0.6	0.5
14	0.8	0.8
15	1.1	1.1
16	1.7	1.6
17	1.7	1.6
18	0.6	0.5
19	0.9	0.8
20	2.2	2.2
21	0.6	0.6
22	0.8	0.8
23	0.6	0.5
24	0.9	0.8
25	0.6	0.5
26	1.1	1.1
27	1.7	1.6
28	3.1	2.9
29	1.1	1.0
30	3.1	2.9
31	2.3	2.2
32	3.1	2.9
33	3.6	3.4
34	2.8	2.6
35	3.3	3.1
36	5.9	5.5
37	10.7	9.9
38	7.1	6.6
39	3.1	2.9
40	5.0	4.8
41	2.5	2.4
42	5.3	4.9
43	4.7	4.4
44	9.3	8.6
45	4.5	5.5
46	1.1	1.1
47	1.1	6.1
48	0.0	0.0
49	0.0	0.0
Mean age in years	34.7	35.4

Table 21 Age at last birth (women aged 45–49), recorded per cent distribution by age at most recent birth and estimated per cent distribution by age at last birth, in five-year age groups

Age at the birth	Most recent birth (recorded)	Last birth (estimated)
I Sudan		
10–14	2.3	2.1
15–19	6.0	5.6
20–24	5.1	4.9
25–29	7.6	7.1
30–34	14.9	14.0
35–39	30.1	28.0
40–44	26.8	25.1
45–49	6.7	12.7
Mean age in years	34.7	35.4
II Other countries		
Syria	38.0	38.9
Lesotho	34.9	36.0
Kenya	39.4	40.4
Ghana	37.7	38.8
Philippines	37.3	38.0

mean age at most recent birth of 34.7 years and an adjusted or estimated mean age of last birth of about 35.4, Sudanese women have their last birth earlier than any country in Africa for which a similar analysis has been done and also lower than the mean estimated for Syria and the Philippines (see bottom rows of table 21).

About 28.0 per cent of the women had their last birth between ages 35 and 39 and a quarter had their last birth between ages 40 and 44.

Analysis for subgroups was only done for rural and illiterate women, since only a small number of women in the 45–49 cohort are either literate or living in urban areas. The apparent lack of difference between those two categories in the mean age at last birth (table 22) indicates the high degree of overlap between the two subgroups (ie illiterate women reside mainly in rural areas).

4.3 INFORMATION ON THE PROXIMATE DETERMINANTS OF AGE AT LAST BIRTH

The end of the fecund span

Data on the current fecundity status of each woman were collected from questions which included the respondent's perception of whether she could bear another child and whether she or her husband had been sterilized. No direct question on menopause was asked but information on whether a woman was menopausal was derived from the question on whether the woman was still menstruating. The actual question used in the SUDFS was:

Do your periods usually come at regular intervals?

Yes [1] No [2] No longer menstruating [3]

Table 22 Age at last birth (women aged 45–49), recorded per cent distribution by age at most recent birth and estimated per cent distribution by age at last birth: rural and illiterate subgroups

Age at the birth	Rural		Illiterate	
	Most recent birth (recorded)	Last birth (estimated)	Most recent birth (recorded)	Last birth (estimated)
11	0.0	0.0	0.3	0.3
12	0.8	0.7	0.6	0.5
13	0.8	0.7	0.6	0.5
14	0.8	0.8	0.3	0.3
15	1.6	1.5	1.3	1.1
16	2.5	2.2	1.8	1.7
17	1.6	1.4	1.1	1.1
18	0.8	0.7	0.6	0.5
19	0.8	0.8	0.9	0.9
20	3.2	3.1	2.3	2.2
21	0.8	0.8	0.6	0.6
22	0.8	0.7	0.9	0.8
23	0.8	0.7	0.6	0.5
24	0.8	0.8	0.9	0.8
25	0.0	0.0	0.3	0.3
26	1.6	1.4	1.2	1.1
27	1.6	1.5	1.5	1.4
28	3.2	3.1	3.2	3.1
29	0.8	0.7	0.9	0.8
30	1.6	1.4	3.2	3.0
31	1.6	1.5	2.0	2.0
32	1.6	1.5	3.2	3.0
33	4.0	3.6	3.8	3.5
34	1.6	1.4	2.7	2.5
35	2.4	2.2	3.5	3.2
36	4.9	4.4	6.2	5.7
37	11.3	10.3	10.6	9.9
38	7.2	6.6	6.4	6.0
39	4.1	3.7	3.2	3.0
40	4.8	4.5	5.2	5.0
41	1.6	1.5	2.4	2.2
42	4.9	4.4	5.6	5.2
43	5.7	5.2	5.0	4.7
44	12.1	10.9	9.6	9.0
45	4.8	5.7	4.7	5.7
46	0.8	0.0	1.2	1.1
47	1.6	9.6	1.2	6.1
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
Mean age in years	35.1	36.0	35.0	35.7

Table 23 presents data on the fecundity status of all ever-married women. In all, about 86.7 per cent of ever-married women reported themselves fecund for various reasons. This percentage varies with age, declining from 96.6 per cent among women aged 20–24 to 23.2 per cent among those aged 45–49. About 9.4 and 3.4 per cent stated they were definitely 'infecund not menopausal'

Table 23 Per cent distribution of all currently married women according to self-reported fecundity status

Current age	Fecund	Infecund, not menopausal	Infecund, menopausal	Sterilized	Menarche not reached	Total	Number of women
I Sudan							
15–19	96.1	2.0	0.0	0.0	2.0	100.0	225
20–24	96.6	3.4	0.0	0.0	0.0	100.0	487
25–29	94.9	4.7	0.2	0.2	0.0	100.0	671
30–34	91.7	7.6	0.4	0.3	0.0	100.0	467
35–39	85.3	11.3	2.3	0.8	0.2	100.0	526
40	68.9	22.0	9.2	0.0	0.0	100.0	173
41	78.9	15.8	5.3	0.0	0.0	100.0	24
42	66.7	27.5	5.9	0.0	0.0	100.0	32
43	76.5	11.8	11.8	0.0	0.0	100.0	11
44	42.9	28.6	28.6	0.0	0.0	100.0	13
45	55.0	23.9	20.2	0.0	0.0	100.0	138
46	54.5	45.5	0.0	0.0	0.0	100.0	7
47	12.5	41.7	41.7	4.2	0.0	100.0	15
48	37.2	30.2	32.6	0.0	0.0	100.0	27
49	23.2	35.7	41.1	0.0	0.0	100.0	38
Total	86.7	9.4	3.4	0.3	0.2	100.0	2854
II Other countries							
Syria	87.7	8.4	3.6	0.4			
Lesotho	86.0	10.9	2.3	0.9			
Kenya	66.5	6.3	4.4	0.9			
Philippines	73.5	6.3	4.7	5.3			

Source: Table 6.7.2, Ministry of National Planning (1981), volume II

Table 24 Reported percentages with a characteristic suggesting that their fecund period is over, by age: all ever-married women

Current age	Self-reported infecundity (non-menopausal)	Menopausal	Sterilized	No birth in the last five years[a]	Any one or more of the characteristics
15–19	2.0	0.0	0.0	0.0	1.9
20–24	3.4	0.4	0.0	3.2	5.4
25–29	4.9	0.3	0.2	6.4	10.0
30–34	8.0	0.4	0.3	14.6	19.3
35–39	13.4	2.3	0.9	19.3	29.0
40–44	30.7	9.2	0.0	37.2	54.5
45–49	47.7	25.3	0.1	48.7	73.4
Estimated age at acquiring the characteristic	44.5[b]	48.1[c]	49.9[d]	43.6[b]	40.5[b]
Observed or assumed percentage	100.0	100.0	0.4	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).
[d]Average years lived without acquiring the characteristic assuming that no one acquires the characteristic beyond age 50.

and 'infecund menopausal' respectively, these percentages increasing with age. It is surprising that no one expressed uncertainty about her fecundity status; this is probably due to over-confidence, especially among the old women. Sterilization plays a very minor or non-existent role in the stopping pattern of childbearing among the Sudanese women (only 0.3 per cent) as elsewhere – comparable figures are Syria (0.4 per cent), Lesotho (0.9 per cent) and Kenya (0.9 per cent).

In table 24 data are presented for various indicators such as terminal infecundity, self-reported infecundity, menopausal status, sterilization status, whether a

woman has had no births in the last five years and whether a woman possesses any one or more of the characteristics of infecundity. The estimated mean ages at acquiring each attribute are shown in the penultimate row of the table.

On average, Sudanese women reach menopause at around 48 years, nearly four years higher than the mean age of self-reported infecundity and about four to five years higher than that indicated by the proportions of women who had had no birth in the last five years of exposure. The average age at becoming infecund due to any cause is about 40.5 years (as shown in the last column of the table), clearly indicating that Sudanese women become infecund nearly eight years before reaching the menopause.

Differentials based on selected subgroups are shown in appendix tables A1, A2 and A3.

Age at terminating sexual relations

No direct data were collected on terminal abstinence in the SUDFS. This aspect can be approached by examining the age-specific proportions of ever-married women in the sample who are currently widowed, divorced or separated. This, however, is not a good method. Marriage in the Sudan is relatively unstable (about 17.5 per cent of all ever-married women reported dissolution of their first marriages). Remarriage, however, is also frequent and 60 per cent of the women whose first marriages were dissolved had remarried by the time of the survey (see Ministry of National Planning 1981, vol 1). This explains the low age-specific proportions of ever-married women who are widowed, divorced or separated, as presented in table 25. The proportions range from 0.0 per cent to 8.9 per cent between the 15–19 and 45–49 age groups respectively and yield a mean number of years spent without being widowed/divorced/separated of nearly 49. This implies that in a majority of cases women will probably remain sexually active up to and after their menopause. Tabulations for subgroups are presented in appendix table A4. However, in the absence of direct information on abstinence and sexual relations, these conclusions should be treated with some caution.

Table 25 Proportion reporting themselves widowed/divorced/separated and mean years spent without acquiring the characteristic: all ever-married women

Current age	Per cent reporting themselves widowed/divorced/separated	N
15–19	0.0	232
20–24	0.7	515
25–29	1.6	715
30–34	3.2	501
35–39	5.6	588
40–44	8.9	302
45–49	8.9	226
Mean years spent without acquiring the characteristic	48.6[a]	3081

[a]Assuming that no one acquires the characteristic beyond age 50.

Use of contraception to limit completed family size

The proportion of current users of contraception in Sudan is very small. Only 3.6 per cent of currently married women (who are not sterilized or terminally abstaining and not pregnant) were using efficient methods of contraception at the time of the survey and less than one per cent were using inefficient methods (table 26). Women in the 25–29 age group were users of more efficient methods (5.9 per cent) followed by those in 30–34 group (4.5 per cent). Since it may be assumed that many of these women would probably want more children, they were probably using contraception for spacing purposes. The older women (those in the 45–49 age group) reported no use of efficient methods, probably because they are more traditional in behaviour, the majority, if not all, are likely to be illiterate and rural residents, and they are convinced that they are infecund or no longer capable of producing more children. From such small age-specific proportions of current users, even among the young women, it can be concluded that contraception plays a minor role in limiting completed family size in Sudan, or no role at all.

4.4 CONCLUSION

The SUDFS data show that the average age of bearing the last child is slightly over 35 years, about a year lower than the estimate for Lesotho (36.0 years) and almost two years below the estimate for Syria (37.9 years). However, the process of childbearing continues into the forties and there is no indication that contraception is being used to limit their family size. Sterility is not an important fertility factor in Sudan. While duration of breastfeeding and amenorrhoea are the two major factors affecting fertility, the estimated low age at last birth may, in part, be due to errors in the data. It seems likely that older women in the 45–49 age group shifted the birthdate of their last birth backwards from the survey date. It is also possible that Sudanese women practice voluntary terminal abstinence as they get older, particularly when their first-borns get married or give birth to a child. However, in the absence of data on terminal abstinence or sexual relations we cannot draw firm conclusions on this.

Table 26 Reported percentages of women using contraception other than sterilization or terminal abstinence

Current age	Not using	Using inefficient method	Using efficient method	Number of women
15–19	95.8	0.8	3.4	225
20–24	96.3	1.4	2.2	487
25–29	93.4	0.8	5.9	671
30–34	95.0	0.5	4.5	468
35–39	97.0	0.9	3.6	522
40–44	96.3	0.4	4.1	255
45–49	99.7	2.3	0.0	195
Total	95.7	0.7	3.6	2824

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

5.1 INTRODUCTION

In the preceding chapters we have analysed in detail the part played by the proximate determinants at each stage of a woman's reproductive life. In what follows we try to relate the contribution of each proximate determinant of fertility to the levels of fertility of the population as a whole and of selected subgroups. The aim is to try to discover the interplay between the intermediate fertility variables and the overall level of fertility. This will be done by applying Bogaarts' model (1978). Unlike the previous chapters, however, here we use finer subgroups by education and type of place of residence. The main limitation we saw in the previous chapters of small sample size arising from the restriction of the analysis of stopping patterns to women aged 45–49, does not apply in this analysis. Thus, education is classified into categories no schooling, 1–3 years, 4–6 years and 7+ years of schooling. Type of place of residence is divided into major urban (mainly Khartoum), other urban and rural areas.

Bongaarts' original model specifies the relationship between the intermediate fertility variables and fertility level as:

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

where TFR is the total fertility rate, defined as the number of births a woman would have at the end of her reproductive life (legitimate children only) if she were to bear children at prevailing age-specific fertility rates and remain married throughout her reproductive span (ages 15–49). TF is the total potential fertility or total fecundity if all women remain married continuously between ages 15 and 49, used neither contraception nor induced abortion and did not breastfeed; C_m is the relative loss of potential fertility due to celibacy or not being continuously married between the ages of 15 and 49; C_c is the relative loss of potential fertility due to the use of contraception; C_a is the relative loss of potential fertility due to the practice of induced abortions; and C_i is the relative loss of potential fertility due to post-partum amenorrhoea, influenced by breastfeeding.

The model refers to a synthetic cohort, based on assumptions that the prevailing age-specific fertility pattern will be the same for the young women in the future and that marriage patterns and contraceptive use will remain unchanged throughout the reproductive spans of all cohorts. The model also assumes that in the absence of lactation (breastfeeding) and contraception the average interval between births is about 20 months. Of this, about 7.5 months represent the average waiting time to conception (ie menstruating interval based on the observed range of between five and ten months), 2.0 months are accounted for by spontaneous foetal loss and 1.5 months attributable to post-partum amenorrhoea in the absence of breastfeeding, and about 9.0 months represent the period of gestation. On this basis, the potential fertility of populations may vary within a narrow range of 13.5 to 17.5 births per woman, with an average of 15.3.

5.2 BONGAARTS' ORIGINAL MODEL APPLIED TO SUDANESE DATA

The indices obtained from equation (1) are:

$$C_m = TFR/TM \quad (2)$$
$$C_c = 1 - 1.08\,(u \times e) \quad (3)$$
$$C_i = 20/(18.5 + i) \quad (4)$$

The inputs of the Bongaarts' model to produce these indices are:

TFR, which equals the total fertility rate derived as the average of the age-specific fertility rates of the women aged 15–49 for the five years before the survey; and

TM is the total marital fertility derived from the age-specific fertility rates of ever-married women (marriage being defined to include all types of unions) aged between 15–49 for the five years before the survey.

The observed TFR and TM were taken as the fixed points for deriving the other indices. Both these rates are subject to errors that may be contained in the birth-history data and no effort is made to correct for such errors in the analysis.

C_c is the index of contraception in equation (1), and consists of u and e, which equal the average proportion of married women currently using contraception (or weighted average age-specific use rates) and average contraceptive effectiveness (average of use effectiveness levels by method) respectively.

i is the mean duration of combined post-partum amenorrhoea and post-partum abstinence (for all births regardless of their survival status) and is calculated by the prevalence/incidence (P/I_{24}) ratio method.

C_a (which measures the relative loss of potential fertility due to induced abortion) was assumed to be absent due to lack of data and therefore set to 1.00.

The results of the application of the Bongaarts' model are presented in table 27. The overall TFR (total fertility rate) for Sudan is about six children per woman. The overall index of non-marriage, C_m is 0.701 indicating

Table 27 Estimate of indices of intermediate fertility variables using Bongaarts' model: total and selected subgroups

Characteristics	TFR	TM	u	e	i[a]	C_m	C_c	C_i[b]	Implied TF_1
Total	5.934	8.47	0.038	0.872	12.24	0.701	0.962	0.653	13.48
Type of place of residence									
Rural	6.356	8.72	0.018	0.843	12.97	0.729	0.982	0.641	13.85
Other urban	5.589	8.78	0.059	0.889	9.87	0.737	0.933	0.709	13.27
Major urban	4.715	7.62	0.139	0.882	0.876	0.619	0.863	0.732	12.08
Level of education									
No schooling	6.383	8.28	0.014	0.871	12.84	0.771	0.987	0.642	3.07
1–3 years	5.634	8.32	0.085	0.873	9.56	0.677	0.913	0.717	12.71
4–6 years	5.098	8.34	0.152	0.875	10.18	0.611	0.891	0.704	13.30
7+ years	3.907	8.48	0.298	0.869	6.35	0.461	0.721	0.797	14.76

[a]Mean duration estimated from current status data by prevalence/incidence ratio method.
[b]Based on combined post-partum amenorrhoea and abstinence.

that total fertility is about 76 per cent of total marital fertility as a result of non-marriage. The index of contraception, C_c is 0.962 and implies that total marital fertility is 96 per cent of total natural fertility due to contraception. The index of the non-exposed/non-susceptible period, C_i, is 0.653, again implying that total natural fertility is 65 per cent of total fecundity as a result of post-partum non-susceptibility, basically influenced by breastfeeding. The estimated indices yield an implied total fecundity rate of 13.5, which can be interpreted to mean that on average a Sudanese woman who is continuously married throughout the reproductive ages 15–49, uses no contraception and no induced abortion and does not breastfeed, has the potential to produce 13.5 children.

Those women who live in rural areas and those with no schooling experience the highest fertility, slightly above the national average, while women residing in major urban and those with seven or more years of schooling have the lowest fertility with 4.7 and 3.9 children per woman respectively. The figures for the other urban, 1–3 years and 4–6 years of education subgroups fall between the two extremes. It seems that women residing in major urban and those with seven or more years of schooling use contraception to limit their family size.

Table 28 converts the indices in table 27 into the number of births averted as a result of non-marriage, contraceptive use and breastfeeding. Although there is a variation between subgroups in total fecundity, the range is not very substantial (only 2.7 children). The apparent deficit among the major urban and those with 1–3 years of schooling subgroups may be due to unreported abortion (both induced and spontaneous), which was not accounted for in the model. It is, however, evident from the table that breastfeeding averted more births than either celibacy or contraceptive use. In fact, as we saw in the preceding chapters, contraception is a very minor fertility factor in Sudan although its inhibiting impact is substantial among the minority of educated women residing in metropolitan Khartoum. Among the rural and the illiterate women breastfeeding averts about five births and non-marriage two, with contraception having little or no impact. The lower band of table 28 shows the percentage of potential fertility due to each of the intermediate fertility variables. Overall, 44 per cent of the potential fertility is due to observed fertility, 35 per cent attributable to breastfeeding, 19 per cent due to celibacy and only 2 per cent accounted for by contraception. Breastfeeding impact is greatest among the rural women (36 per cent) and among the illiterate (also 36 per cent), followed by women in other urban centres and with 4–6 years education (29 per cent) and those with 1–3 years of schooling (28 per cent). Non-marriage has an equal impact among the other urban, major urban and those with 4–6 years of schooling subgroups (24 per cent), with more educated women delaying marriage, a major factor in suppressing their potential fertility (31 per cent).

The main point to emerge from this analysis is that breastfeeding and consequent post-partum infecundability are the main constraints of potential fertility in Sudan, exerting greatest impact among rural and illiterate women. Among the educated women, however, celibacy exerts a greater suppressing effect on fertility with contraception and breastfeeding having more or less equal effects.

5.3 THE EXTENDED BONGAARTS' MODEL

Bongaarts' original model can be extended as:

$$TFR = TF \times (C_{em} \times C_{diss}) \times (C_{ster} \times C_{tab} \times C_{om}) \times (C_{ppam} \times C_{ppab})$$

In this extended model the indices in the original model are broken into finer components, as follows:

C_m is divided into the components:

C_{em} which measures the reduction in fertility as a result of delayed entry into union and proportions never married; and

C_{diss} which measures the reduction in fertility due to marital dissolution.

Table 23 Number of births averted as a result of non-marriage, contraception and breastfeeding: total and selected subgroups

Fertility indicator	Number of births averted by	Total	Rural	Other urban	Major urban	No schooling	1–3 years	4–6 years	7+ years
TFR		5.9	6.4	5.6	4.7	6.4	5.6	5.1	3.9
	Non-marriage	2.6	2.3	3.2	2.9	1.9	2.7	3.2	4.6
TM		8.5	8.7	8.8	7.6	8.3	8.3	8.3	8.5
	Contraceptive use	0.3	0.2	0.16	1.2	0.1	0.8	1.1	3.3
TNM		8.8	8.9	9.4	8.8	8.4	9.1	9.4	11.8
	Breastfeeding	4.7	5.0	3.9	3.3	4.7	3.6	3.9	3.0
TF		13.5	13.9	13.3	12.0	13.1	12.7	13.3	14.8
Factor		Per cent of potential fertility due to							
Observed fertility		44	46	42	39	49	44	38	26
Non-marriage		19	17	24	24	14	21	24	31
Contraceptive use		2	1	5	10	1	6	8	22[a]
Breastfeeding		35	36	29	27	36	28	29	20
Total		100	100	100	100	100	100	100	100

[a]Contraception is a major determinant of infertility among the educated.

Table 29 Estimates of indices of intermediate fertility variables using Bongaarts' extended model: total and selected subgroups

Characteristic	TFR	TMEM	TM	TNM	TF_{ppa}	Implied TF_2	C_m	C_{em}	C_{diss}	C_c	C_a	C_{ppam}	C_{ppab}	C_i
Total	5.93	7.81	8.47	8.79	13.24	13.46	0.701	0.259	0.923	0.962	1.00	0.644	0.984	0.653
Type of place of residence														
Rural	6.36	8.04	8.72	8.88	13.64	13.85	0.729	0.791	0.922	0.982	1.00	0.651	0.984	0.641
Other urban	5.59	7.96	8.78	9.41	13.12	13.27	0.637	0.702	0.908	0.933	1.00	0.717	0.989	0.709
Major urban	4.72	7.62	8.84	11.72	12.08	13.07	0.619	0.655	0.945	0.863	1.00	0.754	0.971	0.732
Level of education														
No schooling	6.38	7.66	8.28	8.38	12.85	13.05	0.771	0.833	0.925	0.987	1.00	0.652	0.984	0.642
1–3 years	5.63	7.67	8.32	9.11	12.34	12.71	0.677	0.737	0.922	0.913	1.00	0.738	0.972	0.717
4–6 years	5.10	7.85	8.34	9.37	12.88	13.31	0.611	0.650	0.940	0.891	1.00	0.727	0.969	0.704
7+ years	3.91	8.03	8.48	11.76	14.76	14.76	0.461	0.487	0.946	0.721	1.00	0.797	1.000	0.787

C_c can be split into three components as:

C_{ster} which measures the reduction in fertility as a result of sterilization;

C_{tab} which measures the reduction in fertility as a result of terminal abstinence; and

C_{om} which measures the reduction in fertility as a result of other types of contraception.

C_i is split into two components:

C_{ppam} which measures the reduction in fertility due to lactational amenorrhoea; and

C_{ppab} which measures the reduction in fertility due to post-partum abstinence beyond post-partum amenorrhoea.

In this analysis, however C_c is not decomposed since contraceptive use in Sudan is too low to warrant the split. In any case sterilization, as we saw in the previous chapter, is also negligible and the SUDFS collected no data on terminal abstinence. Similarly, C_a was again assumed absent here due to lack of data although there may be an incidence of abortion, especially in major urban areas and among the educated population.

It should be emphasized here that in this extended model each of the indices C_m, C_c and C_i is the product of its components. C_i, for instance, is the product of C_{ppam} and C_{ppab}; C_m is the product of C_{am} and C_{diss}. The values of the indices range between 0 and 1.0. A value of 0 implies maximum effect while the value of 1.0 implies no effect on fertility. The value of C_{em} is derived from the age-specific proportion ever in union and C_{diss} is derived from the age-specific proportions within union or currently married. The effect of contraception, C_c is calculated as:

$$C_c = 1 - 1.08 \times u \times c$$

where u is the age-specific proportion currently using contraception among currently married women; e is the effectiveness of method by age; and 1.08 is the correction factor for primary sterility.

The impact of post-partum amenorrhoea and post-partum abstinence, C_i, are calculated as:

$$C_{ppam} = 20/(18.5 + i)$$

where i represents the mean duration of post-partum amenorrhoea by age; and 20 is the birth interval in the absence of breastfeeding and abstinence. Of this, 18.5 is made up from the period of exposure (7.5 months) and gestation (9.0 months), including time loss due to foetal wastage (2.0 months), and 1.5 is the average period of lactational amenorrhoea.

$$C_{ppab} = \frac{(18.5 + i)}{(18.5 + i + j)}$$

where j represents the combined effect of post-partum amenorrhoea and post-partum abstinence; i is again the mean duration of amenorrhoea.

The results are presented in tables 29 and 30 and graphically shown in figure 9. Looking at the values of the indices in table 29 more closely, we see that of the two components of C_i, the non-susceptible/non-exposed period (the combined effect of post-partum amenorrhoea and post-partum abstinence), C_{ppam} (the effect of post-partum amenorrhoea) exerts the greatest effect on fertility ($C_{ppam} = 0.664$). Likewise a larger part of the effect of celibacy, C_m, is attributable to late entry into union, C_{em} ($C_{em} = 0.759$). There are variations among subgroups. The effect of breastfeeding is greatest among the rural and illiterate women ($C_{ppam} = 0.651$ and 0.652 respectively). It is, however, lowest among the major urban and educated subgroups ($C_{ppam} = 0.754$ and 0.797 respectively). Other subgroups have values between these two extremes. Equally important in suppressing the fertility of the major urban residents and educated women is delayed marriage and never marriage ($C_{em} = 0.655$ and 0.487 respectively). Marital dissolution, although common in Sudan, has very little effect on fertility due to the high rate of remarriage. Likewise, post-partum abstinence is not a major fertility factor among the Sudanese women (all the figures of C_{ppab} are close to 1.0; and in fact the educated category shows no effect on fertility due to this factor, ie $C_{ppab} = 1.0$). The suppressing effect of contraceptive use is only substantial among the educated ($C_i = 0.721$) and the major urban women ($C_c = 0.863$). These women need to use contraception to prevent their fertility from rising to offset the modernizing influence of education and urbanization and its associated reduction in breastfeeding habits and

Table 30 Number of births averted as a result of non-marriage, contraception and breastfeeding: total and selected subgroups

Fertility indicator	Number of births averted due to	Total	Rural	Other urban	Major urban	No schooling	1–3 years	4–6 years	7+ years
TFR		5.9	6.4	5.6	4.7	6.4	5.6	5.1	3.9
	Delayed marriage	1.9	1.6	2.4	2.5	1.3	2.1	2.8	4.1
TMEM		7.8	8.0	8.0	7.2	7.7	7.7	7.8	8.0
	Marital dissolution	0.7	0.7	0.8	0.4	0.6	0.6	0.4	0.5
TM		8.5	8.7	8.8	7.6	8.3	8.3	8.3	8.5
	Contraception	0.3	0.2	0.6	1.2	0.1	0.8	1.1	3.3
TNM		8.8	8.9	9.4	8.4	9.1	9.4	13.3	11.8
	DPP amenorrhoea	4.4	4.7	3.7	2.9	4.5	3.2	3.5	3.0
TF_{ppa}		13.2	13.6	13.1	11.7	12.9	12.3	12.9	14.8
	Abstinence	0.3	0.3	0.2	0.4	0.2	0.4	0.4	0.0
TF		13.5	13.9	13.3	12.1	13.1	12.7	13.3	14.8
Factor		Per cent of potential fertility due to							
Observed fertility		44	46	42	39	49	44	38	26
Delayed marriage		14	12	18	21	10	17	21	28
Marital dissolution		5	5	6	3	5	5	3	3
Contraception		2	1	5	10	1	6	8	22
Post-partum amenorrhoea		33	34	28	24	34	25	26	20
Post-partum abstinence		2	2	1	3	1	3	3	0
Total		100	100	100	100	100	100	100	110

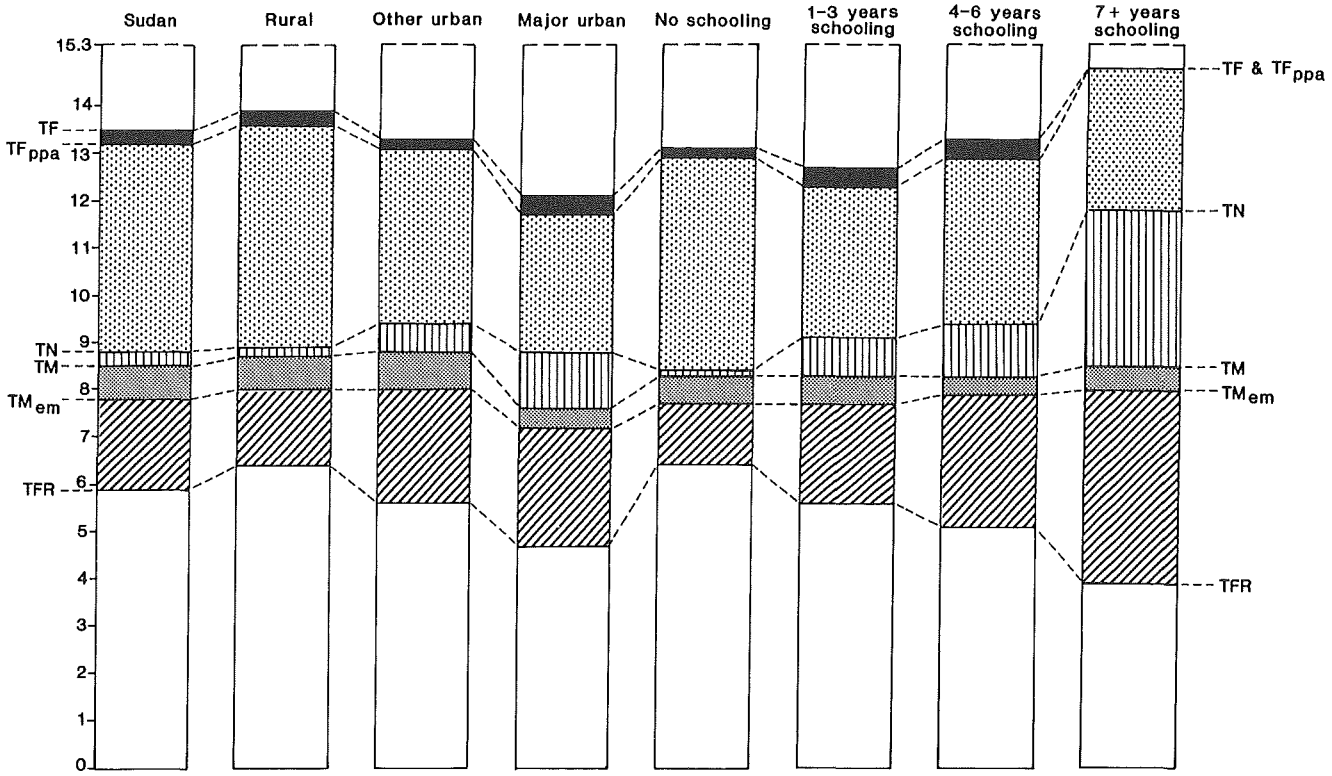

Figure 9 Relationship between the fertility reduction by intermediate variables and measures of fertility

shorter post-partum amenorrhoea as well as lack of strict observance of post-partum abstinence.

We can see from tables 29 and 30 that the variations in the intermediate fertility variables affect fertility levels. Higher levels of TFR among the rural and illiterate women, for example, and among other urban and 1–3 years of education subgroups may be attributable to early entry into union, lower celibacy and absence of contraceptive use. In other words, potential fertility among these categories is constrained largely by intensive breastfeeding and post-partum amenorrhoea. On the contrary, as we have seen, among the educated and major urban subgroups, a combination of late entry into union and non-marriage, contraception and possible unreported abortions may be responsible for suppressing potential fertility to the observed TFR levels.

The results discussed in table 29 are expressed in table 30 as the number of births averted due to the effect of each individual intermediate variable (upper band of the table) as well as in terms of potential fertility as a result of each factor (lower band of the table).

In conclusion, the model has revealed that lactational amenorrhoea is the main suppressing factor of potential fertility (fecundity) in Sudan. It accounts for 33 per cent of total fecundity. Delayed marriage accounts for 14 per cent of total fecundity while marital dissolution, contraception and post-partum abstinence account for 5.2 and 2 per cent respectively. As in many developing countries, the modernizing influence of education and urbanization has been to increase contraception, delay entry into union and promote celibacy. Above all, it has resulted in the breakdown in the breastfeeding habits, the sole and most effective fecundity depressant in non-contracepting societies.

We have noted variations in the total potential fecundity despite having taken into account the sources of such variations in the model. These variations may be due to errors in the survey data and therefore in each of the components of the model; the variations may also be due to unreported contraception, abortions, higher levels of sterility than reported in the survey or lower levels of fecundity than assumed by the model.

5.4 SUMMARY AND CONCLUSIONS

In summary we have found from our data that lactational amenorrhoea plays the most important role in suppressing potential fertility. This is followed by delayed marriage. Overall, contraception, post-partum abstinence and marital dissolution have negligible impacts. It seems that the result of the modernizing influence of education and urbanization has been a reduction in lactational amenorrhoea. However, reduced breastfeeding has been over-compensated by increased contraceptive use among women with higher education and those residing in major urban areas, although this concerns only a very small proportion of the total population. For the larger part of the population – characterized as rural and illiterate – lactational amenorrhoea is the most important fertility factor and can only be relied on as far as spacing and postponing live births is concerned. It canot be relied on to stop all births. Until there is a dramatic transformation in the Sudanese society through mass education to increase contraceptive awareness and use, on aggregate level, fertility in the Sudan is likely to remain high.

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Appendix A

Table A1 Proportion reporting themselves still non-menopausal and mean age at reaching menopause: all ever-married women and selected subgroups

Subgroups	Current age							Mean age at menopause	N
	15–19	20–24	25–29	30–34	35–39	40–44	45–49		
All	100.0	99.6	99.7	99.6	97.7	90.8	74.7	48.1	2761
Literacy									
Literate	100.0	100.0	99.3	100.0	98.0	93.5	75.0	48.3	525
Illiterate	100.0	100.0	99.8	99.4	97.8	89.3	68.9	47.8	2236
Residence									
Urban	100.0	100.0	98.9	99.2	98.4	87.5	63.0	47.4	740
Rural	100.0	100.0	100.0	99.7	97.3	91.1	71.9	48.0	2020

Table A2 Proportion reporting themselves still fecund (non-menopausal) and mean age at becoming infecund: all ever-married women and selected subgroups

Subgroups	Current age							Mean age at menopause	N
	15–19	20–24	25–29	30–34	35–39	40–44	45–49		
All	98.0	96.6	95.1	92.0	86.6	69.3	52.3	44.5	2844
Literacy									
Literate	97.2	98.6	95.7	89.9	84.6	80.6	21.1	43.4	531
Illiterate	98.3	95.8	94.9	92.6	86.4	67.7	46.8	44.1	2313
Residence									
Urban	98.8	97.9	93.3	90.0	84.1	69.8	41.8	43.8	762
Rural	97.7	96.2	95.8	92.8	86.9	68.2	46.8	44.2	2083

Table A3 Proportion reporting a birth in the last five years and mean age at becoming sterile: all ever-married women and selected subgroups

Subgroups	Current age							Mean age at becoming sterile	N
	15–19	20–24	25–29	30–34	35–39	40–44	45–49		
All	100.0	96.8	93.6	85.4	80.7	62.8	51.3	43.6	1452
Literacy									
Literate	100.0	98.7	96.2	85.4	74.4	68.4	0.0	41.2	206
Illiterate	100.0	96.3	93.1	85.4	80.8	60.5	46.3	43.1	1246
Residence									
Urban	100.0	98.7	95.7	82.3	78.3	58.0	31.4	42.2	339
Rural	100.0	96.3	93.0	86.5	81.0	62.2	51.0	43.5	1113

Table A4 Proportion with no combined effects of stopping attributes and mean age at acquiring any one of the stopping attributes: all ever-married women and selected subgroups

Subgroups	Current age							Mean age at acquiring any stopping attribute	N
	15–19	20–24	25–29	30–34	35–39	40–44	45–49		
All	98.1	94.6	90.0	80.7	79.0	45.5	26.6	40.5	3114
Literacy									
Literate	97.4	97.3	92.0	80.1	64.0	55.9	14.3	40.1	568
Illiterate	98.4	93.7	89.5	80.9	71.7	46.3	25.3	40.3	2546
Residence									
Urban	98.8	97.6	89.4	77.6	68.1	46.4	20.2	39.9	842
Rural	97.9	93.7	90.3	82.0	72.0	47.2	26.8	40.5	2272

Table A5 Proportion not widowed, divorced or separated and the mean number of years spent without acquiring the characteristic: all ever-married women and selected subgroups

Subgroups	Current age							Mean age at menopause	N
	15–19	20–24	25–29	30–34	35–39	40–44	45–49		
All	100.0	99.3	98.4	96.8	94.4	91.1	91.1	48.6	3081
Literacy									
Literate	100.0	99.1	97.6	97.6	92.1	91.2	100.0	48.9	568
Illiterate	100.0	99.3	98.6	96.6	94.6	91.0	89.9	48.5	2546
Residence									
Urban	100.0	100.0	97.5	96.9	93.4	89.6	97.9	48.3	842
Rural	100.0	99.0	98.8	96.8	94.8	91.5	91.5	48.6	2272