PN-AAQ 653

DETERMINANTS OF NATURAL FERTILITY IN MATLAB, BANGLADESH

by

Stan Becker
and
Alauddin Chowdhury

Working Paper #40

November 1983

Abstract: In 1970 a one-year prospective study of birth interval dynamics for a group of 200 women in Matlab, Bangladesh was done.[1] The present paper reports on an extended and enlarged study of natural fertility in the same area. During the prospective period of 52 months (1975-1980), 2300 women were asked each month about their reproductive status, presence or absence of the husband, family planning use, and breastfeeding practice. During the first year of the study, anthropometric measures were taken and blood specimens were collected for biochemical analyses of the nutritional status of the women. During the last year of the study when interviewer-respondent rapport was well-established, a question on intercourse frequency was added.

These analyses of patterns in the components of the birth interval are an important step in understanding the intermediate fertility variables, provide insights into the reasons for less than maximum fertility in this population, and enable predictions of how fertility could change with changes in mortality and breastfeeding in Bangladesh.

About the Authors: Stan Becker is a demographer working in biomedical and population research. The research described in this paper was conducted during his three years as a researcher at the International Centre for Diarrhoeal Disease Research, Bangladesh in Dacca. He is currently affiliated with Vrije Universiteit Brussel (Free University of Brussels).

Alauddin Chowdhury, Dr.P.H., received his degree from Johns Hopkins University. He is currently affiliated with the International Centre for Diarrhoeal Disease Research, Bangladesh in Dacca.

---

[1]Chen, L. C., S. Ahmed, M. Gesche, and W. H. Mosley. "A Case Study of Birth Interval Dynamics in Rural Bangladesh." Population Studies 28(2):277-97, 1974.

DETERMINANTS OF NATURAL FERTILITY IN MATLAB, BANGLADESH*

This paper reports the first results from a four-year prospective study of the determinants of natural fertility in Matlab, Bangladesh. First, the background of the study is given. Next, previous research on natural fertility in Matlab is reviewed. Then the methods of the study are described. Following this description, results on two aspects of natural fertility--seasonality and socioeconomic differentials--are given. Finally, a summary and description of plans for further analyses are presented.

Introduction

Matlab is located on the floodplain of the Meghna River basin forty miles south of Dacca. Communication within the area is typically by foot, steamboat, or country boat, with the latter being crucial during the high water season. The climate is subtropical with the monsoon from June to September. Rice cultivation is the major activity of area residents and ninety percent of the population identify their religion as Muslim. Within Matlab, settlements are characterized by groups of dwellings of related families around a central courtyard, collectively called a bari. Baris are clustered together on raised land; villages are constituted of groupings of baris. The low agricultural land thus lies between the villages. The mean number of inhabitants per village is 1160.

The field station of the International Center for Diarrhoeal Disease Research, Bangladesh (formerly the Cholera Research Laboratory) in Matlab, Bangladesh has provided a unique opportunity for prospective studies of fertility dynamics in a natural fertility population. Demographic surveillance was begun in 132 villages of Matlab in 1966 in conjunction with a cholera vaccine trial. In 1968 another 101 villages were added to the surveillance area (Figure 1). In 1969-1971 a small study of fertility dynamics was undertaken (Chen, et al. 1974); because of the rarity of such prospective studies, the results of this study have served as benchmarks for researchers in natural fertility during the past decade.

In 1975, encouraged by the work of Chen and others, a larger study of the determinants of natural fertility in Matlab was initiated. The fourteen villages described in the present study were part of the comparison area in a field experiment of community-based distribution of contraception also started in Matlab at the same time (Stinson, et al. 1982; Phillips, et al. 1982; Rahman, et al. 1980; Bhatia, et al. 1980). Contraception was not withheld from women in these fourteen villages; the Bangladesh government family planning program covered these villages, and any woman who asked for contraception at the Matlab clinic was served as any other person. Contraception use among women in this study remain low, however.

The purpose of this study was to assess biological and behavioral factors associated with natural fertility among non-contracepting women. Natural fertility was first defined by Henry (1961) as fertility occurring in the absence of deliberate control of reproduction. Variations in natural fertility are related to differences in duration of the reproductive span and

*This paper originally appeared as IPD-Working Paper 1983-84. Brussels, Belgium: Interuniversity Program in Demography.

components of birth intervals operating within this span. The reproductive span extends between menarche and menopause but is shortened by marriage delays beyond menarche, widowhood, or death.

The components of the live birth interval defined for this study are: (1) the period of postpartum amenorrhea following a live birth to resumption of menses; (2) the waiting time to conception--from resumption of menses to conception; (3) time lost to fetal wastage (if any); and (4) the live-birth gestation interval.

After age, season has been shown to be the variable producing the greatest fertility differences in Matlab, with twice as many births in the winter as in the summer. This pattern was documented originally by Stoeckel and Chowdhury (1972) and trigonometric regression has recently been used to summarize the patterns by age (Becker 1981). The risks associated with the birth interval components--resumption of menses postpartum and fecundability--also have clear seasonal patterns. The risk of resumption of menstruation is much higher between November and February than in other months (Huffman, et al. 1978). A suggested explanation for this is the fact that this season follows the largest annual harvest of rice and the amount of time spent breastfeeding is reduced because of the increased labor demands on women (Huffman, et al. 1980b).

The peak in conceptions follows this peak in resumption of menses. Fecundability, adjusted for days of absence of husbands, is highest in April (Chen, et al. 1974) and lowest in November.

The mean and median lengths of the subintervals have also been estimated. Mean postpartum amenorrhea intervals for women with a surviving infant ranged from 16 to 23 months in the study of Chen, et al., the former for women below age 30 and the latter for women above age 30. Lengths of this magnitude were also found by Huffman, et al. (1978). The median time women with living children breastfeed has been estimated as thirty months (Huffman, et al. 1980b).

The median conception-wait interval has been estimated as eight months in this population (Chen, et al. 1974). Menken (1975) fit a beta distribution (for fecundability) to these data and estimated fecundability as .07. She also found little evidence of variation between women.

Socioeconomic differentials of fertility in Matlab have been examined for the period 1974-1977 based on vital registration data for the whole population of Matlab by Sheik and Becker (1980). Variables used were religion, education of woman, education of household head, occupation of household head, family type, size of dwelling space, and number of cows and boats. Fertility of Hindus was five to ten percent lower than that of Muslims. In 1974 and 1975 women with higher education had higher fertility, but in 1976-1977 the pattern was reversed. (This reversal probably is due to the greater acceptance of family planning among the better educated as the contraceptive program began [Rahman, et al. 1980]). Among occupation groups, women in

households in which the head engaged in business had the highest fertility while women in households headed by men with other occupations including beggars and disabled persons had the lowest. Clear positive relations were found between fertility and size of dwelling space, fertility and number of boats owned, and fertility and number of cows owned.

Methodology

A sample of approximately 2500 women was followed prospectively from October 1975 to December 1979. All currently married women below age fifty in fourteen villages near Matlab Bazar (Figure 1) were selected for study. This procedure had the following advantages over a random sampling procedure in the entire area: (a) a geographic cluster near the Matlab office allowed better supervision and logistic support; (b) the selected women felt less intimidated by the study knowing that all women in the village were included in the study; and (c) fewer field workers were required. Women entered the study by marriage and left the study if they exited from the currently married state. In addition, women left the study by out-migration, refusal, or by reaching menopause. Menopause was defined according to a woman's report or if she had not menstruated for six or more months and her youngest child was more than five years old. Women who accepted contraceptive sterilization were also excluded and, at the data processing stage, women who began other contraceptive use during the study were excluded from the date of acceptance onward.

Five female field workers were selected and trained extensively for the work. They were all educated women of the locality. The training included the following: (1) definition of reproductive terms relevant to the study and relation of those terms to the local vocabulary; (2) identification of response biases that might occur because of social stigmas, fears, rumors or superstitions; (3) teaching of anthropometric measurement techniques and blood specimen collection; and (4) field testing of the questionnaire.

At the beginning of the study a short questionnaire was given covering retrospective reproductive events and socioeconomic variables. The women were asked their education; the occupation of their husbands; the numbers of living children, dead children, stillbirths, and miscarriages; the date and type of last pregnancy termination; and present reproductive status. Women who entered the study subsequently were also given the questionnaire.

During the prospective period each field worker was assigned approximately twenty women to interview in a given day. During the first three years of the study women were visited at monthly intervals. The interview included questions on reproductive status, breastfeeding status, absence (of either the husband or the respondent in the month), and the occurrence of any child death or change in marital status. Nutritional status was collected, including height at the beginning of the study, weight, and arm circumference at monthly intervals. Further, during the first year, blood specimens were taken at bimonthly intervals for hematocrit analysis. If the respondent was absent, the worker visited a second time in the same month to attempt to

complete the interview. If the woman was still absent, this was noted and information for a two-month interval was collected on the next round. If the absence continued for more than six months, the woman was considered an out-migrant and excluded from the study.

During the last two years, the interval between interviews was increased to two months in all but two villages. Reliability checks (a supervisor routinely selected individuals for an independent re-interview on the day after the formal interview) showed the bimonthly data to be as reliable (though this need not imply validity) as those collected at monthly intervals except for slightly larger discrepancies in reporting of dates of beginning and end of spouse absences. Further details of the reliability checks and other study methods are given in Chowdhury and Becker (1981).

During the last year of the study when rapport had been established between the interviewer and the women, a question was asked on frequency of sexual intercourse. Actually, frequency itself was not asked but rather, "How many days since you last had sexual intercourse with your husband?"--since it seemed clear that this would yield responses with greater accuracy. The reason for introducing the question was to determine to what extent the seasonality of fecundability is determined by a possible seasonal pattern of frequency of intercourse.

Data Processing and Definitions of Terms

There are numerous possibilities for coding and processing data in a four-year longitudinal study. Since reproductive events are relatively rare compared to the visiting interval of one month, it was decided to code only the dates of events. This was straightforward but, of course, led to a variable number of records of variable lengths for each woman. Extensive editing checks were done and corrections were made by consulting the original records. Seventy-five women (less than four percent of all women) who were practicing contraception at the time of entry into the study were excluded. For 170 other women who accepted contraception during the study, the date of acceptance was made the date of termination. The latter appeared a reasonable compromise between total deletion of these cases, which could bias the sample toward lower fertility and leaving them, in which case it would not be a natural fertility population.

We now give some definitions used in the remainder of the report. Resumption of menstruation postpartum is the date of first menstruation after pregnancy termination; it is distinguished from bleeding associated with parturition by the presence of subsequent menstruation at regular intervals or by a subsequent pregnancy. Pregnancy terminations are defined either as live births if the newborn showed any signs of life or otherwise as non-live births. The distinction between miscarriage and stillbirth is based on the duration of pregnancy with the dividing point at seven months.

The postpartum amenorrhea interval is defined as the time from pregnancy termination to the resumption of menstruation. Similarly the conception-wait or menstruating interval is the time from the resumption of menses to

the last menstrual period (LMP) associated with the next pregnancy. If the women became pregnant before resumption of menstruation, the conception-wait interval is defined as zero. The gestation interval is thus defined here as the time between LMP and pregnancy termination. Fecundability is estimated as the number of women with a last menstrual period during a month (i.e., conceptions) plus the number conceiving during amenorrhea in the month divided by the number of women-days with husband present during the month. Breastfeeding is defined as full in the absence of either liquid or solid supplementation. Breastfeeding is considered to end when the child was completely weaned.

All reproductive events considered in the analyses occurred in the prospective period. For analysis of intervals, entirely prospective (those that begin and terminate during the study period) and prospective-censored (those that begin but do not terminate in the study period) are included in the life tables.

An important issue to consider within this study is the historical events preceding its initiation. The study began the year after a serious famine in Bangladesh. The famine's effect on vital events and migration in Matlab--fertility reduced by about 25 percent, mortality increased by 20 percent and out-migration increased by 35 percent--obviously continued into the present study (Chen and Chowdhury 1977; Langsten 1980).

Results

The distribution of the 2368 study women by selected socioeconomic variables (Table 1) shows that 76 percent of the women had no formal education; 89 percent were of the Muslim faith and the modal occupation of their husbands was cultivator. The distribution of the women by time of entry and reason for exit from the study is shown in Table 2. Most of the women entering the study after 1975 were young women entering due to marriage. The refusal rate was low, three percent.

A summary of the reproductive events recorded and rates (per 1000 woman-years of observation) is given in Table 3. The observed general marital fertility rate (GMFR) was 264. Note that this is a GMFR for non-sterilized, non-contracepting women. The level of 135 non-live births per 1000 terminations (88 miscarriages and 46 stillbirths) indicates that the extent of coverage of pregnancy terminations was quite good. This is nearly identical to the rate of 136 found in the prospective Khanna study in the Punjab (Potter, et al. 1965).

Seasonal Patterns

There is a pronounced seasonality of reproductive events in this population. Figure 2 shows the season patterns of three measures: (a) live birth rate; (b) the probability of resuming menstruation among women beginning the month in postpartum amenorrhea; and (c) fecundability. Seasonal patterns varied in intensity over the four-year period. The cause of the irregularity

is found in the extremely low fertility the year before the survey began, due to the disruption accompanying the flooding and famine of 1974-1975 (Ruzicka and Chowdhury 1978). Fecundability rebounded in the spring of 1976 giving a birth peak in the winter of that year and then the normal pattern began to be re-established. As documented previously, the risk of resumption of menstruation postpartum peaks in the winter (Figure 2), though in these data a yearly cycle is much less apparent.

During the last year of the study the question on days since last seasonal intercourse was added to permit examination of the extent to which the seasonality of fecundability is determined by a possible seasonal pattern of frequency of intercourse. Figures 3 and 4 summarize the analyses pertinent to this question. In Figure 3 the peak of fecundability clearly corresponds to the minimum of the mean days since last intercourse, though the trough of fecundability does not correspond with the longest mean time. Of course we would expect fecundability to be less sensitive to the mean days since last intercourse than to the proportion of women reporting a short interval since last intercourse. The proportion of women having intercourse within three days prior to the interview is shown by month in Figure 4. The correlation between this series and fecundability is .62 ($p < .05$). Further modeling of the effects of the observed seasonal changes in intercourse frequency on fecundability showed that such changes cannot account for the full variation of fecundability (Becker forthcoming). Further work is in progress to quantify these effects.

Socioeconomic Differentials in Subinterval Components

Three simple socioeconomic indicators are available from the initial questionnaire. These are: education of the women, occupations of the husbands, and religion (see Table 1).

Since the age distributions are not the same in the different education and occupation groups (Table 4), age must be controlled when they are compared. Table 5 shows age-specific fertility rates and non-live birth rates for the given groups. Fertility differences are largest between the occupation groups with the highest general fertility rate (GFR) among women whose husbands work in business and the lowest among those with husbands engaged in agriculture and other occupations. (The rate for the business category is seventeen percent higher than the rate in the "other" category, supporting the findings reported by Sheik and Becker [1980].)

Fertility levels are different between educated and uneducated women only in the youngest age group, with fertility eleven percent higher for uneducated women ($p < .1$). Can this difference be explained by differences in the natural fertility parameters or is there possibly a beginning of conscious but unreported fertility regulation among the younger educated women? This question will be addressed below. The age-standardized fertility for Hindu women is slightly higher (seven percent) than that for Muslim women; again the difference comes largely from the higher fertility among Hindu women below twenty years of age ($p < .01$ for the comparison in this age group). It

is worth noting that this Muslim-Hindu fertility difference is the opposite of that found in the Bangladesh Fertility Survey for the country as a whole. This apparent inconsistency could be due to differences in contraceptive use between the groups, or more likely, to regional differences in fertility within the country.

Non-live birth rates vary only slightly between the socioeconomic groups. Again because of differences in age distribution, age must be controlled in the comparisons. The only comparison of standardized rates which reaches statistical significance is between agriculture and business occupations. The highest age-standardized rate is for women whose husbands work in agriculture. The rate for non-educated women is nineteen percent higher than that for educated women, and that for Muslims is eleven percent higher than that for Hindus (Table 5). For Hindu women below age twenty, the rate is a mere one-third that of their Muslim contemporaries; but for women above age thirty, the Hindu rate is forty-three percent higher. Though neither of these differences actually reaches statistical significance (at $< .05$ level), reflecting the small number of events, it seems probable that there is a true difference in the age pattern in the two religious groups.

Turning to the subintervals, Table 6 gives the median conception-wait intervals according to age and socioeconomic group for women who resumed menstruation in the prospective period. The values generally hover around eight or nine months in both age groups, the same values found by Chen, et al. (1974). Note that under the assumption of a geometric distribution, a median conception-wait of nine months corresponds with a level of fecundability of .07, identical to the estimate obtained by Menken (1975). A more rigorous estimation of fecundability using these censored data and assumptions of a beta distribution remains to be done. Exceptions to the median values of eight or nine months are women with some education and women whose husbands have "other" occupations who both have longer times to conception, and women whose husbands are businessmen who have a shorter delay to conception. Thus the lower fertility among younger educated women can be due to the additional three months waiting time to conception for these women. The medians vary insignificantly between age groups.

Table 7 shows the median lengths of postpartum amenorrhea for the same age and socioeconomic groups. The clear age differential is immediately apparent with older women having intervals on average four months longer. The median for women with some education is three months shorter than that for women without education. This difference effectively cancels the three-month-longer conception-wait interval of educated women in the comparison of the total birth interval. These results confirm those found by Huffman, et al. (1978) that increasing socioeconomic status is associated with shorter postpartum amenorrhea in Matlab.

Table 8 gives the median lengths of full breastfeeding and the total time breastfeeding for women having live births who initiated full breastfeeding and who did not experience a child death. The most striking feature of this table is the comparatively short median time after birth for introduction of

supplementary foods among Hindus; by ten weeks after birth, fifty percent of Hindu mothers have begun supplementation, while the corresponding time for Muslim mothers is thirty weeks. There were only minute differences across age groups so these data are not shown, apparently indicating that the social norms regarding breastfeeding are not dependent on age of the mother. The longest median interval is found among women whose husbands are in agriculture.

The median total breastfeeding length is very long in all age and socioeconomic groups; half of the children born live in the study were still being breastfed after two and one-half years of age. The shortest medians are for women whose husbands are businessmen and the longest are for Hindu women. Thus Hindu women begin supplementation earlier and continue breastfeeding longer than Muslim mothers.

The link between breastfeeding length and amenorrhea in these data is illustrated by Table 9. For women who begin supplementation within one month of parturition, the median amenorrhea length is eight months. This is much longer than might be expected; the reason is probably that though supplementation begins within one month, the frequency and duration of suckling is still high. The relatively small increase in the median amenorrhea length with increasing mean durations of full breastfeeding probably may be explained similarly. For women who continue full breastfeeding beyond eleven months, the median length is seventeen months.

Estimation of Total Birth Interval

We now replicate the estimation of the total live birth interval done by Chen, et al. following the results from renewal theory (Sheps and Menken 1973). The probabilities of each type of birth outcome are given as well as the mean durations of gestation and postpartum amenorrhea associated with each outcome (Table 10). For stillbirths and miscarriages the means can be estimated directly since at least 95 percent of the intervals began and ended in the prospective period. For live births, 36 percent of the postpartum amenorrhea intervals were censored; thus for this mean interval, the median is substituted. The estimation of the mean conception-wait interval is problematic. Sixteen percent of the menstruating intervals begun in the prospective period did not close within thirty-six months (Figure 5). The l_x curve for conception-wait appears to have an asymptote near the value of .16 indicating that this proportion of women may never have a next conception. Thus to estimate the mean conception wait-interval here, we have integrated the l_x function up to 36 months and then subtract .16 x 36. This yields an estimate of 8.0 months.

The resulting estimate of the live birth interval is 35.4 months compared to the value of 33.8 derived by Chen, et al. (1974). The inverse of the birth interval multiplied by the proportion of fecund women gives an estimate of the fertility rate for fecund women. Using the estimated proportion of women who will not have a next conception (.86), the derived estimate of fertility is 285 per 1000. This is close to the observed fertility rate of 264.

Discussion and Plans for Future Work

Though it can be said that there are not evident conscious restraints on fertility among most couples in Matlab, the resulting natural fertility is nevertheless considerably below the maximum possible. The reasons are very long postpartum amenorrhea due to the extremely long average duration of breastfeeding and relatively low fecundability. Fecundability varies over two-fold depending on the month of the year and, even at its highest, is considerably below the levels (at and above .2) reported for other populations (Leridon 1977). An explanation for the low fecundability is the relatively low frequency of intercourse. Assuming, for simplicity, no variance between couples, a mean open interval of 4.7 days (the value for all months combined) corresponds to a mean of only three times of sexual intercourse per month while the corresponding means reported in the United States and India are 8 and 6 (Leridon 1977).

In fact the work on models of fecundability according to frequency of intercourse (Barrett and Marshall 1969; Schwarts, et al. 1980) allows independent estimation of mean frequency of intercourse from the estimate of fecundability. These models present estimates of fecundability as a function of frequency of intercourse. By extending the curve (Barrett and Marshall 1969), we find for a mean fecundability of .07, a pattern of intercourse every 11 days is indicated. This implies a frequency of 2.7 per month which is very close to the rough estimate of 3 derived from the reported interview data.

With few exceptions, the socioeconomic differentials in the birth interval components were relatively small. It is expected that such variations would be less in a natural fertility population than in a Malthusian population. In this area of Bangladesh the social and cultural mores applicable to breastfeeding and sexual relations appear to change only slightly across socioeconomic groups (Maloney, et al. 1981). An exception is the earlier introduction of supplementary foods among Hindu women.

It is obvious that numerous analyses remain to be done. Some which have emerged from this work and which are in the planning stages are: (a) estimation of fecundability with a beta distribution; (b) quantification of the effect of seasonal differences in frequency of intercourse on the seasonality of fecundability; (c) multivariate analyses of differentials in the subintervals by socioeconomic status, using proportional hazards models; (d) further study of the interactions between nutrition and postpartum amenorrhea and conception-wait; and (e) study of the relation between frequency of intercourse and fecundability using individual data.

Figure 1: Map Showing Matlab Surveillance Area and Villages in the Present Study

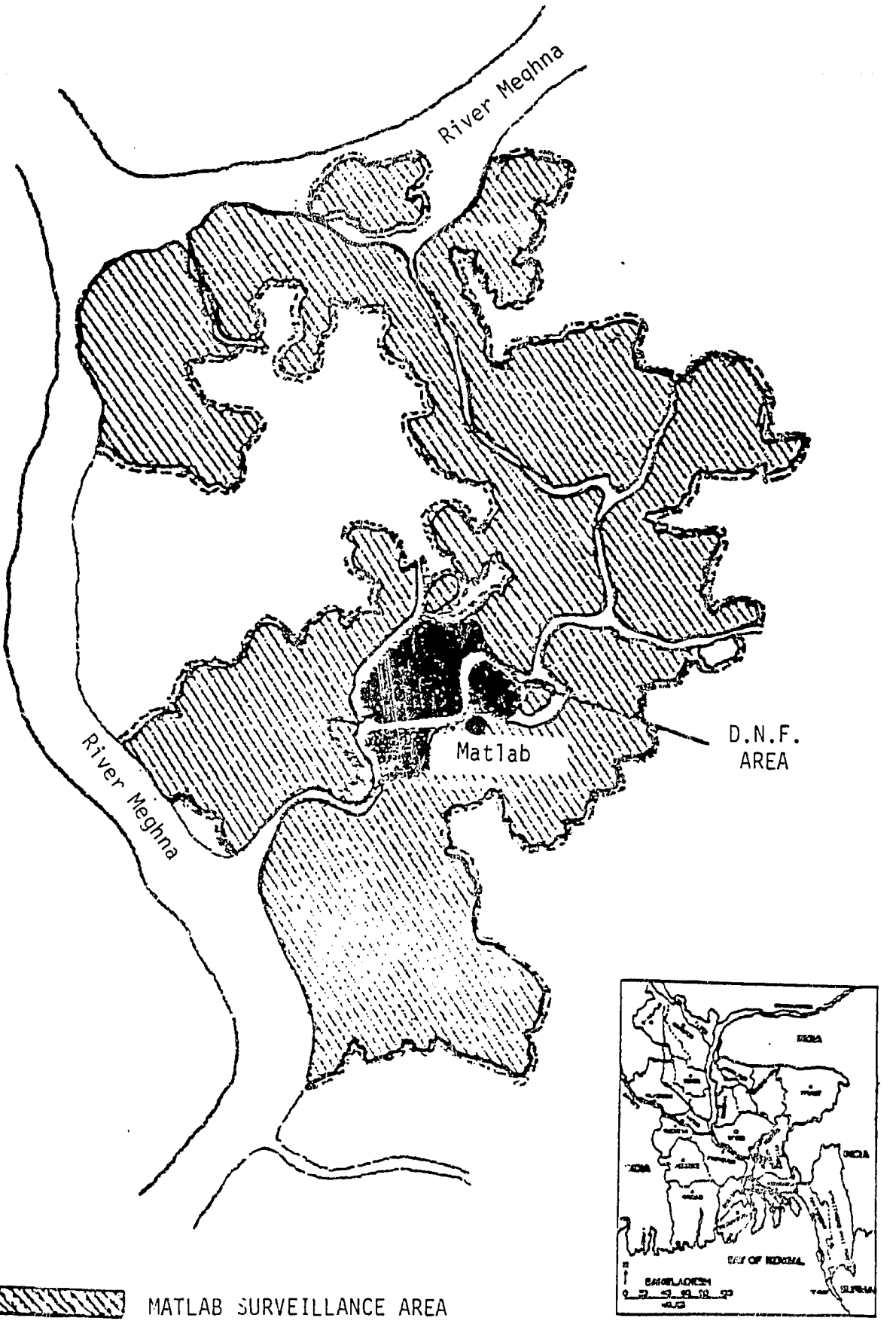
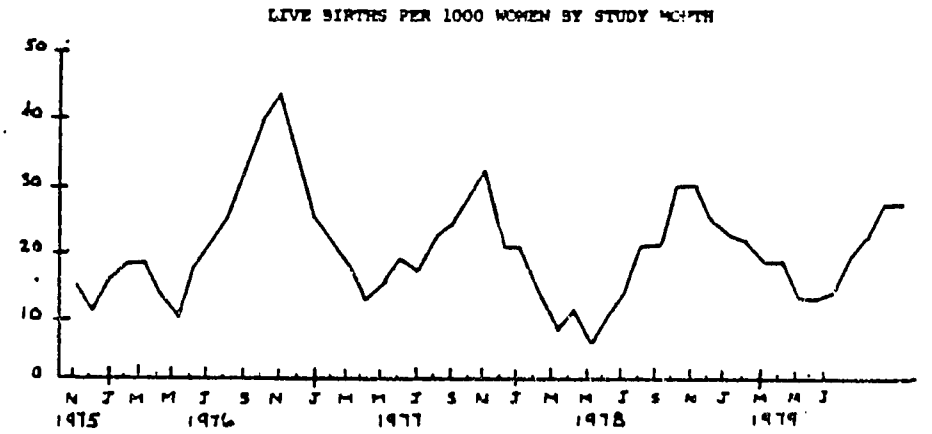
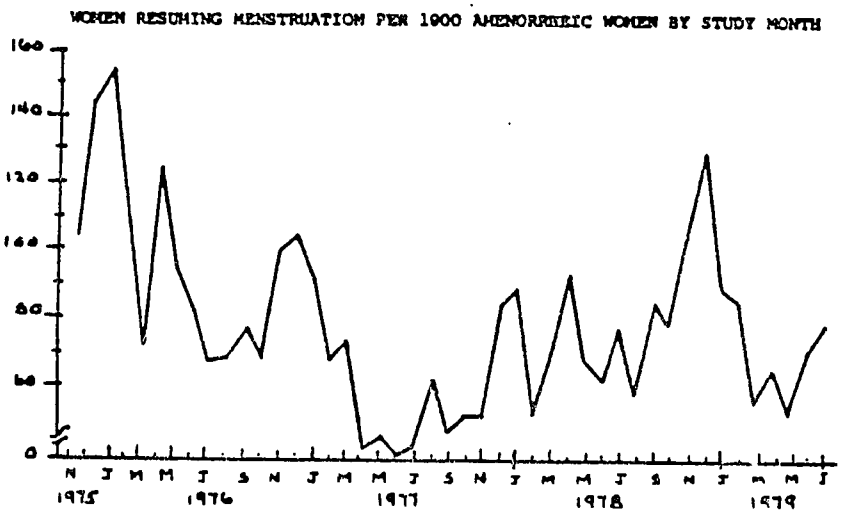


Figure 2: Live Births, Estimated Probability of Resumption of Menstruation and Estimated Probability of Conception by Calendar Month of the Study





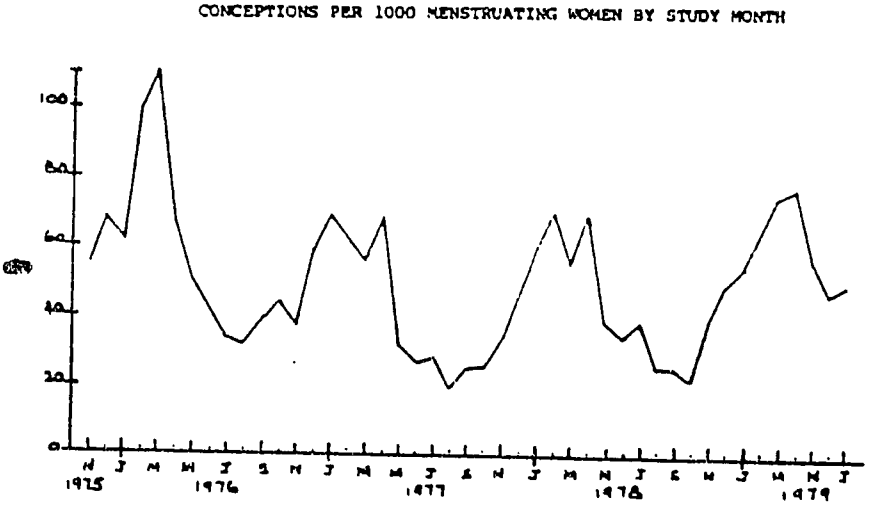


Figure 3: Fecundability and Mean Days Since Last Sexual Intercourse by Calendar Month

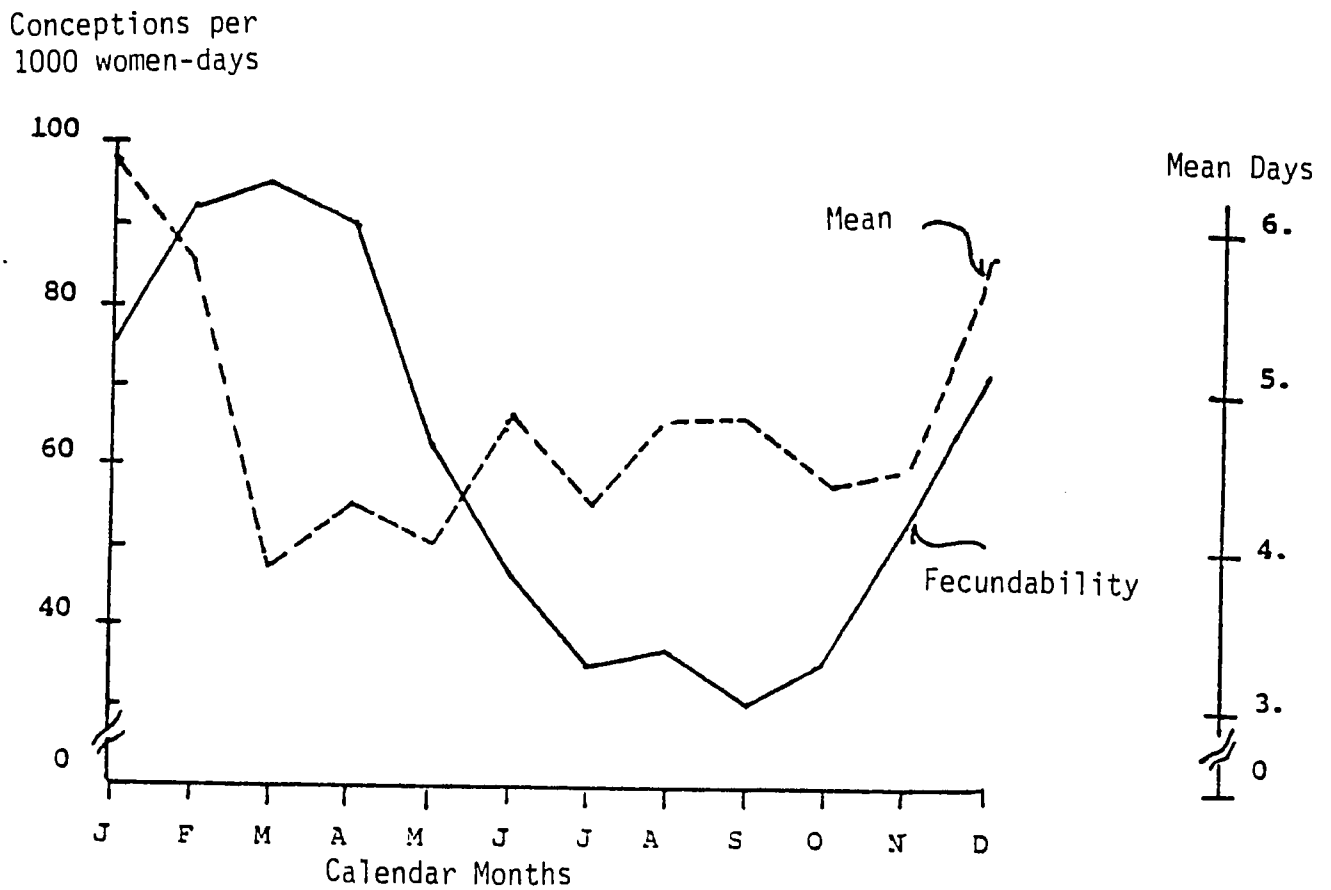


Figure 4: Fecundability and Proportion Having Intercourse Within Three Days by Calendar Month

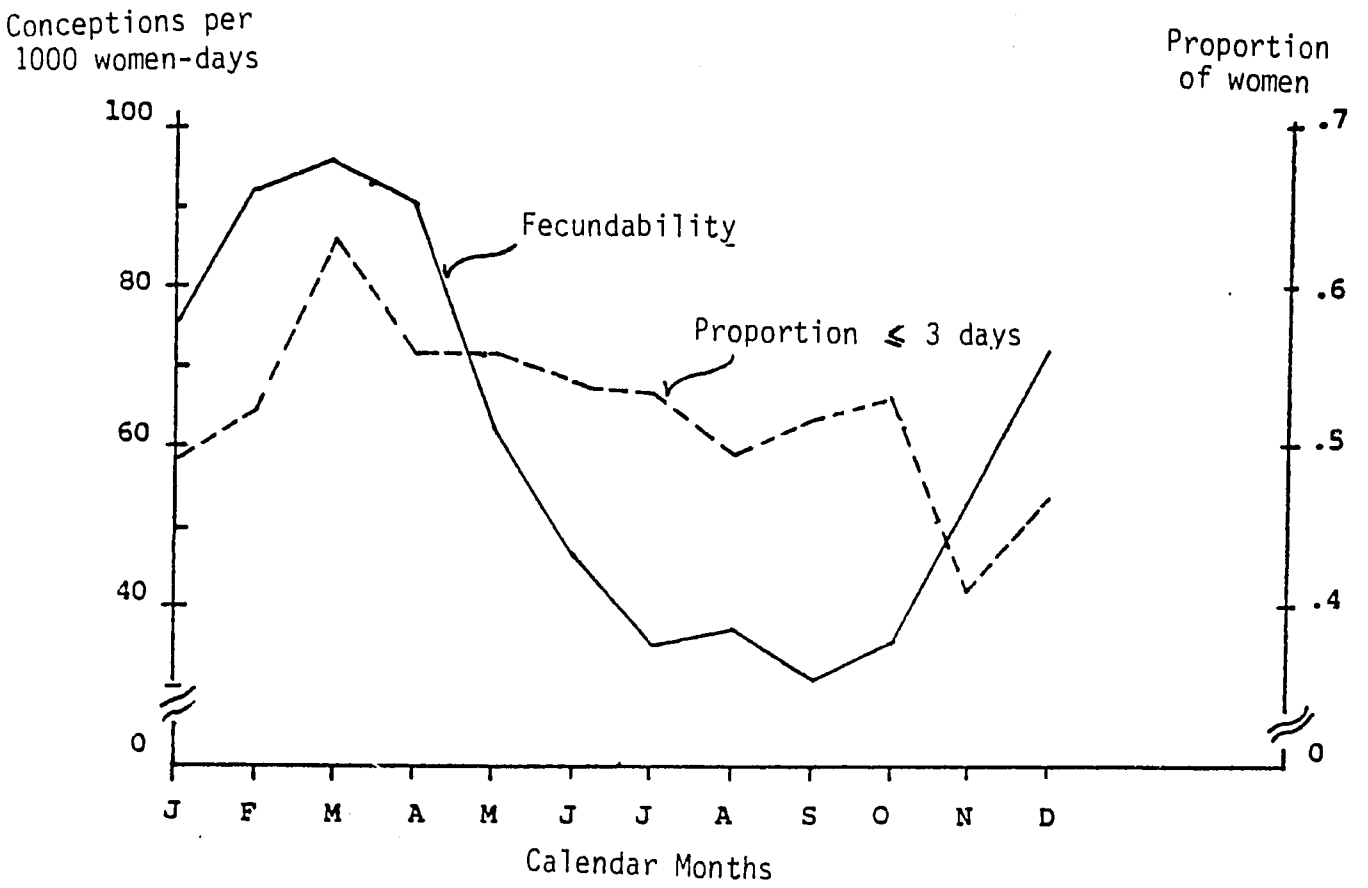


Figure 5: Proportion of Women Not Yet Pregnant by Months Since Resumption of Menses

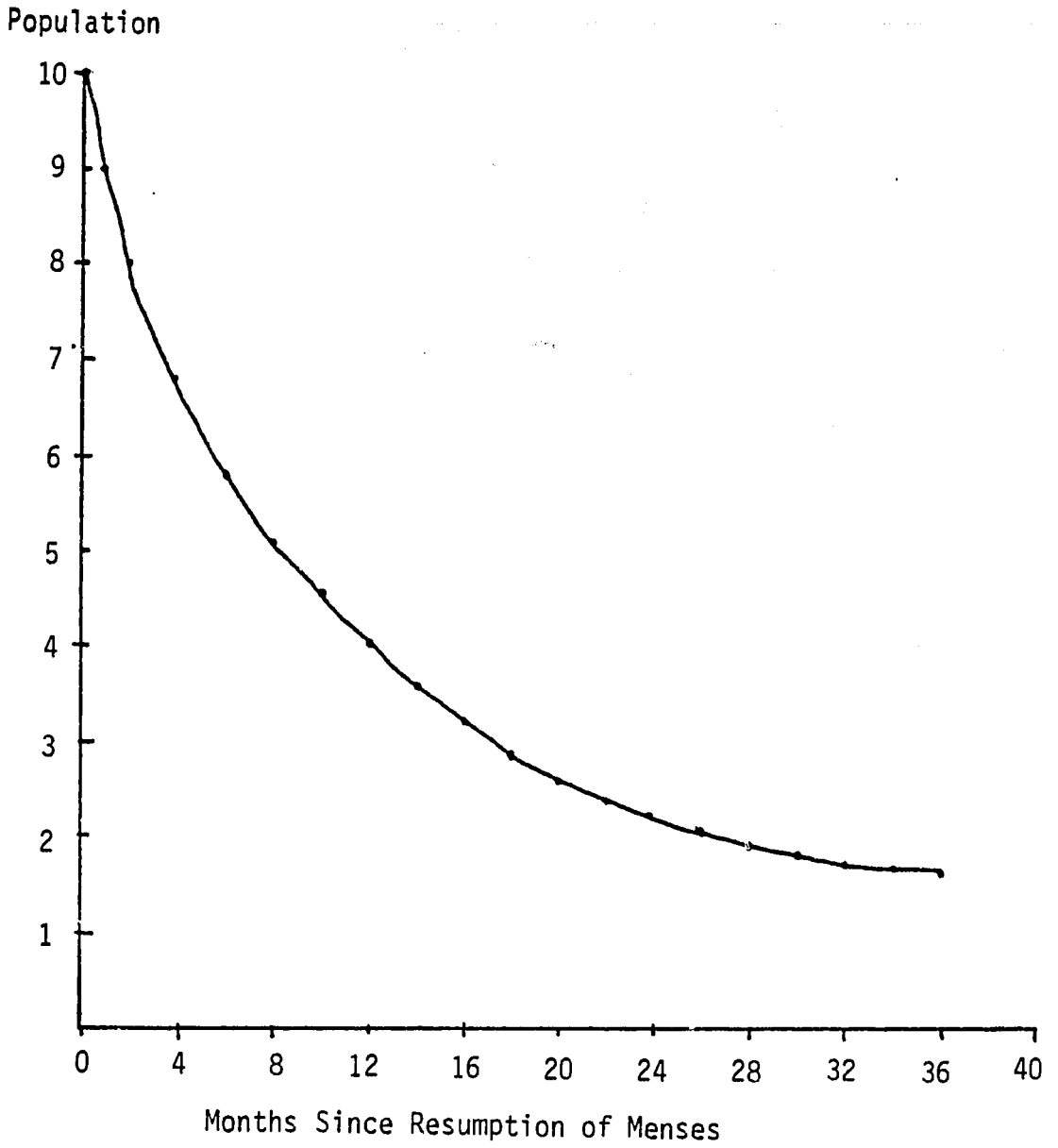


Table 1: Distributions of the 2368 Study Women by Selected Socioeconomic Characteristics

	Percent
Formal Education	
None	76
1 - 5 years	21
6 years and above	4
Religion	
Islam	89
Hinduism	11
Husband's Occupation	
Cultivator	31
Agricultural laborer	7
Fisherman	10
Mill worker	11
Unskilled laborer	4
Boatman	4
Businessman	11
Service and professional work	14
Self-employed	4
Other (domestic labor, students, beggars, handicapped persons)	5

Table 2: Number of Women in the Study by Time of Entrance into the Study and Reasons for Exit from the Study, by Age Group

Age Group	All Women	Entrance into Study		Reason for Exit from Study							
		At Beginning	After Beginning	Truncation	Refused	Change in Marital Status	Out-Migration	Menopause	Death	Long Absence	Family Planning Use
All Ages	2367	1920	447	1697	56	111	166	118	20	25	174
< 20	666	395	271	519	10	44	62	1	5	14	11
20 - 29	753	648	105	566	16	24	71	2	6	5	63
30 - 39	676	632	44	483	17	26	25	31	7	3	84
40 +	272	245	27	129	13	17	8	84	2	3	16

Table 3: Woman-years of Observation, Numbers of Prospective Reproductive Events and Rates of Reproductive Events by Type of Event and Age Group

Age	Woman-years of Observation	Conception	Pregnancy Termination		Resumption of Menstruation	Conception	Pregnancy Termination		Resumption of Menstruation
			Live Birth	Non-Live Birth			Live Birth	Non-Live Birth[a]	
All Ages	7464	2229	1969	307	2390	299	264	134	320
< 20	1995	721	633	81	644	361	317	113	323
20 - 29	2463	930	846	117	997	378	343	121	405
30 +	3006	578	490	109	749	192	163	182	249

[a]Non-live births per 1000 pregnancy terminations.

Table 4: Percentage of Study Women Less Than 25 Years of Age in Each Socioeconomic Group

Socioeconomic Variable and Category	Percentage of Women Less Than 25 Years of Age
Education of Woman	
None	41
Some	60
Occupation of Husband	
Agriculture	41
Business	45
Fishing	43
Other	50
Religion	
Muslim	45
Hindu	45

Table 5: Women-years of Observation, Live Births, Non-live Births, Fertility Rates and Proportion of Pregnancy Terminations Which Were Non-live Births by Woman's Age Group and Socioeconomic Characteristics

Socioeconomic Characteristics	Woman-years of Observation	Live Births	Non-live Births	Fertility Rate	Non-live Births Per 1000 Terminations
Education					
No Education					
All ages	5941	1486	246	250(258)[a]	142(140)[b]
< 20	1339	435	63	325	127[c]
20 - 29	1939	635	90	328	124
30 +	2663	416	93	156	183
Some Education					
All ages	1900	481	60	267(247)	111(118)
< 20	675	198	18	293	83
20 - 29	640	210	27	328	114
30 +	485	73	15	151	170
Occupation of Husband					
Agriculture					
All ages	2946	721	129	245(252)	152(150)
< 20	731	226	30	309	117
20 - 29	911	308	50	338	140
30 +	1304	187	49	143	208
Business					
All ages	862	249	35	289(286)	123(122)
< 20	190	64	8	337	111
20 - 29	334	118	16	353	119
30 +	338	67	11	198	141
Fishing					
All ages	779	212	35	272(274)	142(139)
< 20	197	76	6	387	73
20 - 29	263	82	13	312	137
30 +	320	54	16	169	229
Other Occupations					
All ages	3153	785	107	249(245)	120(120)
< 20	897	267	37	298	122
20 - 29	1071	337	38	315	101
30 +	1186	181	32	153	150
Religion					
Muslim					
All ages	6818	1714	272	252(253)	137(136)
< 20	1762	534	77	303[c]	126
20 - 29	2268	743	104	328	123
30 +	2788	437	91	158	172
Hindu					
All ages	923	253	34	274(271)	118(122)
< 20	252	49	4	392	75
20 - 29	311	102	13	328	113
30 +	360	52	17	144	246

[a] The rate in parentheses is the age-standardized rate using number of women-years of observation for all women as the standard.

[b] The rate in parentheses is the age-standardized rate using number of terminations for all women as the standard.

[c] Comparison significant at < .05 level.

Table 6: Life Table Medians of Conception-wait Interval (in Months) by Age Group of Woman and Socioeconomic Characteristics*

Socioeconomic Variable and Category	Age Group		
	All Ages	Below 25	25 and Above
All Women	9	9	9
Education			
None	8	8	9
Some	11	11	11
Occupation of Husband			
Agriculture	8	8	8
Business	7	7	7
Fishing	8	6	8
Other	12	11	12
Religion			
Muslim	9	9	9
Hindu	8	8	8

*These life tables included all resumption of menstruation events so a woman can be represented more than once.

Table 7: Life Table Medians of Interval from Live Birth Delivery to Resumption of Menstruation, by Woman's Age Group and Socioeconomic Characteristics*

Socioeconomic Variable and Category	Age Group		
	All Ages	Below 25	25 and Above
All Women	16	14	18
Education			
None	17	15	18
Some	14	13	16
Occupation of Husband			
Agriculture	17	16	18
Business	16	15	17
Fishing	16	14	18
Other	15	13	18
Religion			
Muslim	16	14	18
Hindu	16	13	21

*These life tables included all resumption of menstruation events so a woman can be represented more than once.

Table 8: Life Table Medians of Intervals of Full Breastfeeding (Without Supplementation) and of Total Breastfeeding for Women with Live Births in the Prospective Period and No Child Death, by Socioeconomic Characteristics

Socioeconomic and Category	Radix of Life Tables	Median Full Breastfeeding (Months)	Median Total Breastfeeding Interval (Years)[a]
All Women	1194	29	32
Education			
None	879	30	32
Some	315	23	30
Occupation of Husband			
Agriculture	432	31	30
Business	147	27	28
Fishing	110	21	35
Other	505	27	33
Religion			
Muslim	1061	30	31
Hindu	133	10	34

[a]Interval from birth to complete cessation of breastfeeding.

Table 9: Life Table Median Lengths of Postpartum Amenorrhea for Women Beginning Full Breastfeeding After a Live Birth, by Length of Full Breastfeeding*

Length of Full Breastfeeding (in Months)	Radix of Life Table	Median Length of Postpartum Amenorrhea
All Lengths	3203	15
< 1	201	8
1 - 2	272	12
3 - 4	218	15
5 - 6	252	16
7 - 8	253	15
9 - 10	152	16
11 +	161	17

*In this table women are included if they began full breastfeeding in the month of a live birth and ended full breastfeeding in the prospective period. If a woman had two such breastfeeding intervals, she would be represented twice in the tables.

Table 10: Comparisons With Chen, et al. of Estimated Components of the Live Birth Interval (Chen, et al. Results in Parenthesis)

Waiting Time to Conception (Months) Menstrual Interval	Outcome	Probability per Conception	Length of Interval (Months) Gestation	Postpartum Sterility
	(i)	(P_1)	(G_1)	(S_1)
(M)	(1) Fetal Loss	.088 (.13)	3.0 (1.0)	1.8 (2)
8.0 (8)	(2) Still Birth	.046 (.02)	8.0 (8.5)	3.3 (2)
	(3) Live Birth	.865 (.85)	9.0 (8.5)	15.0 (15)

Estimates of Mean Intervals and Fertility Rate

Estimated Mean Conception Interval $= M + \sum_{i=1}^{3} P_1 \ (G_1 + S_1)$

$= 30.6$ months (28.7)

Estimated Mean Live Birth Interval $= \frac{1}{P_3}$ x mean conception interval

$= 35.4$ months (33.8)

Estimated fertility rate = (12/estimated mean live birth interval) x proportion of women who will have another conception)

$= .285$

Appendix Table 1: Radices of Life Tables for Prospective Intervals from Life Birth Delivery to Resumption of Menstruation (LB-RM) and from Resumption of Menstruation to Conception (RM-C) by Socioeconomic Characteristics and Age Group

Socioeconomic Variable and Category	Age Group: All Ages		Below 25		25 +	
	LB-RM	RM-C	LB-RM	RM-C	LB-RM	RM-C
All Women	1954	2383	1096	1164	858	1219
Education						
None	1476	1829	773	823	703	1006
Some	478	554	323	342	155	213
Occupation of Husband						
Agriculture	713	899	385	423	328	476
Business	248	302	129	147	119	155
Fishing	211	250	121	121	90	129
Other	782	932	461	474	321	459
Religion						
Muslim	1703	2098	942	1020	761	1078
Hindu	251	285	154	144	97	141

REFERENCES

Barrett, J. C. and J. Marshall
1969 "The Risk of Conception on Different Days of the Menstrual Cycle." Population Studies 23(3):455-461.

Becker, S.
forthcoming "Les Causes du Mouvement Saissonier des Naissance au Bangladesh Rural." Population Studies.

Becker, S.
1981 "Seasonality of Fertility in Matlab, Bangladesh." Journal of Biosocial Science 13:97-105.

Bhatia, S., W. H. Mosley, A. S. G. Faruque, and J. Chakraborty
1980 "The Matlab Family Planning Health Services Project." Studies of Family Planning 11(6):202-212.

Chen, L. C., S. Ahmed, M. F. Gesche, and W. H. Mosley
1974 "A Prospective Study of Birth Interval Dynamics in Rural Bangladesh." Population Studies 28(2):277-297.

Chen, L. C. and A. K. M. A. Chowdhury
1977 "The Dynamics of Contemporary Famine." International Union for the Scientific Study of Population International Population Conference, Mexico, Vol. I:409-426.

Chowdhury, A. K. M. A. and S. Becker
1981 "Determinants of Natural Fertility: Methods and Descriptive Tables for the Prospective Study 1975-1978." Scientific Report No. 48. Dacca, Bangladesh: International Center for Diarrhoeal Disease Research, Bangladesh.

Government of Bangladesh
1978 World Fertility Survey: Bangladesh Fertility Survey 1975; First Report. Dacca, Bangladesh.

Henry, L.
1961 "Some Data on Natural Fertility." Eugenics Quarterly 8(2):81-91.

Huffman, S., A. K. M. A. Chowdhury, J. Chakraborty, and W. H. Mosley
1978 "Nutrition and Postpartum Amenorrhea in Rural Bangladesh." Population Studies 32(2):251-260.

Huffman, S. L., A. K. M. A. Chowdhury, J. Chakraborty, and N. K. Simpson
1980b "Breastfeeding Patterns in Rural Bangladesh." American Journal of Clinical Nutrition 33:144-154.

Langsten, R.
1980 "Causes of Changes in Vital Rates: The Case of Bangladesh." Ph.D. Dissertation, University of Michigan, Michigan.

Leridon, H.
1977 Human Fertility. Chicago: University of Chicago Press.

Maloney, C., K. M. A. Aziz, and P. C. Sarkar
1981 "Beliefs and Fertility in Bangladesh." Monograph. Dacca, Bangladesh: International Center for Diarrhoeal Disease Research, Bangladesh.

Menken, J.
1975 "Estimating Fecundability." Dissertation, Princeton University.

Phillips, J. F., W. S. Stinson, S. Bhatia, M. Rahman, and J. Chakraborty
1982 "The Demographic Impact of the Family-Planning Health Services Project in Matlab, Bangladesh." Studies in Family Planning 13(5):131-140.

Potter, R. G., J. B. Wyon, M. New, and J. E. Gordon
1965 "Fetal Wastage in Eleven Punjab Villages." Human Biology 37:262-273.

Rahman, M., W. H. Mosley, A. R. Khan, A. I. Chowdhury, and J. Chakraborty
1980 "Contraceptive Distribution in Bangladesh: Some Lessons Learned." Studies in Family Planning 11(6):191-201.

Ruzicka, L. and A. K. M. A. Chowdhury
1978 "Demographic Surveillance System-Matlab, Vol. 4: Vital Events and Migration--1975." Scientific Report No. 12. Dacca, Bangladesh: Cholera Research Laboratory.

Schwartz, D., P. D. M. MacDonald, and V. Heuchel
1980 "Fecundability, Coital Frequency, and the Viability of Ova." Population Studies 34(2):397-400.

Sheik, K. and S. Becker
1980 "Socioeconomic Status and Fertility in Rural Bangladesh." Unpublished manuscript. International Center for Diarrhoeal Disease Research, Bangladesh.

Sheps, M. C. and J. Menken
1973 Mathematical Models of Conception and Birth. Chicago: University of Chicago Press.

Stinson, W. S., J. F. Phillips, M. Rhaman, and J. Chakraborty
1982 "The Demograpnic Impact of the Contraceptive Distribution Project in Matlab, Bangladesh." Studies in Family Planning 13(5):141-148.

Stoeckel, J. and A. K. M. A. Chowdhury
1971 "Seasonal Variation in Births in Rural East Pakistan." Journal of Biosocial Science 4:107-116.

28

MICHIGAN STATE UNIVERSITY

WORKING PAPERS ON WOMEN IN INTERNATIONAL DEVELOPMENT

Published by the Office of Women in International Development at Michigan State University and partially funded by the Ford Foundation and a Title XII Strengthening Grant

EDITOR: Rita S. Gallin, Office of Women in International Development and College of Nursing

EDITORIAL BOARD: Marilyn Aronoff, Department of Sociology
Ada Finifter, Political Science
Peter Gladhart, Departments of Family and Child Ecology and Resource Development
John Hinnant, Department of Anthropology
Susan Irwin, Department of Anthropology
Akbar Mahdi, Department of Sociology
Nalini Malhotra, Department of Sociology
Anne Meyering, Department of History
Ann Millard, Department of Anthropology
Barbara Rylko-Bauer, Department of Anthropology
Judith Stallmann, Department of Agricultural Economics
Paul Strassmann, Department of Economics
Diane Turner, Department of Anthropology

MANAGING EDITOR: Margaret Graham, Office of Women in International Development

EDITORIAL POLICY: The series of Working Papers on Women in International Development publishes reports of empirical studies, theoretical analyses, and projects that are concerned with development issues affecting women in relation to social, political, and economic change. Its scope includes studies of women's historical and changing participation in political, economic, and religious spheres, traditional roles within and outside the family, gender identity, relations between the sexes, and alterations in the sexual division of labor.

MANUSCRIPTS (in duplicate) should be submitted to the editor, Rita S. Gallin, Ph.D., WID Publication Series, Office of WID, 202 International Center, Michigan State University, East Lansing, Michigan 48824. They should be double-spaced and include the following: (1) title page bearing the name, address, and institutional affiliation of the author(s); (2) one-paragraph abstract; (3) text; (4) notes; (5) references cited; and (6) tables and figures. To further the rapid dissemination of information, a timely schedule of manuscript review and publication is followed.

TO ORDER PUBLICATIONS OR RECEIVE A LISTING OF WORKING PAPERS, write to the Office of WID, 202 International Center, Michigan State University, East Lansing, MI 48824.

MSU is an Affirmative Action/Equal Opportunity Institution