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A Validation Study of Backward and Forward Pregnancy Histories in Matlab, Bangladesh

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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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FIGURES

Dedicated to the memory of V. C. Chidambaram 1935–1984
Deputy Project Director of the World Fertility Survey

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1 Introduction

In most developing countries, vital registration data, where they exist at all, are of poor quality and coverage, or are available only for local regions, so that making accurate direct estimation of fertility is impossible. Thus demographers have turned to retrospective surveys to estimate fertility. One type of retrospective survey instrument which records a woman's entire fertility experience is the pregnancy history. The World Fertility Survey (WFS) has sponsored surveys which include a pregnancy history in forty-two countries (Scott and Singh 1981).

However, fertility estimates derived from these surveys are subject to two types of error: the misplacement of births in time and the omission of births altogether. It is known that the probability of omission increases with the number of years that the event occurred before the survey, and the patterns of misplacement error are thought to vary according to whether the questionnaire is designed to proceed forwards from the first birth or work backwards from the last birth. Potter (1977) has suggested a model for misplacement errors and has found indirect evidence of their existence in El Salvador and Bangladesh. Another common error affecting fertility estimates is age misstatement by the woman. The effects of age reporting errors have been studied by several authors (eg van de Walle 1968; Sivamurthy and Ahmed 1979).

The Demographic Surveillance System (DSS) of Matlab, Bangladesh provides a unique opportunity for evaluating the extent of these errors in pregnancy history data. Matlab is situated 40 miles south of Dacca on a flat deltaic plain with numerous rivers and canals. The inhabitants are engaged mainly in rice cultivation. The area and population are described more fully elsewhere (Ruzicka and Chowdhury 1978).

The vital registration system of Matlab has been operating under the aegis of the Cholera Research Laboratory (now the International Centre for Diarrhoeal Disease Research, Bangladesh) in 132 villages since 1966. Censuses were conducted in the area in 1966, 1970, 1974 and 1978. The registration procedures in the DSS are as follows (for further details see Cholera Research Laboratory 1978). Pregnancy terminations, deaths, marriages and migrations are recorded by female village workers who visit each household weekly. A male field assistant, during monthly visits, records all events on standard registration forms. Pregnancy terminations are designated as live births, miscarriages or still births where the distinction between the last two is based on whether the pregnancy was less than or greater than seven months. An in-migrant is defined as someone who moves into the area for permanent residence. (Residence of at least six months is considered permanent.) Out-migration is the opposite.

When the idea of a study of errors in pregnancy history data was first proposed, some demographers argued that Matlab could not be used for a validation study since, with 13 years of continuous surveillance in the vital registration system, the population has become very aware of the number and the timing of vital events. According to this argument, their retrospective reports are likely to be more accurate than reports produced in other areas of Bangladesh. This is termed the contamination effect. But since a validation study of this nature can only be done under these circumstances, to argue that contamination nullifies the research is to argue that there should be no validation. Instead, with an awareness of this criticism, we attempted to study the contamination effect as part of the research by comparing survey data from an adjacent non-DSS area with survey data from the DSS area.

2 Methods

2.1 STUDY DESIGN

The procedures of the Bangladesh Fertility Survey (BFS) were followed as closely as possible to allow comparison of the results of this validation with results of the BFS (see Government of Bangladesh 1978 for details of the BFS). Interview forms of the BFS were used, with two important changes. First, to examine the differences in error patterns between 'backward' and 'forward' pregnancy histories, a backward form was designed, using the same format as the forward BFS form (figure 1, panel B). Secondly, provision was made for reporting the month of a pregnancy termination in combination with the years ago it occurred. This option was not included in the BFS, and its omission led to inaccurate data in that if the respondent could not give the month and year of the child's birth, then only the number of years ago that the birth occurred was asked. But since fully 85 per cent of the pregnancy terminations did not have the year and month reported, and many women did not report children under age one as 'zero' years old, numerous errors arose (Chidambaram and Pullum 1981). Allowing reporting of month and years ago eliminates most of this problem (compare question 315 in the panels of figure 1). Since nearly all Bangladeshi women know the Bengali month or season of their births, simple arithmetic using this and the month of interview yields the number of months ago.

The sampling universe for the study was women in the Matlab DSS area and in villages adjacent to it. Within the DSS area, in order to minimize the possible contamination effect, villages in which longitudinal studies of fertility are being done were excluded (83 villages of the Contraceptive Distribution Project and Maternal and Child Health programme fell into this category, as did 14 villages of the Determinants of Natural Fertility Study) and only villages which have had registration since 1966 were considered. The 37 DSS villages which met these conditions were clustered in two areas, one near Matlab and the other in the vicinity of the town of Nayergaon.

For the non-DSS sample, to study possible contamination several villages adjacent to the DSS study villages were selected with the help of the Matlab staff. Villages of comparable size, religion and social setting were chosen. Thus the design called for use of two questionnaires in two areas.

The criteria to determine eligible women were those of the BFS, that is, the women had to be ever married, aged between 15 and 50, and to have slept in the household the previous night. However, within the DSS many women who satisfied these criteria would not have lived in the area continuously since 1966. For the purposes of this study three groups of women within the universe of eligible women in the DSS area were distinguished.

1 Women who had resided in the vital registration area continuously since 1966 or since marriage.
2 Women who had in-migrated and never out-migrated.
3 Women who had previously out-migrated, guests and other recent arrivals not yet classified as in-migrants. Recall that a stay of six months' duration is required for classification as an in-migrant.

Prior to the fieldwork, all women in the DSS census books in Matlab were identified as belonging to one of these groups. Only interviews with the women in the first two groups could be used in the validation study. To determine sample sizes, standard procedures were followed (Snedecor and Cochran 1976). For the contamination testing, to detect a difference of 0.10 in the proportions of women (in the two areas) who could report the date of birth of any of their children, a sample size of 300 was required. For the validation part of the study sample sizes within the DSS itself also had to be determined. The precision available with a sample size of 300 women in group 1 was deemed sufficient for the variables of interest. Half of these women were to be interviewed using a backward questionnaire and half using a forward questionnaire.

Using the census books of 1966, 1970 and 1974 the proportion of women currently residing in a village who were in group 1 was estimated as 0.57. Using this information, the 1974 population figures for the 37 villages, and the required sample size, it was determined that interviews would be needed in 3-5 of the DSS villages. A cluster of villages in the Nayergaon area was selected to simplify logistics.

The DSS sample size pertained to women in group 1 only. However, during the fieldwork two procedures of interviewing were combined. First a fixed number of all eligible women were interviewed and then women in group 1 only were selected until the required sample size was reached. The reasons for this were:

1 For the analysis of possible contamination the sampling criteria had to be identical in the non-DSS and DSS areas, and in the non-DSS area there was no easily identifiable group of women corresponding to group 1 in the DSS area.
2 Interviewing all eligible women in each village made the field instructions and procedures simple.
3 The age distribution of women in group 1 was found to be very skewed to the older ages (most women change residence at the time of marriage) so that analyses of these data alone would not be representative.

It was felt that the results would be most comparable with the Bangladesh Fertility Survey if interviewers who

A Extract of original Bangladesh Fertility Survey pregnancy history table

PREGNANCY HISTORY TABLE

312	313	314	IF A LIVE BIRTH			
			315	316	317	318
Preg-nancy Order	What was the name of your first/next baby born alive?	After ____ (name) and before ____ (name) was born did you have any other preg-nancies?	In what month and year was ____ (name) born?	Was the baby a boy or a girl?	Is the child still living?	(If not alive) How long did this boy/girl live?
01		YES [1] (SKIP TO 319) NO [2] (ASK 315-318)	Beng/Eng MONTH ____ YEAR ____ YEARS AGO ____	BOY [1] GIRL [2]	YES [1] (PROCEED WITH NEXT PREGNANCY) NO [2] (ASK 318)	MONTHS ____ YEARS ____ ASK THE NEXT PREGNANCY

B Extracts of the forward and backward questionnaires of the present study showing alterations of the BFS questionnaire

Forward

312	313	314	
			315
Preg-nancy Order	What was the name of your first/next baby born alive?	After ____ (name) and before ____ (name) was born did you have any other preg-nancies?	In what month and year was ____ (name) born?
		YES [1] (SKIP TO 319) NO [2] (ASK 315-318)	Beng/Eng MONTH ____ YEAR ____ YEARS AGO ____ MONTH ____

Backward

312	313	314	
			315
Preg-nancy Order	What was the name of your last/previous baby born alive?	Before ____ (name) and after ____ (name) was born did you have any other preg-nancies?	In what month and year was ____ (name) born?
		YES [1] (SKIP TO 319) NO [2] (ASK 315-318)	Beng/Eng MONTH ____ YEAR ____ YEARS AGO ____ MONTH ____

Figure 1 Extract of the pregnancy history questionnaire of (A) the original Bangladesh Fertility Survey and (B) the forward and backward questionnaires of the present study

had worked in the BFS were hired. The time required for training would also be less. Nawab Ali of the BFS contacted former interviewers, but as many of them had married or obtained permanent employment, only two former employees could be hired. Fortunately, two other women who had had experience in pregnancy history surveys similar to the BFS were located and hired.

Interviewers were given instructions at the National Institute of Population Research and Training in Dacca. Since they had already gained experience in a similar survey, a day's training was thought sufficient, after which they were taken for a field trial in a village just outside Dacca. The BFS Interviewer's Manual was used as guidelines for the collection of the forward pregnancy histories (Government of Bangladesh 1975).

A change was made, however, in the manner of estimating the respondent's age. In the BFS if a woman did not know her age, the interviewer asked the woman if she had married before or after menarche. If marriage took place after menarche, the woman was asked how many years after; she was then asked the number of years from marriage to her first birth and the number of years since that birth (or age of the oldest child, if surviving). Thirteen was taken as the age of menarche in the BFS. Since there is evidence of a recent rise in the age of menarche in Bangladesh, 14 was used as the age of menarche in this survey (Chowdhury *et al* 1977).

Emphasis was placed on the collection of accurate age data for the children and respondent. Unlike the BFS, since both 'month and years ago' was needed for those events for which the date was not provided, the Bengali month for each event had to be asked. After month was recorded, the interviewer calculated the 'months ago' and probed for 'years ago'. In addition, before the interview a list of all living children of the respondent in birth order was made, following the pattern of the prior listing of persons in the BFS household questionnaire. The list served as a framework for probing any events (especially foetal losses and still births) in the intervals between two living children.

2.2 FIELDWORK

The survey began on 27 February 1980 in a non-DSS village, Padua, near Nayergaon. The interview team, based at Nayergaon, was composed of the four female interviewers and a male supervisor. The procedure was for the interviewers to conduct first 75 forward interviews and then 75 backward interviews within a village and then move to the next village. Normally in an experimental study of this sort, questionnaires would be randomly assigned or alternated. However, the randomization would only have been possible with a prelisting procedure in both areas,[1] and alternation was judged to be too confusing to the interviewers. The design chosen could have led to biases if the interviewers selected certain types of women for one questionnaire type instead of proceeding directly through the village as instructed. Indeed, as is noted below, the women who received the forward questionnaire were older than those who received the backward questionnaire.

In the two non-DSS villages 300 pregnancy histories were collected from all eligible women as described. Each worker did approximately 8 interviews per day. Much time was spent in walking the long distance between *baris*. In the five DSS villages 300 interviews were conducted following the same procedure as in the non-DSS villages. Then 266 more interviews were carried out with women in group 1 in order to complete the required sample size for the validation study. The entire work was completed in five weeks.

Before the actual interviewing in the DSS area, the household census card was collected from each household by the supervisor so that it could not be consulted to obtain the respondent's age and the birth dates of her children. The supervisor also checked the schedules for completeness, and, in the DSS area, recorded the registration number of the respondent. At the end of each day, he checked each schedule for internal consistency. Interviewer number, age of the respondent, registration number, type of DSS case and other information were then entered in a note-book. At least once a week an investigator visited the field to check on the progress of the work and deal with problems.

2.3 CODING OF SURVEY DATA, VITAL REGISTRATION DATA AND MATCHING METHODS

Even before the fieldwork was complete, coding of questionnaires began. For the non-DSS villages, coding of the interviews was straightforward. For the DSS villages some additional information was included. The respondent was located in the census book and her census age and date of in-migration (if any) were coded. Type of DSS case was also coded.

To construct an independent pregnancy history from the vital registration data all available census, birth, death and migration records were utilized. The procedures for this work are given in appendix A.

Next a computer list of the pregnancies reported by each women in the survey was prepared. The list and the file created from the census, birth and death records were compared manually. Women in the survey who were guests, or otherwise did not appear in the census books, had been excluded. Then a combined pregnancy history for each woman was constructed. Each single birth event or event pair in the combined file was given one of the following match codes:

1 Matched pair
  - A Name the same, sex the same, pregnancy order the same
  - B Name the same, sex the same, pregnancy order not the same
  - C Name different, sex and order the same
  - D Only one name available, sex and order the same (often birth reports did not give the name)
  - E No names available, two live births, sex and order the same
  - F Two pregnancy losses, sex and order the same
  - G Two pregnancy losses, sex not given or only given once, order the same
  - H Live birth in vital registration but still birth reported in survey, order the same
  - I Two pregnancy losses, sexes different

2 Record in DSS only, still birth or miscarriage.

3 Record in DSS only, live birth.

4 Report in survey only, event occurred more than 14 years earlier.

5 Report in survey only of still birth or miscarriage less than 14 years earlier.

[1] Though a list was available for women in the DSS area a separate prelisting would nevertheless have been necessary to guarantee comparable methods in the DSS and non-DSS areas.

6 Report in survey only of a live birth less than 14 years earlier with no subsequent death.

7 Report in survey of a live birth less than 14 years earlier with a subsequent death.

In this matching the order of the events in the two files was crucial if the match was not of type 1A or 1B. However, comparison of the actual dates of the events was prohibited since using this information as a criterion for matching would bias the later analysis. After the matching was complete, the match type was coded for each pregnancy and the pregnancies were numbered sequentially to allow construction of the matched pregnancy history computer file.

3 Analysis of Possible Contamination in DSS Villages

To assert that the validation study is contaminated is to say that women in the DSS area remember the births and deaths of their offspring better than women outside the DSS area, because these women have been asked about demographic events by the surveillance workers at least once each month since 1966 or the time of their migration into the DSS area. The study design allowed tests for contamination: three types of data are compared in the DSS and non-DSS areas. The first is the proportion of women with at least one pregnancy who were able to report the date of at least one event. The second is the mean number of pregnancy terminations (live births and non-live births) per woman by age group. The third is the length of closed birth intervals. Each of these will be examined in detail. In each case, two groups of women in the DSS area can be compared with women of the non-DSS sample. The first group is the sample of all eligible women selected by the sample criteria as used in the non-DSS villages. Direct comparisons between these two groups can be made to test for the presence of contamination. The second DSS group is the purposive sample of women who had resided continuously in the area since 1966 or since in-migration.

3.1 PROPORTIONS OF PAROUS WOMEN REPORTING DATE OF BIRTH FOR AT LEAST ONE BIRTH

If contamination exists in the DSS area, a higher proportion of women will be able to report the date (month and year) of one or more of their pregnancy terminations. If the women could not report a date, the number of years and months ago that the event occurred was asked. The

Table 1 Per cent of parous women reporting month and year for at least one birth by area for age groups, education groups and week of interview

	Non-DSS area		DSS area					
			All women		All eligible women		Non-migrant women sample	
	No. of women	Per cent reporting	No. of women	Per cent reporting	No. of women	Per cent reporting	No. of women	Per cent reporting
Total sample	271	34	501	27[a]	255	28	246	27
Age group								
<20	33	52	43	67	21	67	22	68
20-29	101	43	181	34	97	37	84	31
30-39	78	33	134	28	75	23	59	34
40-49	59	8	143	6	62	6	81	6
Education of respondent								
0	224	34	385	26	209	25	176	27
1-5	43	37	99	31	39	36	60	28
6+	4	0	17	35	7	57	10	20
Week of interview								
1	89	33	-	-	-	-	-	-
2	158	34	-	-	-	-	-	-
3	24	38	161	27	161	27	-	-
4	-	-	165	30	94	29	71	32
5	-	-	175	25	-	-	175	25

[a] Significantly different from the non-DSS per cent ($p<0.05$).

ability to report a calendar date of an event in Bangladesh is dependent on the educational level of the respondent. Since education was not a characteristic used in the sampling design and there were more educated women in the DSS sample (table A1), educational level is controlled in this analysis.

An unexpected result appears (table 1). The proportion of women who could report the date of at least one pregnancy termination is significantly lower in the DSS area than in the non-DSS area ($p \leq 0.05$). Even among women with no education the proportion reporting at least one date is significantly lower in the DSS area ($p \leq 0.05$). In fact, after removing the effect of differing educational distributions in the two areas by direct standardization (using the educational distribution of the non-DSS area and the proportions of the DSS area), the overall DSS proportion is even lower. Thus the observed difference between the areas is not due to differences in the educational level of the women.

These results suggest a possible 'reverse contamination' effect. Before considering such an effect, however, we attempt to pinpoint the sources of the differences. Younger women in both areas were better able to report dates of pregnancy terminations than older women. In the DSS area, a higher proportion of women under the age of 20 reported at least one date, though the result did not attain statistical significance. However, in the older age groups a greater proportion of women in the non-DSS area reported at least one date.

Since the study design specified the completion of all interviews in the non-DSS villages before the work started in the DSS villages, a possible explanation of the observed difference is that the interviewers began their work with enthusiasm and used careful probes to ascertain the dates of events, but later, in the DSS area, they became tired and were less careful. The proportions by week of work show a slight trend downwards (table 1). The test for linear trend in proportions revealed a significant coefficient at the 0.10 level. Though the pattern is irregular, the last week had the lowest proportion, lending support to the idea that the work may have been done less carefully in the final days of interviewing. However, since all the DSS interviews were done at the end of the study, the possible effects of reverse contamination, as opposed to the slackness of interviewers, are confounded in these data.

Similar proportions for the most recent birth are shown in table 2. The most recent birth to women in the DSS area has the advantage of being a DSS birth in most cases, ie a birth occurring to DSS women within the operation of the vital registration system. The reported date of this birth is the one most likely to have been affected by contamination. At the same time, the date of the most recent birth is the one women are likely to remember best. The reporting pattern of table 1 is repeated, although the differences by age group are somewhat reduced (table 2).

Table 2 Per cent of parous women reporting date of the most recent birth by area and age group

Age group	Non-DSS area		DSS area (all eligible women)	
	No. of women	Per cent reporting	No. of women	Per cent reporting
All ages	271	31	255	27
<30	145	35	122	40
30+	126	23	133	15

3.2 MEAN NUMBER OF PREGNANCY TERMINATIONS

Assuming that fertility is the same in the non-DSS and DSS villages, the mean numbers of pregnancy terminations can be compared to measure possible contamination. If contamination exists, women in the DSS area will be more likely to remember events than women in the non-DSS area.

The mean numbers of reported pregnancy terminations, live births and non-live births by age group (table 3) are similar for the non-DSS and DSS (all eligible women) sample. The overall mean number of pregnancy terminations of 4.76 in the DSS non-migrant sample is higher than the mean for the other areas; however, the difference is largely due to the high proportion of older women in the purposive sample.

3.3 INTERVAL BETWEEN BIRTHS

During the interviews, there was a natural tendency on the part of the respondents to say that the next child came 'three years later' or 'two and one half years later', and so on. The interviewers were instructed to probe for the month of birth to determine the exact timing of the pregnancy termination, but the respondent, after saying 'three years later', may simply have reported the same month of pregnancy termination as well, so that inter-pregnancy intervals of 12, 18, 24, 30, 36, 42 and 48 months may appear more often in the data than expected. Interval length can therefore be used as a test for contamination.

In table 4 the number of women reporting intervals of a given order in the forward questionnaire is given. [2] In addition the intervals (calculated from either the date of birth or years and months ago for each termination) which were of 12, 18, 24, 30, 36, 42 or 48 months are expressed as a proportion of all reported intervals of between 12 and 48 months. Assuming a uniform distribution of births between 12 and 48 months, a proportion of $7/36 = 0.194$ is expected.

Again the results point to less accurate data in the DSS area, the reverse of the contamination hypothesis. The proportion (0.232) for the whole DSS area is significantly different from 0.194 at the 0.01 level. Indeed, the least accurate data appear in the purposive sample of

[2] No patterns or significant differences were found in the analysis of intervals from the backward questionnaires.

Table 3 Mean number of pregnancy terminations, live births and non-live births by age group and area

Age group	Non-DSS area				DSS area											
					All women				All eligible women sample				Non-migrant women sample			
		Type of termination				Type of termination				Type of termination				Type of termination		
	Number of women	All birth events	Live births	Non-live births	Number of women	All birth events	Live births	Non-live births	Number of women	All birth events	Live births	Non-live births	Number of women	All birth events	Live births	Non-live births
All ages	300	4.27	3.86	.41	566	4.48	4.13	.35	300	4.23	3.91	.32	266	4.76	4.38	.38
<20	60	.62	.57	.05	94	.55	.49	.06	56	.43	.38	.02	38	.79	.66	.13
20-29	103	2.98	2.70	.28	192	2.92	2.74	.18	105	2.75	2.64	.12	87	3.13	2.88	.25
30-39	78	6.14	5.62	.53	137	6.18	5.55	.55	77	5.97	5.43	.54	60	6.42	5.87	.55
40-49	59	8.02	7.34	.68	143	7.53	6.97	.56	62	7.94	7.39	.65	81	7.14	6.64	.50

Table 4 Closed birth interval lengths reported in multiples of six months as a proportion of all reported intervals, by area and interval order for the forward questionnaire

Birth interval order	Non-DSS area		DSS area					
			All women		All eligible women		Non-migrant women sample	
	All intervals reported[a]	Proportion reported in multiples of six months	All intervals reported	Proportion reported in multiples of six months	All intervals reported	Proportion reported in multiples of six months	All intervals reported	Proportion reported in multiples of six months
All intervals	431	.190	930	.232[b]	394	.206	536	.252[b]
1-2	92	.185	180	.233	87	.207	93	.258
2-3	86	.209	174	.247	76	.197	98	.265
3-4	68	.176	152	.257	61	.180	91	.308
4-5	59	.220	128	.250	58	.224	70	.271
5-6	50	.140	111	.198	41	.195	70	.200
6-7	33	.212	88	.227	29	.276	59	.203
7-8	23	.217	62	.177	24	.125	38	.211
8-9	20	.150	35	.257	18	.278	17	.235

Expected proportion of intervals reported in multiples of six months =194 (7/36)

[a] All intervals of length 12-48.
[b] Significantly different from the non-DSS proportion ($p<0.05$).

DSS non-migrant women. The proportions in this group are above 0.194 for every birth interval order and the overall proportion (0.252) is significantly different from 0.194 at the 0.001 level. On the other hand, the proportions for the sample of all eligible women in the DSS (0.206) are not significantly different from 0.194.

From these three tests for contamination, the general pattern seems to be that reporting was significantly *worse* in the DSS sample than in the non-DSS sample. Reporting on the number of pregnancy termination events was not different in the two areas, but reporting of dates and the timing of the events was poorer in the DSS area.

Two explanations can be given. First, it is possible that after having monthly visits by vital registration staff for 13 years, the women in the DSS area have learned how to give quick answers to get rid of the interviewer. However, a second explanation is also possible, as we have suggested above. Since the interviews in the DSS area were done during the last three of the five weeks of work, the interviewers may have been tired and in a hurry to finish the work, and so were less careful about probing. Because these possibilities were not anticipated in the study design, the two possible effects cannot be distinguished with these data. However, contamination was also studied in a subsequent survey for validating the Brass fertility and mortality questions. In this survey the interviews in the non-DSS villages took place between two periods of DSS interviews, so that the possible time effect was fortunately controlled. The survey also had different interviewers, a different questionnaire, and was carried out in a different area of Matlab. Yet the reverse contamination effect persisted (Becker *et al* 1982). Clearly, the survey data from the DSS areas cannot be said to be more precise than similar survey data collected elsewhere in the country; indeed the results indicate that the DSS survey data are somewhat less precise than data obtained with similar methods elsewhere.

3.4 AGE REPORTING OF WOMEN

Contamination in the age reporting of women might also exist, and it is therefore important to see if there are differences in the age reporting of women in the DSS and non-DSS areas. An additional concern is that the differences in age reporting vary with the type of questionnaire.

The top panel of table 5 gives a comparison of the non-DSS and DSS age distributions. No significant differences are apparent between areas. However, marked differences were observed in the reported ages of women between the forward and backward questionnaires (lower panels of table 5). The women who answered the backward questionnaire had much younger reported ages than women who answered the forward questionnaire. This was first observed in preliminary tables done while the fieldwork was in progress. In Padua, the first non-DSS village, 33 per cent of the women interviewed using the backward form had reported ages of less than 20 while the corresponding percentage interviewed using the forward form was only

Table 5 Reported age distributions of women by questionnaire type and area

Questionnaire type and age group	Area		
	Non-DSS area		DSS area (all eligible women)
Both questionnaires			
All ages	(300) 100		(300) 100
<20	20		19
20-29	34		35
30-39	26		26
40-49	20		21
Forward questionnaire			
All ages	(150) 100		(150) 100
<20	13		17
20-29	41		31
30-39	25		30
40-49	21		22
Backward questionnaire	Padua	Mohismari	
All ages	(75) 100	(75) 100	(150) 100
<20	33	20	21
20-29	31	25	38
30-39	23	31	21
40-49	13	24	19

17. Since age of the woman was supposed to be determined before commencing the pregnancy history questions for both forms, these differences were shocking. When questioned, the fieldworkers answered that on the days that the forward questionnaires were used, most of the young women were out in the fields helping with the wheat harvest. (It should be recalled that the procedure was to conduct 75 interviews with the forward questionnaires and then 75 interviews with the backward questionnaires in each village. The forms were not randomized or alternated because it was felt that this would create too much confusion for the interviewers.) It can be seen from table 5 that the difference in age distributions continued to appear in the later interviews in the DSS area.

Fortunately, since another source of age data was available in the DSS area, it was possible to determine whether the differences were due to errors in reporting age or selection of the sample interviewed. Age for the non-migrant sample of women in the DSS area was available from the 1974 census or from in-migration records. Table 6 compares the survey age with the census age for the forward and backward forms for these women. Overall the percentage of women reporting

Table 6 Comparison of reported ages of women with ages from the DSS census records, by census age and type of questionnaire

Census age	Number of women	Survey age relative to census age				Per cent of women by census age
		All	Younger relative to census age	Same age as census age	Older relative to census age	
Forward questionnaire						
All ages	251	100	49	17	33	100
< 30	99	100	49	25	25	39
> 30	152	100	49	12	39	61
Backward questionnaire						
All ages	246	100	51	17	31	100
< 30	114	100	57	17	26	46
> 30	132	100	46	18	36	54

younger ages in the survey relative to the census age is not very different between form types. Nevertheless, there was a greater tendency in the survey for young women to report younger ages with the backward form than with the forward form (the two-tailed Z-test gives $p = 0.11$). But the more important cause of the difference in age distributions is apparent from a simple comparison of the distributions of the survey women by census age for the two forms (last column of the table). While 39 per cent of women interviewed with the forward form were below 30 years of age according to the census, the corresponding percentage for the backward form was 46 (the two-tailed Z-test gives $p = 0.11$). Since the census age of the respondents was unknown to the field staff, it is obvious that the interviewers selected younger women for the backward questionnaire. Indeed they expressed a feeling that the forward forms were easier to complete, especially for older women with many births. Since the questionnaire type was not randomized, it was possible for this bias to enter surreptitiously.

3.5 SUMMARY

Reviewing the results of the contamination analysis, the following pattern emerges. First, the number and type of events reported is not affected by contamination. However, young women in the DSS area are better able to report the dates of birth than women of the same age outside the DSS area. This is a sign of contamination. On the other hand, older women in the DSS area exhibit a consistent reverse contamination effect. They report dates of events less often than their non-DSS counterparts and they are more likely to report birth intervals in rounded years or half years. One explanation for this rounding is that women who have been visited by DSS workers each month for the past decade or more have learned how to give quick and acceptable, but not necessarily accurate, answers to interviewers in order to shorten the interviews. The need to remember the timing of events would also be perceived as less important by these women since all dates of events are recorded in the household card which could easily be consulted.

4 Validation Analyses

Of the 566 women interviewed in the DSS area, 497 were eligible for the validation analysis. The remaining women were either guests (15), newcomers to the DSS area (10), or had out-migrated from the area at some time in the past (44). The distribution of the 497 women according to questionnaire type and selected variables is shown in table 7. As with the full sample, younger women are over-represented in the backward questionnaire.

The distribution of birth events in the merged survey and vital registration pregnancy histories, according to the source of the event, type of questionnaire and age of the women is shown in table 8. Of the 2395 unique events, 1802 (75 per cent) were matched pairs and of those, 1268 had dates available in the DSS records. The remaining matches only have ages available from census records, ie children who were born before the registration began in 1966. Thus for women aged 30 and above the percentage of all events that were matched pairs dropped to 70 and the percentage with dates available to 41. On the other hand, 89 per cent of the events reported by young women were matched pairs with a birth date in the DSS record. Thus the validation of the pregnancy histories for younger women will be nearly complete. Indeed for 253 of the women (51 per cent) the complete pregnancy history was available from the vital registration records.

The validation analyses fall into three distinct categories presented separately below: first, an analysis of missed events; secondly, the errors of misplacement in time for matched events; thirdly, the combined effects of missed and misplaced events on fertility rates.

Though strictly speaking statistical tests comparing the backward and forward questionnaires are not valid because the questionnaires were not randomized, a few such tests are presented to indicate the strength of a relationship. For many other variables (eg missed events, differences between reported and actual time of birth, and exactness of sequences of matched events), it

Table 7 Per cent distribution of women in backward and forward pregnancy history interviews by interviewer, age, marital status, education and gravidity group

	Questionnaire type		
	Both types	Forward	Backward
Number of women	497	251	246
Interviewer			
a	23	24	22
b	21	20	23
c	28	26	29
d	28	30	26
Age group			
<20	15	15	15
20-29	32	27	38
30-39	25	29	22
40+	27	30	25
Gravidity group			
0-3	39	35	44
4-6	30	29	31
7+	31	37	26
Marital status			
Currently married	93	92	93
Separated or divorced	1	1	2
Widowed	6	7	5
Formal education (in years)			
None	74	73	75
1-4	15	18	13
5+	11	9	12

Table 8 Birth events to non-migrant women by source of event record, age of the woman and type of questionnaire

Mother's age	Source of event	Questionnaire type		
		Both questionnaires	Forward	Backward
All ages	*All events*	2395	1279	1116
	Both PH and DSS (matched events)	1802	938	864
	with birth date	1268	658	610
	with age only	534	280	254
	DSS only	71	45	26
	PH only, before 1966	470	261	209
	PH only, after 1966	52	35	17
< 30	*All events*	550	233	317
	Both PH and DSS	512	214	298
	with birth date	500	211	289
	with age only	12	3	9
	DSS only	17	7	10
	PH only, before 1966	6	5	1
	PH only, after 1966	13	5	8
30+	*All events*	1851	1050	801
	Both PH and DSS	1290	724	566
	with birth date	768	447	321
	with age only	523	278	245
	DSS only	54	38	16
	PH only, before 1966	464	255	209
	PH only, after 1966	39	30	9

Table 9 Rates of omission of birth events by type of questionnaire, outcome of the birth and age group of the woman

Age group of the woman and measure	Questionnaire type and outcome of the birth					
	Both forms		Forward		Backward	
	Non-live	Live	Non-live	Live	Non-live	Live
All ages						
Number of events missed	43	28	28	17	15	11
Number of events registered	109	1232	63	642	46	590
Rate of omission (per 100)	39.4	2.3	44.4	2.6	32.6	1.9
< 30						
Number of events missed	9	8	4	3	5	5
Number of events registered	29	492	14	207	15	285
Rate of omission (per 100)	33.3	1.6	28.6	1.4	33.3	1.8
< 30						
Number of events missed	34	20	24	14	10	6
Number of events registered	80	739	49	435	31	305
Rate of omission (per 100)	43.8	2.7	49.0	3.2	32.3	2.0

is possible to test assumptions of independence, equiprobability, etc.

4.1 MISSED EVENTS

A missed event was defined as a birth found in the vital registration system which the women did not report in the pregnancy history survey.[3] There were 71 missed events among the 1339 registered births in the DSS pregnancy histories (census records are not included in this count), giving an overall omission rate of 5 per cent. This of course represents only a lower bound for the actual rate since events which occurred before the woman entered the vital registration system could not be validated, ie the woman may have forgotten an event which occurred before she moved into the area or before 1966.

A number of questions may be asked about missed events. Do the rates of omission vary by type of questionnaire? Do the rates of omission differ according to age group of the woman after controlling for the number of events? Are non-live births more likely to be missed than surviving live births? Are female births more likely to be missed than male births? Are women with no formal education more likely to miss events than women who have some education? Each of these questions is considered in this section.

[3] One might consider the 52 events which were reported to have occurred after 1966 in the survey and which had no match with a DSS record, to be missed events in the registration system. These cases were examined in detail with the following results: 22 actually occurred before the woman came into the DSS area; 8 were reported to have occurred 12-14 years before the survey so an error in timing of the event could have occurred in the report of the woman; 22 others were not located. Of the latter 22, 18 were non-live births.

The omission rates by type of birth outcome, questionnaire type and age of the woman are shown in table 9. Over half of the missed events were non-live births, with a rate of omission of 39 per cent. The rate of omission for live births was 2 per cent. The differences between rates of omission for non-live and live births are highly significant for all age and type of questionnaire groups.

Looking at the rates by age and type of questionnaire, it is seen that the omission of both live and non-live births was more likely among women interviewed with the forward forms, although none of the observed differences reach statistical significance. Actually because of the preliminary listing of all living children in the same manner for both types of questionnaire, we would expect differences in overall rates of omission to be minor between questionnaire types. The only statistically significant difference between rates for the age groups is that for non-live births with the forward form. With this questionnaire a non-live birth was nearly twice as likely to be missed by an older woman than by a younger woman (rates of 49 and 29, respectively). Table 10 gives a different perspective on these data. Here, in addition to the percentage of events missed, the percentage of women with missed events is given. The rates of omission for women are higher for the forward questionnaire in all but one age group. The age-standardized proportions of women with missed events (0.16 and 0.07 for the forward and backward questionnaires, respectively) and proportions of events missed (0.06 and 0.04) are significantly different ($p \leq 0.01$ and $p = 0.08$ for the two tests).

To test the hypothesis that live births who subsequently died were more likely to be missed than live births who survived, rates of omission were calculated according to the survival status of the birth. Of the 28 missed live births, 21 were children surviving at the time of the survey and 7 had died. The corresponding numbers for

Table 10 Number and per cent of women with missing pregnancy terminations and number and per cent of missing events, by age of woman and type of questionnaire

Age group	Number of parous women	Number of matched pregnancy termination events with dates	Number of women with missed events	Number of missed events	Per cent of parous women with missed events	Per cent of events missed
Forward questionnaire						
All ages	233	656	40	45	17	7
<20	21	22	3	3	14	14
20-29	67	189	4	4	6	2
30-39	71	314	22	26	31	8
40 +	74	131	11	12	15	9
Backward questionnaire						
All ages	224	610	22	26	10	4
<20	19	23	1	1	5	4
20-29	89	266	8	9	9	3
30-39	54	202	6	6	11	3
40 +	62	119	7	10	11	8

all events in the DSS system were 1497 and 266, yielding rates of omission of 14 and 26 per thousand for the surviving and dead children, respectively. Though not statistically significant, dead children were missed more than surviving children.

With respect to the sex of the missed live births, 13 were males and 15 were females. The proportion male (0.464) is below the expected proportion of 0.512 based on a sex ratio at birth of 105, though the difference does not attain statistical significance because of the small number of events.

Finally, table 11 presents characteristics of the 62 women who had missed events. As expected, these women are older and of higher parity than women who did not forget any events. (When considered by type of questionnaire, the age and parity differences do not attain statistical significance for the backward form, again because of the small number of events.) Unexpectedly, however, the proportions of educated women among those who missed events are not lower than the proportion of educated women among those with no missed events. This is especially surprising since older women in the survey have a lower educational level.

Table 11 Characteristics of women with no missed events and of women with missed events by type of questionnaire

	No missed event	With missed events	
		Forward	Backward
Number of women	435	40	22
Mean parity	4.5	7.1[a]	7.1
Mean survey age	31.2	34.9[a]	33.2
Proportion educated	.26	.28	.23

[a] Significant at 0.05 level in two-tailed test.

4.2 THE ACCURACY OF REPORTS OF TIMING OF BIRTHS

There were 1268 matched birth events for the 497 women in the 14-year period before the survey. For 1266 of these events, it is possible to compare the birth dates calculated from the mothers' reports with the actual dates recorded in the vital registration data.[4] However, since the mothers reported Bengali month of birth while the vital registration data are recorded with western months and each Bengali month overlaps with two western months, several conversions were necessary.[5]

[4] Two additional matched events were only discovered when we were examining misclassified events after the analyses of matched events were complete.

[5] The following procedure was used. First, the number of completed months between the birth event and the interview was computed from the survey data. A corresponding value was calculated from the vital registration data using the date of birth and the interview date. The difference of the survey and vital registration values was then taken – call it DIFF. Next an algorithm was used to determine the Bengali month of the birth from the vital registration data. If the reported Bengali month agreed with the calculated month, then DIFF, if not zero, was made a multiple of 12. Thus, for example, values of 11 and 13 which were due only to differences in the calendars were changed to 12 in this way. If the reported Bengali month did not agree with the Bengali month calculated from the registration dates, and if DIFF was not zero, then one month was subtracted from DIFF if it was positive and one month was added if it was negative. The latter provided a liberal correction for the overlap in calendars when the mother did not report the correct month.

Differences between actual and reported time since birth will be analysed according to three sets of variables: those defining the conditions of the interview itself, characteristics of the mother, and characteristics of the birth. Finally, the patterns of the errors for women with two or more matched events will be considered.

Interview variables

Table 12 shows the distributions of the differences between the mother's reporting of the time of the birth and the actual date according to the type of questionnaire. In general the reporting is very accurate; 46 per cent of the event 'dates' were remembered exactly (within a two-month interval, as noted above) and for 75 per cent of the events the mother recalled the month of the birth correctly. These proportions are the same for both the forward and backward questionnaires, indicating that the questionnaires had no differential effect on the mother's ability to recall the time of the event. However, the distributions of the errors are slightly different for the two forms. The percentage of events reported to have occurred before they actually did was 39 for the forward form but 33 for the backward form. The percentages reported to have occurred after the actual date were 16 and 21. Thus there was a tendency for the women to report that the event occurred before it actually did with both questionnaires and this effect was more pronounced with the forward form ($p<0.01$). In addition, on average the errors were slightly larger for the forward form; the mean absolute error was 17.4 months for the forward form and 15.6 for the backward form ($t=1.54$).

Table 12 Per cent distribution of difference between reported and actual time of occurrence by type of questionnaire

Accuracy of reported time of occurrence	Months difference	Questionnaire type	
		Forward	Backward
Number of events		656	610
Reported 'too young' in the survey	24 or more	4	5
	13-23	3	1
	12	6	8
	1-11	3	7
Reported correctly	0	46	46
Reported 'too old' in the survey	1-11	9	8
	12	15	14
	13-23	5	4
	24 or more	10	7

Table 13 summarizes the distributions of the errors according to the type of questionnaire and the actual years since the event. As expected, the proportion of dates reported exactly declines sharply as the time since the event increases, from nearly 90 per cent for births occurring within the two-year period before the survey to 30 per cent for births occurring 10 or more years before the survey. Overall, the mean error is four months for the forward form and two months for the backward form.

Table 13 Comparison of reported age of child (or birth date) in the pregnancy history survey with actual date of birth from registration data for all matched events, by completed years since the event and type of questionnaire

Years since the birth event (in completed years)	Number of matched events	Per cent reported exactly	Per cent reported too young	Mean months too young	Per cent reported too old	Mean months too old	Mean overall difference (in months)
Forward questionnaire							
All ages	656	46	15	18	39	17	+4
0-1	101	87	1	12	12	15	+2
2-3	121	66	7	12	27	15	+3
4-5	79	42	15	12	43	13	+4
6-7	98	31	21	15	48	14	+4
8-9	104	30	15	20	55	18	+7
10 +	153	26	28	21	47	22	+5
Backward questionnaire							
All ages	610	46	21	15	33	16	+2
0-1	116	88	4	10	7	8	0
2-3	113	65	8	11	27	16	+4
4-5	81	43	22	11	35	17	+3
6-7	89	20	32	13	48	17	+4
8-9	76	25	28	13	47	13	+3
10 +	135	26	33	19	41	19	+1

Table 14 Number of matched events, proportion with age/date reported exactly and mean absolute error for inexact events, by interviewer

	Interviewer				
	All	a	b	c	d
Number of events	1266	277	274	359	356
Proportion exact	.46	.54	.47	.41	.44
Mean absolute error in months (for inexact events)	16.5	15.1	14.3	19.2	16.0

Four interviewers carried out the interviews with the 497 women. Table 14 shows the accuracy of the events recorded by these interviewers. In this and subsequent tables, two measures are used to judge the accuracy of reporting: the proportion of the events whose time of occurrence was reported exactly and the mean absolute error for events not reported exactly. These two measures were chosen since they are derived from different data and thus can be tested independently.

Interviewer *a* had the highest proportion of events reported exactly. Interviewer *c* had the lowest proportion and also for events reported incorrectly the mean absolute error was highest for this interviewer. Analysis of variance tests of the hypothesis that the proportions exact were the same across interviewer and of the hypothesis that the mean absolute errors were the same across interviewer yielded rejections in both cases ($p<0.01$ in both cases).

Characteristics of the mother

Table 15 shows the accuracy of reporting according to the age group of the mother, the questionnaire type and years since the birth. Younger women were better able to report the timing of the events exactly, even when years since the event is controlled. This is true for both questionnaires. Two caveats need to be mentioned, however. First, since younger women were better educated, this may not be a true age effect. Secondly, it has been shown that there was a slight contamination effect in the reports of younger women which implies that the observed pattern may not be wholly representative, and this result must be interpreted cautiously.

It is a plausible hypothesis that a woman who has had many pregnancies will not be able to report the timing of the pregnancy terminations as well as a woman who has had fewer pregnancies. To test this hypothesis, the number of years since the birth must again be controlled. Tables 16 and 17 provide an analysis of the exactness of reporting by gravidity group of the mother. From the per cent exact in both tables, it is clear that the hypothesis is accepted, ie controlling for the timing of the event, women who had fewer events in total can remember their timing better than women who have had more events.

The accuracy of the woman's recall of a particular event may depend more on the order of that event than on her total number of birth events. To explore this for the forward and backward questionnaires, the accuracy of events was tabulated according to birth order and years since the event (table 18). The table indicates that the timing of the first events is remembered better than the timing of later events among women interviewed with the forward form. This is not true of the backward

Table 15 Accuracy of reporting by mothers of the time of occurrence of matched birth events by type of questionnaire, time since the birth event and age of the mother

Time since birth event (completed years)	Mothers less than 30 years old					Mothers over 30 years old				
	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference
Forward questionnaire										
All years	211	65	8	28	+3	445	37	18	44	+5
0-1	59	93	0	7	+1	42	79	2	19	+3
2-3	59	71	9	20	+2	62	63	3	34	+5
4-5	26	62	12	27	+3	53	32	17	51	+4
6-7	30	27	20	53	+4	68	32	22	46	+4
8-9	26	42	4	54	+9	78	27	18	56	+6
10+	11	36	18	46	+2	142	25	28	47	+5
Backward questionnaire										
All years	289	61	16	23	+1	321	33	25	42	+4
0-1	83	87	2	10	+1	33	91	9	0	−1
2-3	74	70	5	24	+4	39	54	13	33	+4
4-5	44	52	16	32	+2	37	32	30	38	+5
6-7	41	34	32	34	−1	48	8	31	60	+8
8-9	25	32	28	40	+2	51	22	28	51	+3
10+	22	32	55	14	−10	113	25	29	46	+3

Table 16 Accuracy of reporting by mothers of the time of occurrence of matched birth events by type of questionnaire, time since the birth event and gravidity of the mother

Time since birth event (completed years)	Gravidity group 1-4					Gravidity group 5+				
	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference
Forward questionnaire										
All years	171	67	9	24	+2	485	39	17	44	+5
0-1	50	92	0	8	+1	51	82	2	16	+3
2-3	53	74	9	17	+1	68	62	3	35	+6
4-5	21	57	14	29	+2	58	36	16	48	+4
6-7	21	29	24	48	+3	77	31	21	48	+4
8-9	17	50	13	38	+4	87	26	15	59	+7
10+	9	22	11	67	+12	144	26	29	46	+4
Backward questionnaire										
All years	225	65	11	24	+2	385	35	27	38	+3
0-1	70	88	1	10	+1	46	89	9	2	−1
2-3	59	71	5	23	+3	54	57	11	32	+4
4-5	32	56	9	34	+3	49	35	31	35	+4
6-7	32	41	22	38	+2	57	9	37	54	+5
8-9	12	50	8	42	+6	64	20	31	48	+2
10+	20	30	45	25	−3	115	25	31	44	+2

Table 17 Per cent of events reported exactly by years since occurrence of the event and gravidity group of the mother

Completed years since event	All gravidity groups	Gravidity group				
		1-2	3-4	5-6	7-8	9+
All years	46	88	60	41	39	31
0-1	88	93	87	90	86	78
2-3	66	74	71	64	51	63
4-5	43	–	58	41	43	24
6-7	26	–	38	20	24	21
8-9	28	–	56	22	32	19
10+	26	–	28	29	26	23

– Percentages not shown if less than 20 cases.

Table 18 Accuracy of reporting by mothers of the time of occurrence of matched birth events by years since occurrence of the event, order of the event and type of questionnaire (per cent exactly reported)

	Order of the event and type of questionnaire											
	All orders			Order 1			Order 2-4			Order 5 +		
	F	B	Diff.	F	B	Diff.	F	B	Diff.	F	B	Diff.
All years	46	46	0	63	51	+12	42	47	−5	44	45	−1
0-3	77	77	0	91	74	+17	74	80	−6	73	74	−1
4-7	36	31	+5	65	50	+15	30	36	−6	34	21	+13
8+	27	26	+1	35	29	+6	23	20	+3	24	27	−3

form, where respondents remembered second events better than first events. Thus the first pregnancy is located better in time where it is the first event to be asked about in the forward questionnaire. This may be because interviewers probe more at the beginning of the interview, as documented in tape-recordings of the BFS (Thompson, Nawab Ali and Casterline 1982). For pregnancies of intermediate order, however, the backward questionnaire works better.

Tables 19 and 20 show the accuracy of reporting by educational group of the mother. The proportions of events reported exactly were significantly lower for women with no formal education than for women with some education in both types of questionnaire. However, where women misreport the timing of a birth, the magnitude of the error does not vary significantly according to educational level.

Psychological theory suggests the hypothesis that, controlling for the timing of events, women remember most recent events better than earlier events. The data in table 21 enable us to test this hypothesis. During the four years preceding the survey, most recent events are remembered significantly better than other events, but for events which occurred earlier, there are no differences.

Characteristics of the birth event

We have already seen that the women in the survey missed non-live births much more frequently than live births (table 9). We may also hypothesize that where women do recall non-live births, the accuracy of the reported timing is less than for live births. Table 22 shows that the proportions exact are significantly higher for live births than for non-live births for both types of questionnaire, although an unexpected result emerges

Table 19 Accuracy of reporting by mothers of the time of occurrence of matched birth events by type of questionnaire, time since the birth event and educational group of the mother

Time since birth event (completed years)	Mothers with no formal education					Mothers with some formal education				
	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference
Forward questionnaire										
All years	465	43	17	40	+5	191	54	10	36	+4
0-1	65	83	2	15	+2	36	94	0	6	0
2-3	79	65	8	28	+4	42	71	2	26	+4
4-5	55	40	13	47	+5	24	46	21	33	+2
6-7	73	26	26	48	+3	25	44	8	48	+6
8-9	75	33	15	53	+7	29	24	14	62	+7
10+	118	25	30	46	+4	35	29	20	51	+7
Backward questionnaire										
All years	474	44	22	34	+3	136	55	16	29	+2
0-1	86	88	5	7	0	30	90	3	7	0
2-3	83	61	10	29	+3	30	73	3	23	+4
4-5	62	40	23	37	+4	19	53	21	26	0
6-7	68	15	35	50	+4	21	38	19	43	+3
8-9	62	26	29	45	+2	14	21	21	57	+5
10+	113	27	32	42	+2	22	23	41	36	−1

Table 20 Number of matched birth events, proportion with age/date reported exactly and mean absolute error for inexact events, by type of questionnaire and education of the mother

	Both questionnaires		Forward questionnaire		Backward questionnaire	
	No educ.	Some educ.	No educ.	Some educ.	No educ.	Some educ.
Number of matched events	939	327	465	191	474	136
Proportion exact	.43[a]	.54	.43[a]	.54	.44[a]	.55
Mean absolute in months (for inexact events)	16.6	16.1	17.3	17.0	15.8	14.9

[a] Significant difference (two-tailed Z and t-tests) at 0.05 level.

Table 21 Number of matched birth events, proportion with age/date reported exactly and mean absolute error for inexact events, by years before the survey that the event occurred and whether last event or not

	Years before the survey						
	All years	0-1	2-3	4-5	6-7	8-9	10+
Most recent event							
Number of events	392	203	103	20	27	16	23
Proportion exact	.72	.90	.77	.30	.26	.25	.17
Mean absolute error in months (for inexact events)	14	8	12	-	16	-	23
Not most recent event							
Number of events	874	14	131	140	160	164	265
Proportion exact	.35	.64[a]	.57[a]	.44	.26	.28	.26
Mean absolute error in months (for inexact events)	17	26	16	14	15	16	20

– Means not presented if less than 15 non-zero cases.
[a] Significant difference at 0.01 level (two-tailed Z-test).

Table 22 Number of matched birth events, proportion with age/date reported exactly and mean absolute error for inexact events, by type of questionnaire and birth outcome

Measure	Both questionnaires		Forward questionnaire		Backward questionnaire	
	Live births	Non-live births	Live births	Non-live births	Live births	Non-live births
Number of matched events	1201	65	622	34	579	31
Proportion exact	.47[a]	.31	.47[a]	.38	.48[a]	.23
Mean absolute error in months (for inexact events)	16.1	21.7	17.6[a]	12.3	14.5[a]	29.8

[a] Significant difference (two-tailed Z and t-tests) at 0.05 level.

regarding the magnitude of error of events which are misplaced in time. With the backward form, the woman is less likely to state the exact timing of a non-live, as compared to a live, birth, and given that the timing of a birth is misreported, the error is significantly larger in the case of a non-live birth. But for the forward form, the latter statement does not hold true, and the conditional, expected error in timing for non-live births is less than that of live births. This curious reversal cannot be explained at present.

Since boys are valued more than girls in Bangladesh, it seems likely that women will recall the timing of male births more accurately than female births. Table 23 and the second panel of table 24 show that the proportion of births with the timing recalled exactly is higher for boys than for girls for all ages of children and for both types of form. However, the overall difference does not attain statistical significance, nor does the mean error differ according to sex, indicating that the effect is rather small.

Another interesting feature of these data emerges from this table. There are 592 male births and 609 female births, giving a sex ratio at birth of 97, well below its normal range of 103-107. Although the proportion male is not significantly different from the expected level ($z = 1.33$), it is worthy of further investigation. A comparison with the original survey data reveals that the low sex ratio is not found in the DSS data as a whole but is confined to the matched birth events for non-migrant women, ie the subset of data for the validation study.

Apart from chance, two explanations are plausible. First, the women who migrated may have had a higher proportion of male births. Secondly, the birth events before 1966 may have had a higher proportion of males. The two explanations are linked, ie it is possible that women with older sons (born before 1966) are more likely to have migrated in order to live as part of the extended family of their sons than either women with older daughters or younger women. This would explain the observed low sex ratio of births among the non-migrant women.

Similarly, mothers may remember the timing of live births still surviving at the survey better than live births who did not survive. In the first panel of table 24, we see that this is indeed the case: mothers could report the exact timing of births for only 28 per cent of live births who subsequently died as compared to 51 per cent of surviving children ($p<0.05$). In addition, misreporting

Table 23 Accuracy of reporting by mothers of the time of occurrence of matched birth events by type of questionnaire, time since the birth and sex of the birth[a]

Time since birth event (completed years)	Male birth					Female birth				
	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference	No. of matched events	Per cent reported exactly	Per cent reported too young	Per cent reported too old	Mean overall difference
Forward questionnaire										
All years	320	48	16	36	+4	317	43	15	42	+4
0-1	46	96	0	4	+2	48	83	2	15	+1
2-3	57	72	9	19	+2	58	62	3	35	+5
4-5	35	49	9	43	+4	43	35	21	44	+3
6-7	52	29	27	44	+2	44	32	14	55	+6
8-9	54	32	9	59	+10	49	29	21	50	+4
10+	76	28	30	42	+4	75	24	24	52	+5
Backward questionnaire										
All years	286	49	18	33	+3	305	45	22	33	+2
0-1	50	94	2	4	0	59	88	2	10	+1
2-3	51	69	6	26	+3	58	64	7	29	+4
4-5	39	56	15	28	+6	40	33	28	40	0
6-7	38	21	37	42	+1	48	21	27	52	+6
8-9	36	22	22	56	+5	40	28	33	40	0
10+	72	29	26	44	+2	60	23	43	33	−1

[a] In this table the total number of births with sex reported (1228) is greater than the number of live births with sex reported (1201) because sex was sometimes reported for non-live births.

Table 24 Number of matched live birth events, proportion with age/date reported exactly and mean absolute error for inexact events, by survival status of the birth and sex of the birth

	All live births	Survival status of live birth at the time of the survey		Sex of live birth	
		Alive	Dead	Male	Female
Number of events	1201	975	226	592	609
Proportion exact	.47	.51[a]	.28	.49	.45
Mean absolute error in months (if not exact)	16.1	14.7[a]	20.3	16.0	16.2

[a] Significant difference between groups (two-tailed Z and t-tests) at 0.05 level.

was significantly larger for children who subsequently died.

Patterns of errors within women

Of the 497 women in the validation study, 324 women had two or more births recorded both in the pregnancy history survey and vital registration sources. The patterns of the differences between the reported and actual dates of these sequences of births are of interest. In the previous section, the events themselves were the unit of study; in this section the series of events is considered. The analysis addresses four questions:

1 To what extent is the accuracy of the reported times of events heterogeneous between women?
2 If a woman misreports the timing of the first event, is misreporting of the next event more likely?
3 If a woman misreports two or more events consecutively, to what extent are the signs and magnitudes of the two errors related?
4 Generally, to what extent are the differences between actual and reported times for successive events correlated?

The heterogeneity of women with respect to the accuracy of reports may be measured by comparing the actual proportion of women who gave the months of all matched birth events with the expected proportion, taking each reported birth as an independent event. Only accuracy of month, instead of accuracy of both month and years ago, is used. Table 25 presents the analysis for

Table 25 Expected and observed proportions of women who can report the months of their matched birth events correctly, by number of matched events

	Number of matched birth events			
	2	3	4	5
Number of women	85	84	63	59
Number of events	170	252	252	295
Proportion of events with month exactly reported	.75	.83	.74	.74
Expected proportion of women with months of all matches exactly reported[a]	.56	.57	.30	.22
Actual proportion of women with months of all matches exactly reported	.65	.64	.38	.29

[a] Letting 'p' be the proportion of events with month exactly reported and 'r' the expected proportion of women with months of all matched events exactly reported, under the null hypothesis of independence of reporting of events, $r = p^n$ where n = 2,3,4,5 is the number of matched events.

women with two to five consecutive matched events. The observed proportion of women who accurately report the months of all matched births is consistently above the expected proportion, though because of small sample sizes only the difference for women with two events has statistical significance ($p \leq 0.1$). Patterns of reporting errors emerge clearly.

To identify the kinds of dependencies in the errors for individual women, we consider the differences between the actual and reported timing of births for the first two matched events in the forward form and the last two matched events in the backward form. In this analysis only women with an unbroken series of two or more matched events are considered; so, for example, women with a missed event between two matched events are excluded. Table 26 shows this comparison. The hypothesis that the exactness of the second event is independent of the exactness of the first is rejected ($p<0.001$) for both types of questionnaire. A woman who misreports the first event is more likely to misreport the second event as well.

Let us consider now the sign of the differences of the misplaced events. In this analysis, data for all women with an unbroken series of two or three matched events are used. Series which include correctly reported events are excluded. The expected proportion of women who would have all positive or all negative differences (indicating that the event was reported to occur too early or

Table 26 (A) Accuracy of reported timing of the second matched birth event by accuracy of the first matched event for the forward questionnaire and (B) accuracy of the next to last matched event by accuracy of the last matched event for the backward questionnaire

A Forward questionnaire

Accuracy of first event	Accuracy of second event					
	All reports		Exactly reported	Not exactly reported		
	No.	Per cent		All	Reported too young	Reported too old
All reports	145	100	41	59	17	43
Exactly reported	57	100	58	42	16	26
Not exactly reported	88	100	30	70	17	53
Reported too young	24	100	42	58	42	17
Reported too old	64	100	25	75	8	67

B Backward questionnaire

Accuracy of last event	Accuracy of next to last event					
	All reports		Exactly reported	Not exactly reported		
	No.	Per cent		All	Reported too young	Reported too old
All reports	151	100	46	54	19	35
Exactly reported	110	100	55	45	15	31
Not exactly reported	41	100	24	76	29	46
Reported too young	20	100	20	80	50	30
Reported too old	21	100	29	71	10	62

Table 27 Comparison of expected and observed patterns of error for women with two and three consecutive birth events misplaced in time by type of questionnaire

	Forward questionnaire				Backward questionnaire			
	Number of women with triplet	Expected proportion of women with triplet[a]	Observed proportion of women with triplet	Z value	Number of women with triplet	Expected proportion of women with triplet[a]	Observed proportion of women with triplet	Z value
All women with three matched events	40	1.000	1.000		16	1.000	1.000	
+++(too old)	25	.422	.625	2.6	4	.062	.250	3.2
−−−(too young)	6	.016	.150	6.8	8	.220	.500	2.7
Other combinations	9	.562	.225		4	.719	.250	
	Forward questionnaire				**Backward questionnaire**			
	Number of women with pair	Expected proportion of women with pair[a]	Observed proportion of women with pair	Z value	Number of women with pair	Expected proportion of women with pair	Observed proportion of women with pair	Z value
All women with two matched events	62	1.000	1.000		31	1.000	1.000	
++(too old)	43	.587	.694	1.7	13	.300	.419	1.5
−−(too young)	10	.055	.161	3.7	10	.200	.323	1.7
Other combinations	9	.358	.145		8	.500	.258	

[a] Letting 'p' be the overall proportion of events that are over-reported for women with two events and letting $q = 1 - p$, then the expected proportion of women with ++ is p^2. For triplets the same logic gives the expected proportions of +++ as p^3 and −−− as q^3.
[b] The two Z-tests in each subtable are not independent since the sum of the proportions too old, too young and other is necessarily unity.

too late, respectively) was calculated from the overall proportion of negative and positive differences for these women, under the assumption of independence. The results show a clear tendency for women either to overstate consistently the number of years and months since births or to understate these values consistently, with very few mixtures of over and under-statement (table 27).

A more precise method for measuring the relationship between the magnitudes of errors is correlation analyses. Again the analysis was restricted to women with an unbroken series of two or more matched events. The results of this analysis are shown in table 28. The correlations are at comparable levels in both types of questionnaire. Interestingly, most of the partial correlations were not significant, indicating that the misplacement error in reporting the timing of an event is conditional only on the timing error of the preceding event reported in the interview.

4.3 ACCURACY OF FERTILITY

A primary objective of most fertility surveys is to provide estimates of levels and recent changes in fertility, and it is therefore important to determine the extent to which errors of omission and event misplacement affect those estimates.

For the first analysis, fertility rates computed from survey data are compared with rates computed for the

Table 28 Correlation analyses of reporting errors in sequences of matched events by type of questionnaire[a]

Event sequence	Measure	Questionnaire type: Forward	Questionnaire type: Backward
Women with two	n		
matched events	n	52	50
in sequence	r_{12}	.54	n.s.
Women with three	n	37	51
matched events	r_{12}	.89	.91
in sequence	r_{23}	n.s.	.88
Women with four	n	29	33
matched events	r_{12}	.41	n.s.
in sequence	r_{23}	.41	.42
	r_{34}	.51	.55
Women with five	n	43	30
or more matched	r_{12}	.79	.37
events in sequence[b]	r_{23}	.76	.70
	r_{34}	.44	.73
	r_{45}	n.s.	.77

[a] As the partial correlations were generally non-significant (excepting $r_{13.2}$ in the forward questionnaire and $r_{35.4}$ in the backward questionnaire) they are not shown.
[b] For women with more than five events in the forward (backward) form, only data for the first (last) events were used.
NOTE: n.s. denotes non-significant

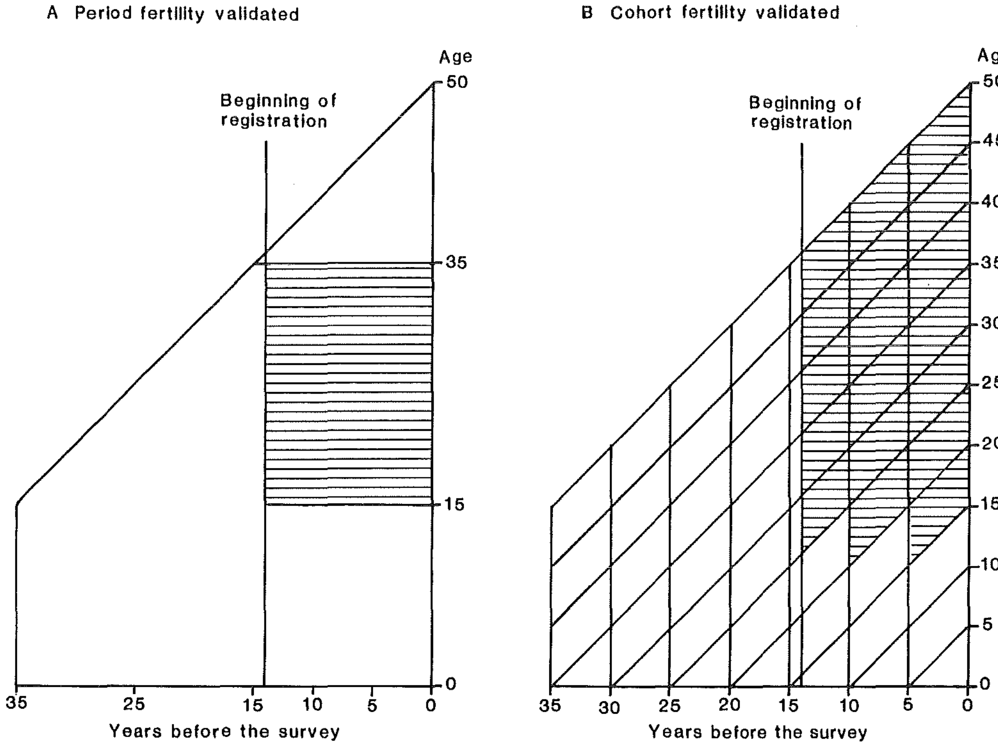

Figure 2 Lexis diagrams showing (A) the 15-34 years age group used for analysis of period fertility and (B) five-year age groups used for analysis of cohort fertility

same women from vital registration data, for twelve-month periods before the survey. The ages of women were decreased by one year at each step back in time. As all age groups of women are not represented in years before the survey (see Lexis diagram in figure 2A), the fertility of women aged 15-24 and 25-34 is examined.[6]

Denominators are identical for both the known and reported rates. To construct the numerator of the actual fertility rate, all registered live births of the women were selected. For corresponding rates from reported data, only live births in a matched pair with a registered event were used.[7] Any effect of births which were misplaced into the period after 1966 from before 1966 is eliminated by this procedure. However, since most event misplacement was backward in time, the number of events misplaced forward across the 1966 boundary is likely to be small.

Since the mean percentage of missed live births was only 2.3, the overall mean fertility for the period is almost identical in the actual and reported series (table 29). However, considering the values for individual years, differences of considerable magnitude are observed. It should be recalled that none of these differences can be attributed to sampling error. The means of the absolute differences for the series are 58 and 62 births per 1000 women for the forward and backward questionnaire respectively, or 20 per cent of the mean actual fertility. These large differences arise from a combination of factors: first, there was a genuine and substantial variation in fertility over the period, caused most notably by the war in 1971 and famine in 1974-5; and secondly, the time elapsed since the birth, where it was misreported, was usually overstated. Thus rates for individual years are inaccurate, though the inaccuracy, as well as the genuine variation in fertility, is greatly reduced by grouping individual years into intervals of two years or more.

The patterns of errors in the estimates are similar but not the same in the forward and backward questionnaires. The magnitude of the errors clearly increases with the number of years before the survey, though no clear time-dependent pattern of over- or underestimation is apparent (figure 3). It is interesting to note, however, that at ten years before the survey, both the forward and backward questionnaires overestimate fertility, an effect, possibly, of rounding of children's ages.

Fertility rates were also calculated for age groups 15-24 and 25-34 for each two-year period. Within questionnaire type, the patterns of errors by age group are quite similar (table 30). A one-way analysis of variance shows that there are no significant differences between the levels of error in the four age/questionnaire groups.

In the analysis of most fertility surveys, rates are presented for five-year age groups in five-year periods proceeding backwards from the survey. This type of analysis focuses on cohort fertility (parallelograms in the Lexis diagram in figure 2B), as distinguished from period fertility (rectangles in the Lexis diagram in figure 2A). The number of woman-years observed in each parallelogram was calculated using information on the

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[6] The lack of women aged 33 and 34 in 1966 and 1967 is ignored.

[7] The separate effect of missed events is considered only for cohort fertility rates below.

Table 29 Fertility of women 15-34 years of age calculated from actual dates of birth and from survey data, by type of questionnaire and years before the survey

Years before the survey	Calendar years[a]	Forward questionnaire				Backward questionnaire			
		No. of women observed	Fertility rates (per 1000)			No. of women observed	Fertility rates (per 1000)		
			Actual data	Reported data	Difference (actual–reported)		Actual data	Reported data	Difference (actual–reported)
1	1979	137	277	277	0	161	335	342	− 7
2	1978	138	254	254	0	150	260	233	27
3	1977	132	349	333	16	142	345	289	56
4	1976	125	416	336	80	139	324	338	− 14
5	1975	120	208	258	− 50	128	242	234	8
6	1974	121	339	372	− 33	126	278	389	−111
7	1973	122	385	254	131	126	333	238	95
8	1972	121	223	306	− 83	120	283	225	58
9	1971	127	339	260	79	117	299	256	43
10	1970	129	310	333	− 23	118	210	356	−146
11	1969	130	292	331	− 39	116	241	302	− 61
12	1968	130	339	231	108	107	383	237	146
13	1967	129	225	209	16	109	220	257	− 37
14	1966	124	202	387	−185	105	171	229	− 58
Mean		128	297	296	1[b],58	126	280	280	0[b],62

[a] The twelve-month period was actually from April of the year given to March of the subsequent year.
[b] Both the mean of the signed differences and the mean of the absolute difference are given.

Table 30 Fertility of women 15-34 years of age calculated from actual dates of birth and from survey data by ten - year age group and two-year period before the survey

Period before the survey (in months)	Calendar years[a]	Age 15-24				Age 25-34			
		Number of women years of observation	Fertility rates (per 1000)			Number of women years of observation	Fertility rates (per 1000)		
			Actual data	Reported data	Difference (actual–reported)		Actual data	Reported data	Difference (actual–reported)
Forward questionnaire									
0-23	78-79	137	285	270	15	138	246	261	15
24-47	76-77	114	404	351	53	143	364	322	42
48-71	74-75	106	236	283	−47	135	304	341	−37
72-95	72-73	115	296	261	35	128	313	297	16
96-119	70-71	128	328	320	8	128	320	273	47
120-143	68-69	134	321	276	45	126	310	286	24
144 +	66-67	141	227	340	−113	112	196	241	−45
Mean		.	300	300	0[b],45		293	289	5[b],32
Backward questionnaire									
0-23	78-79	162	340	340	0	144	255	235	20
24-47	76-77	158	342	310	32	123	325	317	8
48-71	74-75	154	266	318	−52	100	250	300	−50
72-95	72-73	151	331	252	79	95	274	221	53
96-119	70-71	152	270	316	−46	84	213	270	−57
120-143	68-69	138	304	246	−58	85	318	306	12
144 +	66-67	117	162	239	−77	97	258	258	0
Mean			288	289	−1[b],49		270	272	−2[b],29

[a] The twenty-four month period actually begins on April of the first year listed and ends in March two years later.
[b] Both the mean of the signed differences and the mean of the absolute difference are given.

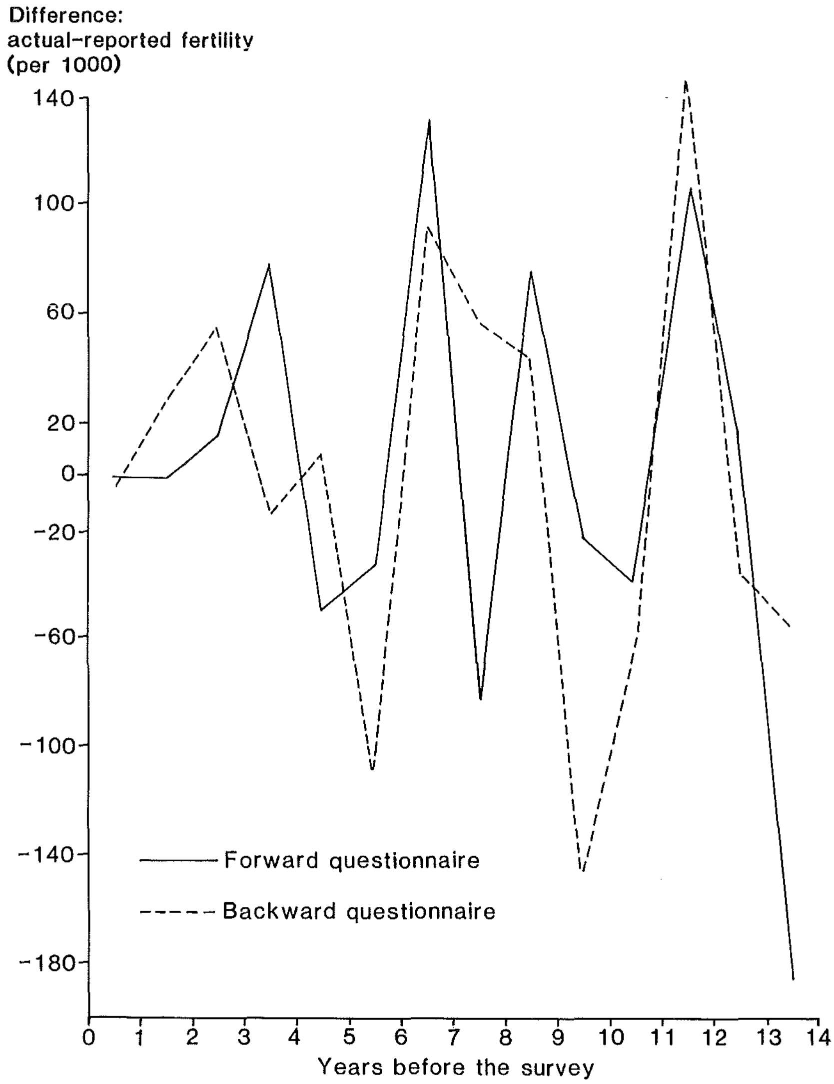

Figure 3 Difference between fertility rates from actual and reported times of births for backward and forward questionnaires by year before the survey

date of entry of each woman into the registration system. The numerator for the survey rate was the number of matched live births reported by the woman to have occurred in the given interval. For the vital registration rates, two numerators were calculated. In the first, all vital registration births were used. In order to separate the effect of missing events from the effect of event misplacement, in the second numerator live births that were missed in the survey were excluded.

These comparisons (table 31 and figure 4) show an underestimation of fertility in the period immediately preceding the survey for both questionnaires, even when missed events are excluded. In the period 5-9 years before the survey, there is again a net underestimation of fertility in the forward form, though it is now due partly to missed events. For the backward form, both over- and underestimation occur in this period. At 10-14 years before the survey, the errors in the rates derived from the forward questionnaire are greater than those from the backward questionnaire. Fertility is greatly overestimated in this period in the forward questionnaire and indeed when missed events are excluded, the magnitude of the error increases. (The denominator had decreased.)

Figure 5 summarizes the errors for the two questionnaire types by whether missing events are excluded or not. These box and whisker plots show the medians, the quartiles and the extreme values of the 18 differences in rates for each group (seven differences for the period 0-4 years before the survey, six for the period 5-9 years and five for the period 10-14 years). When missed births are included, the median error is negative for both types of questionnaire, ie fertility is underestimated on average. The medians are both zero when missed births are excluded. From the figure, it is also apparent that the errors are of nearly the same magnitude above and below zero for the backward questionnaire but for the forward questionnaire this is not true. The extreme errors for the backward questionnaire are for the age group 20-24 with an underestimate of fertility in the

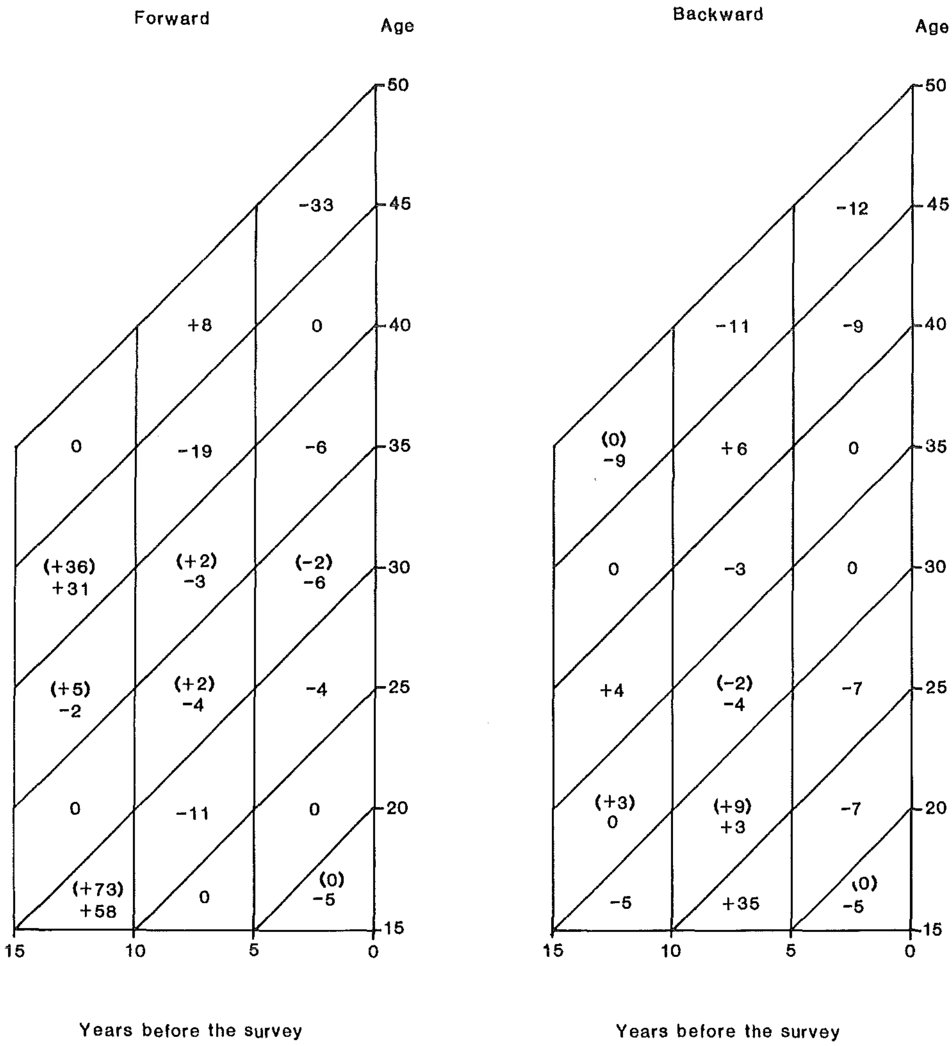

Figure 4 Lexis diagram showing percentage differences[a] between the fertility rates calculated from vital registration and from survey data with (and without) missing births for forward and backward questionnaires

[a] $\{(R-A)/A\}*100$ with missing births
$\{(R-A_{\bar{m}})/A_{\bar{m}}\}*100$ without missing births

R = reported fertility
A = actual fertility
$A_{\bar{m}}$ = actual fertility excluding births missing in the survey

period 0-4 years before the survey and a corresponding overestimate in the period 5 years earlier. For the forward questionnaire, the extreme errors occur in two different age groups in two different time periods.

It is also of interest to compare the fertility calculated from the survey data alone for the fertility of all the cohorts for the backward and forward questionnaires. For these calculations the census age of the woman was used to remove any possible bias in the estimation of the age in the survey that might be related to fertility. Note that these rates will not correspond with rates for the same age groups in the previous table. This is true for two reasons. First, census age and not survey age is used. Secondly, when we compared known and reported fertility rates, we used woman-years observed in the registration system, while for the forward–backward comparison using the survey data alone, each woman is assumed to have spent five years in each age group. This assumption is sometimes false, since many women will have migrated into the area where the registration system operates at the time of their marriage. Fertility calculated in this way is necessarily lower.

Table 31 Comparison of actual fertility (with and without missed events) and reported fertility for three time periods before the survey by five-year age group and type of questionnaire

Age at interview	No. of women[a]	Period before the survey: 0-4 years Actual fertility[b]	Reported fertility	Per cent difference[c]	5-9 years Actual fertility	Reported fertility	Per cent difference	10-14 years Actual fertility	Reported fertility	Per cent difference
Forward questionnaire										
15-19	36	204 (194)	194	−5 (0)						
20-24	35	331	331	0	159	159	0			
25-29	32	323	310	−4	342	303	−11	145 (133)	230	+58 (+73)
30-34	34	278 (266)	260	−6 (−2)	358 (339)	345	−4 (+2)	320	320	0
35-39	38	258	242	−6	326 (311)	316	−3 (+2)	338 (316)	331	−2 (+5)
40-44	30	76	76	0	238	192	−19	258 (247)	337	+31 (+36)
45-49	31	39	26	−33	168	181	+8	235	235	0
Mean[d]				−8, 8 (−6, 6)			−5, 8 (−3, 7)			+17, 18 (23, 2)
Backward questionnaire										
15-19	35	232 (221)	221	−5 (0)						
20-24	47	349	326	−7	113	153	+35			
25-29	46	326	304	−7	324 (306)	333	+3 (+9)	169	161	−5
30-34	31	248	248	0	341 (333)	326	−4 (−2)	350 (339)	350	0 (+3)
35-39	23	200	200	0	261	252	3	311	323	+4
40-44	21	95	86	−9	171	181	+6	313	313	0
45-49	29	57 (50)	50	−12 (0)	136	121	−11	229 (208)	209	−9 (0)
Mean[d]				−6, 6 (−5, 5)			+4, 10 (6, 11)			−2, 3 (−1, 4)

[a] Thirteen women with the forward questionnaire and 12 women with the backward questionnaire were excluded because their reported (survey) age was above 49. Also two women in each questionnaire type were excluded because their reported age was less than 15.
[b] Figures in parentheses are the corresponding values when missing events are excluded, if different.
[c] Per cent difference = (reported–actual)/actual.
[d] Both the mean of the signed per cent differences and the mean of the absolute differences are given.

Table 32 Fertility (per 1000) by age group of women in given five-year periods before the survey, by type of questionnaire

Age group	No. of women in group at time of survey	Years before the survey: 0-4	5-9	10-14	15-19	20-24	25-29	30-34
Forward questionnaire								
15-19	25	112	56	110	84	92	100	77
20-24	43	241	269	274	272	267	246	
25-29	29	317	332	333	320	331		
30-34	38	253	344	260	315			
35-39	39	221	233	292				
40-44	30	113	138					
45-49	26	46						
Backward questionnaire								
15-19	26	100	88	55	77	92	143	90
20-24	52	258	278	277	231	257	269	
25-29	36	311	313	308	300	297		
30-34	39	277	262	386	276			
35-39	26	231	193	262				
40-44	28	121	159					
45-49	29	21						

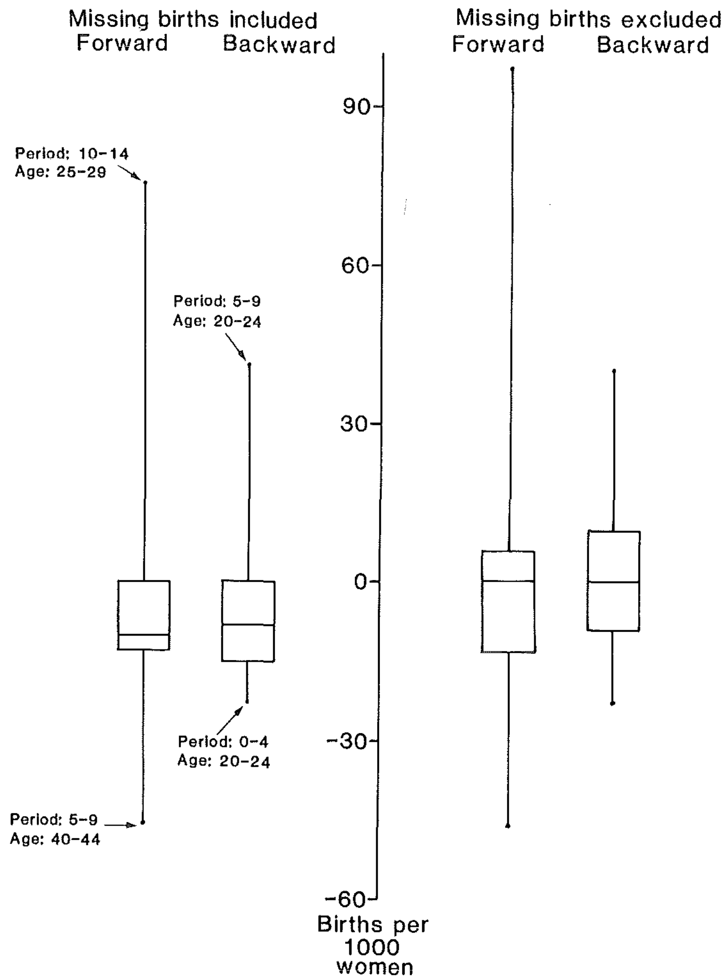

Figure 5 Box and whisker plots of differences between fertility rates from vital registration data and from survey data by type of questionnaire and inclusion or exclusion of missing survey births

Given that the rates are based on small numbers of women, fertility levels are remarkably consistent both across time periods and between questionnaire types (table 32 and figure 6). An exception is the value of 386 for women aged 30-34 in the period 10-14 years before the survey in the backward questionnaire. Since the rate of 193 for this cohort five years earlier is relatively low, both perturbations may be due to children's ages being rounded up to ten in the backward questionnaire.

Potter and others have hypothesized that reported levels of fertility in the periods immediately preceding the survey are low relative to the fertility of the same age groups in earlier periods. The patterns in table 31 indicate that this is true to a small extent of these data because of the predominant overestimation of time since the birth event. Table 33 gives another perspective on this question. In this table the percentage differences of table 31 are arranged according to age group for several periods. The underestimation of fertility for the five years prior to the survey is again clear and the transfer of births backwards in time gives an overall overestimation of fertility for the period 5-14 years before the survey. The overestimation is mainly located in the group aged 15-19. For this group, the Potter effect is evident; such patterns could easily lead to a false interpretation of fertility decline in recent years.

Table 33 Per cent difference between reported and actual fertility rates by age group, time period and type of questionnaire[a]

Age group	Years ago	Questionnaire type	
		Forward	Backward
15-39[b]	0-4	−4	−4
	5-14	+5	+3
15-19	0-4	−5	−5
	5-14	+29	+15
20-24	0-4	0	−7
	5-14	−5	+1
25-29	0-4	−4	−7
	5-14	−3	0
30-34	0-4	−6	0
	5-14	+14	−1
35-39	0-4	−6	0
	5-14	−9	−1

[a] Per cent difference = (reported–actual)/actual. For the period 5-14 the mean (rounding 0.5 down) of the differences for 5-9 and 10-14 is given.

[b] The arithmetic means of the five five-year age groups are presented.

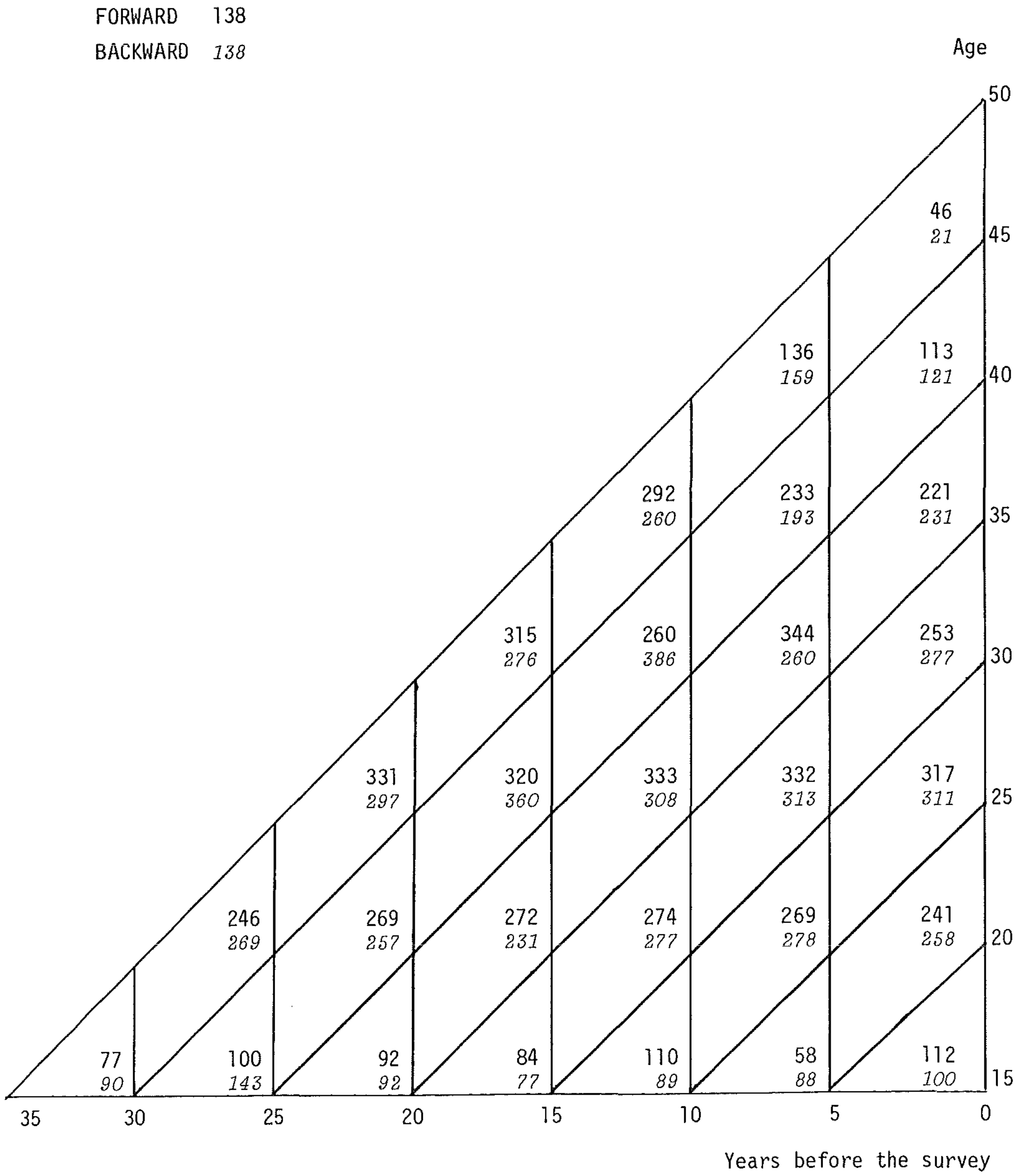

Figure 6 Fertility calculated from survey data for forward and backward questionnaires by five-year age groups and five-year periods before the survey

5 Summary, Conclusions and Recommendation for Future Fertility Surveys

In March 1980, 866 pregnancy history interviews were carried out in the Nayergaon area of Comilla District, Bangladesh, 566 in five villages of the Matlab Demographic Surveillance System (DSS) and 300 in two adjacent villages outside the surveillance system. This design allowed study of possible contamination in women's reports, a contamination expected because of the presence of the vital registration system.

Survey procedures were designed to follow as closely as possible those of the 1975 Bangladesh Fertility Survey, though the training period was considerably shorter for the present study, as all four interviewers had previous experience of collecting pregnancy history data (indeed two were former BFS interviewers). The present study used only the pregnancy history section, not the entire BFS questionnaires. In place of the household questionnaire, a simple listing of all the living children of eligible women was made before the pregnancy history interview itself. The pregnancy history was the same as that of the BFS with two exceptions. First, a backward questionnaire was designed with the same basic format as the forward BFS questionnaire, and secondly, the month of birth was asked for all birth events. Half of the interviews were done with the forward form and half with the backward form.

The analysis of contamination showed that the reporting of younger women was slightly better in the DSS area than in the non-DSS area but the reporting of older women exhibited a reverse contamination effect. Overall, it can be concluded that there was very little contamination attributable to the presence of the registration system.

For 497 women in the DSS area, the pregnancy history survey data could be validated with pregnancy histories independently constructed from the vital registration data for the 14-year period from 1966 onwards, the year when the surveillance system was instituted. The first discovery in the validation analysis was that most of the women could correctly give the Bengali month of their pregnancy terminations, with 75 per cent of the events in the 14-year period having month correctly reported.

For half of the events, the women were able to correctly report both the month and the number of years ago. This is a very high figure, considering that 75 per cent of the women had no formal education. We may conclude that by asking the Bengali month of birth and probing sufficiently for years ago, very accurate data on the timing of births can be obtained.

Among women who misplaced births in time, the general tendency was to place the event too far back in time. Though the overall proportion of events reported exactly was not different in data obtained from the backward and forward questionnaires, the forward questionnaires produced a slightly greater tendency to push the event back in time.

Five per cent of the births registered in the 14-year period were missed in the pregnancy history survey data. Most of the missed events were non-live births, however, so that the rate of omission of live births was only 2.3 per 100. The chance of an event being missed was greater when the forward questionnaire was used.

Because of the missed events, there was an overall underestimation of fertility rates. In addition, the transfer of events backwards in time produced underestimates of fertility in the five-year period immediately before the survey and overestimates of fertility in the period 10-14 years before the survey. However, the magnitude of the errors was only about 5 per cent.

Given that no marked contamination effect was found in the study and that the proportion of the study population who were literate was fairly representative of Bangladesh as a whole, we may tentatively conclude that accurate pregnancy history data can be collected in rural Bangladesh for at least a 15-year period before the survey. Regarding the two types of questionnaire, the backward questionnaire worked better than the forward questionnaire. With the backward form, there was a significantly lower proportion of missed events, a more symmetric distribution of reporting errors in the timing of births around the actual date of birth, and a slightly lower absolute error for events which were misplaced in time. However, since missed live births were rare and a very critical variable — the proportion of events correctly placed in time — was exactly the same for the two tionnaires, overall differences in error patterns of fertility rates between the two questionnaires were minimal. The superiority of the backward form due to the more symmetric distribution of misreporting errors was reflected in more accurate fertility rates only in the period 10-14 years before the survey.

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Appendix A – Construction of Independent Pregnancy History from Vital Registration Data

To ensure that the pregnancy histories constructed from vital registration data would be completely independent of the survey data, coders were only given the name and census number of the women in the survey. Census and vital registration data were then searched methodically as described below.

For each woman who was in the survey and in the 1974 census book (which had been updated in the field so in-migrants after 1974 were also included), information was coded from the census for her and her children. Next, computer cards of birth records for the villages in the sample were sorted by year and identification number of the mother. The records were then listed by village and year. Coding assistants compared the identification numbers of the mothers on the list with the numbers of the women interviewed in the survey. If the birth was to a woman in the survey, the original birth report was located and the names of the mother and child along with the woman's survey number were coded on the birth record. These records were punched, sorted and listed by women's interview number. Child death records were processed similarly.

At Johns Hopkins University, DSS birth, death, census and migration records for the period 1966-78 have been edited and arranged by family and individual members, with the help of a large computer. The source data for this work were the punched records from Dacca. From this matched file a list of women in the survey villages was made with their matched birth events. This file was used as a check of the birth events coded by the above procedures.

With the 1974 census records, the birth records and death records punched and listed sequentially by mother's survey number, a vital registration pregnancy history was constructed for each woman. If both a census and birth record existed, the data were checked and the census record was retained. In the case of a birth record for which a census record did not exist or a death record for which neither a census nor birth record existed, a new card was coded (in the census format) for later processing steps. A similar procedure was followed if an event was only located in the Johns Hopkins file. In this manner a unique set of birth and child death events for each survey woman was constructed.

Table A1 Number and distribution of interviews by interviewer, and by age, education and marital status of the respondent in the total, non-DSS and DSS samples

	Area					
	Both areas		Non-DSS		DSS	
	Number	Per cent	Number	Per cent	Number	Per cent
Total sample	866	100	300	100	566	100
Interviewer						
	210	24	87	29	123	22
	204	24	84	28	120	21
	237	27	77	26	160	28
	215	25	52	17	163	29
Age of respondent (reported)						
<20	154	18	60	20	94	17
20-29	295	34	103	34	192	34
30-39	215	25	78	26	137	24
40-49	202	23	59	20	143	26
Completed years of schooling						
0	672	78	249	83	423	75
1-5	167	19	46	15	121	21
6+	27	3	5	2	22	4
Marital status						
Married	796	92	275	92	521	92
Separated, divorced or widowed	70	8	25	8	45	8