DEMOGRAPHY© Volume 24, Number 2 May 1987

FERTILITY ESTIMATION FROM RETROSPECTIVE SURVEYS: BIASES ATTRIBUTABLE TO PREGNANCY-RELATED MOVEMENT OF MOTHERS

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For many developing countries, data compiled from retrospective inquiries of a sample of households or eligible women are often the major source for estimation of fertility levels, patterns, and trends for the population. The series of World Fertility Surveys (WFSs) conducted during 1974–1981 in 41 developing countries exemplify such sample surveys (WFS, 1984), and recently (since 1980) similar large-scale surveys have been conducted in a number of states in India.[1] In these surveys data are typically compiled in two schedules or questionnaires (at a minimum) called the "household schedule" and the "individual questionnaire." The household schedule usually compiles particulars of the household and the head of the household and census-type information for each individual member of the household and is administered to the head or any other adult member of the household (generally a male). Members listed in the household schedule include the usual residents who are present (resident present), those who are temporarily absent (resident absent), and sometimes the visitors. In some surveys data on births and deaths to normal residents are also compiled in the household schedule. The individual questionnaire is administered to every ever-married or currently married woman in the reproductive ages (15–49) in the sample households. Data are obtained for each woman on her pregnancy or birth history, contraceptive history, attitudes to and knowledge of family planning methods, and so forth. The interview is, by necessity, restricted to women available for interview during the period of the survey in the village or the town. Various period and cohort fertility measures, such as age-specific fertility rates and average number of children ever born for women in different ages, are estimated from the data gathered through the individual questionnaires.

Recent analysis has revealed that estimates of fertility rates based on data compiled from eligible women available for interview during such a survey may be biased, sometimes quite seriously, for the following reasons.

1. The eligible women interviewed, because they were available at the time of the survey, may not represent the age–marital structure of all resident eligible women in the sample households. Resident women absent from the household during the survey dates, and therefore not interviewed by the investigators, may not be fully compensated for in numbers and age–marital status distribution by the visitors to the household who could be interviewed because they were temporarily available during the period in which the investigating team was present.
2. More important, when resident married women are likely to be absent from the household because of pregnancy- or fertility-related factors, the age-specific fertility rates estimated on the basis of data from women available for interview (resident present and visitor) can be seriously biased. Many countries, such as India,

Nepal, Bangladesh, Sri Lanka, and Fiji, have the custom for married women to go to their mothers' houses for delivery, at least for the first few pregnancies. The average duration of stay in mothers' homes varies between 1 and 12 months, depending on the prevailing cultural practices. Usually a woman spends the last trimester of pregnancy and 3–6 months after delivery in her mother's house. This duration of absence may play an important role in determining the nature and magnitude of bias in the fertility rates estimated from data compiled from those interviewed. Similarly, the definition of "visitor" in the category of eligible women included in the data set contributes to the nature of the bias. The criteria specified in terms of the number of days that a visiting woman must have stayed in the household prior to the interview, or the number of days she expects to stay in the index household after the survey date, influence the bias. The duration variables determining the residents absent as well as the visitor will be identical only by accident, and any differences between the two contribute directly to the magnitude of the bias in fertility estimation. It is simplistic to assume that all would go in our favor to provide unbiased estimates of fertility rates.

The three aspects of residents absent that contribute to determining the fertility of the resident population—namely the number of eligible women absent, their age distribution, and their age pattern of fertility—cannot be expected to be fully accounted for and adjusted by the inclusion of visitors in the resident women category with the term "visitor" defined a priori before the commencement of the survey.

3. The bias may also depend on the duration of the retrospective period over which the period-specific fertility measures are computed. For most of these surveys, the period fertility measures are calculated on the basis of births to women over the previous 12 months. A comparison of the 12-month–based rates with 24-month–based rates in a number of surveys in India revealed that the former rates are systematically higher than the latter when rates are based on household records or individual questionnaires (Srinivasan et al., 1985).

It has been widely observed that the information on vital events collected through sample surveys in developing countries is subject to response errors, sometimes of a serious magnitude. Errors of failure to report vital events, as well as errors in the time allocation of events that were reported, have been observed. Failure to report events increases with the duration of recall lapse. Such response errors are likely to get confounded with the biases arising from the inability to interview certain resident women. It can be expected that such a bias will increase with the duration of the retrospective period over which fertility rates are computed, since the differentials in the cohort fertility of residents absent and visitors play important roles in such differences. Unless it is proved initially that the current and cohort fertility levels and the reporting problems of the visitors group are identical with the residents absent group, any comparison of these two rates based on a longer interval of time is likely to be increasingly biased and invalid.

This duration-specific bias is different conceptually from biases arising from errors in the time referencing of births by respondents, which were investigated in detail by Potter and others and are commonly known as the Potter effect (Potter, 1977). The bias discussed here arises because of the selection of women on the basis of their availability at the time of the interview. Hence it can be more appropriately termed "interview selection bias." The longer the reference period, the higher will be the proportion of resident absent members who have given birth to a child during the period (since fertility is related to duration of observation) and hence not been compensated for fully by the interview of the visitors at the time of survey.

4. A sample design in which only a sample of households is interviewed from each village or town also contributes to the bias in rates, since intravillage movement is not likely to be captured by the sample households. When a woman goes to her mother's home in the same village and the whole village is covered, the same woman will be interviewed there as a visitor. There is no sampling problem or serious problem related to definition of a visitor in such a context.

An opportunity to test the nature and magnitude of the bias in fertility rates estimated from the individual questionnaire as compared with those estimated from the household schedule arose during the analysis of data compiled in a large-scale WFS-type survey conducted in the second half of 1982 in the state of Orissa, India. In this survey (Srinivasan et al., 1985), which covered five districts of the state, a random sample of 5,000 households was selected for interview, 1,000 households from each district. As in the WFS, two schedules were administered: a household schedule and an eligible women schedule similar to the individual questionnaire. The items on which particulars were compiled in this survey were greater in number and variety than those contained in the WFS core questionnaires (WFS, 1977a).

As part of the household schedule, data were compiled on the births, deaths, and movements that occurred to the usual resident members during the previous two years (since the beginning of 1980). Detailed records of such events are available. The data on births and the age distribution of married women listed as usual or normal residents in the household schedule provide an opportunity to compute the age-specific marital fertility rates that can be considered as "de jure rates." Similar rates could also be based on resident women interviewed through the individual questionnaire. The individual interviews also included visitors who had been staying in the sample household for a month or more prior to the survey date or would be staying (as reported by them) for a month or more subsequent to the survey date.

From these two independent data sets (household and individual), it is possible to carry out an analysis of the three different resident types of women, namely normal residents as reported in the household record, residents present and interviewed for the individual questionnaire, and visitors interviewed. The information on births reported to have occurred to them during the two-year period (June 1, 1980, to May 31, 1982) prior to the interview was also available, facilitating computation of fertility rates. It should be noted that even for the resident women interviewed through the individual questionnaire their age distribution and the births that occurred to them during the two-year period could be different from the data yielded by the household schedule, since information was obtained on the same events from two different respondents. The age of a woman as reported by the head of the household—who may be her husband, her father-in-law, or any other adult member of the household—may be different from that reported by her, and both of them may diverge from the truth when the respondent is illiterate or has no idea of her age or year of birth. Similarly, the time of occurrence of the births, even though confined to those that occurred during the previous two years, can be reported differently by different respondents. The errors of omission and time allocation may also operate differently for the two types of respondents; only in a fairly literate population or a population with a good record of family members' birth dates can the two data sets be expected to agree fully.

For Orissa we have data on the number of married women and births during June 1980–May 1982, distributed by the age of women, for all residents as reported by the head of the household and similar data for residents present and visitors from the interview with the women. These data, compiled without any adjustments on age or

Table 1.—Comparison Between Two Fertility-Related Data Sets From Orissa Sample Survey

Data source	Total	Age of women[a] 15–19	20–24	25–29	30–34	35–39	40–44	45–49
Household schedule								
No. of currently married women	4,803	494	964	992	776	745	463	369
% currently married women	100.0	10.3	20.0	20.7	16.2	15.5	9.6	7.7
No. of births[b]	1,743	255	623	483	248	101	29	4
Age-specific marital fertility rate	181	258	323	243	160	68	31	5
Individual questionnaire								
Residents present								
No. of currently married women	4,461	410	860	940	741	713	447	350
% currently married women	100.0	9.2	19.3	21.1	16.6	16.0	10.0	7.8
No. of births[b]	1,365	183	477	401	203	77	21	3
Age-specific marital fertility rate	153	223	277	213	137	54	23	4
Visitors								
No. of currently married women	175	56	76	29	7	4	2	1
No. of births[b]	53	18	23	9	3	0	0	0
Age-specific marital fertility rate	151	161	151	155	214	0	0	0
Total								
No. of currently married women	4,636	466	936	969	748	717	449	351
% currently married women	100.0	10.1	20.2	20.8	16.1	15.5	9.7	7.6
No. of births[b]	1,418	201	500	410	206	77	21	3
Age-specific marital fertility rate	153	216	267	212	138	54	23	4

[a] Age of currently married women is age at time of interview; for births, age refers to age of mother at time of birth.
[b] Births from June 1, 1980, to May 31, 1982.

other characteristics, are reported in table 1. A woman's age is as reported on the household record or eligible woman record at the time of the survey (conducted during June–December 1982), but for births age is the age of the mother at the birth of the child. The computation of rates is not strictly in terms of woman-years of exposure, since the denominators in each case have not been adjusted backward to the middle of the birth reference period (June 1, 1981), and the rates are neither probabilistic nor as usually computed in demography. Since the purpose of the present exercise is, however, to present the nature and magnitude of the biases that exist between the two data sets in terms of the age distribution of women or of mothers at the birth of children, it was decided not to undertake any adjustments on the raw data for making the comparisons.

Table 1 shows that the number of eligible women listed as usual residents as per the household schedule was 4,803, and among them the number who could be

contacted individually and interviewed for the individual questionnaire was 4,461, leaving a balance of 342 resident women (7 percent) not interviewed. The addition of visitors, defined as above, helped to bridge this gap by 175 women, leaving a net deficit of 167 women not covered by the survey. The proportion of eligible women considered as usual residents of the household who could not be interviewed individually was 17 percent in the age group 15–19 and 11 percent in the age group 20–24. The addition of visitors to the pool of women to be interviewed brought the age distribution of eligible women from the two data sets to almost identical patterns (see lines 2 and 13 of table 1). There are, however, substantial differences in the marital age-specific fertility measures of the two data sets, with age-specific fertility rates computed from the household schedule being higher than those computed from the individual questionnaire in every age group (see lines 4 and 15). The differences are quite sharp for 15–19 and 20–24; household-data–based rates are higher by 16 and 17 percent, when compared with rates based on the individual questionnaire. In every age group, the eligible women available for interview have systematically lower fertility rates in comparison with the household-schedule–based rates, giving empirical validation to hypothesis 2 mentioned above.[2] The addition of visitors to the pool of women to be interviewed, though it restores the age pattern of currently married women to the de jure pattern, does not fully restore the age-specific fertility rates.

To test whether similar observations could be made with WFS data, the Bangladesh and Nepal Fertility Surveys (WFS, 1977b, 1978) were examined. The age distribution of currently married women as obtained from the household schedule for usual residents was compared with that from the individual questionnaires for residents present and interviewed and visitors. Since the household record in these surveys does not contain information on vital events occurring to the usual residents of the households in the previous year (or two), as in the Orissa survey, we were not able to compare the fertility measures based on the two data sets. Table 2 presents the age distribution of currently married women, as obtained from the two data sets.

The table shows that in the Bangladesh Fertility Survey, 724 (12 percent) of the currently married women in the age group 15–49 could not be contacted for individual interview, the percentages being 17 and 11 for the ages 15–19 and 20–24. The number of resident women not available for interview is disproportionately higher in the younger ages than in the older ages. The addition of visitors (defined in the WFS as those who have slept in the household the previous night) brings the age distribution of eligible women closer to the household record, but even after adding the visitors, there is a gap of 427 women (7 percent) in the number interviewed, in comparison with the number of resident women listed in the household record.[3]

Similarly, in Nepal about 12 percent of the usual resident eligible women could not be interviewed and the addition of visitors (considered as those who slept in the household the previous night) reduced this gap to 6 percent. The percentage missed by interview is again disproportionately higher among women in the younger ages. Again, it is not as much this omission of women to be interviewed that seems to make a difference to the age-specific fertility rates as it is the selectivity of the women who could not be interviewed because of their pregnancy-related movements. This omission is likely to contribute to the bias in the estimation of age-specific fertility measures based solely on data from individual questionnaires. It is likely that the age-specific marital fertility rates based on interviews with eligible women tend to underestimate systematically the actual de jure rates based on the household schedules, and the magnitude of the bias seems to be higher in the younger than in the older ages. The magnitude of the bias seems to be related to the pregnancy-related movements of women to their mothers' houses for delivery.

Table 2.—Eligible Women Listed in the "Household Schedule" and Interviewed for the Individual Questionnaire in the Bangladesh and Nepal Fertility Surveys

Data source	Total	Age						
		15–19	20–24	25–29	30–34	35–39	40–44	45–49
Bangladesh								
Household schedule								
Usual residents								
No. of currently married women	5,933	1,181	1,312	1,131	754	624	521	410
% currently married women	100.0	19.9	22.1	19.1	12.7	10.5	8.8	6.9
Individual questionnaire								
Usual residents								
No. of currently married women	5,209	981	1,173	1,007	693	555	471	329
% currently married women	100.0	18.8	22.5	19.3	13.3	10.7	9.0	6.3
Visitors								
No. of currently married women	297	116	102	41	15	9	9	5
% currently married women	100.0	39.1	34.3	13.8	5.1	3.0	3.0	1.7
Total								
No. of currently married women	5,506	1,097	1,275	1,048	708	564	480	334
% currently married women	100.0	19.9	23.2	19.0	12.9	10.2	8.7	6.1
Nepal								
Household schedule								
Usual residents								
No. of currently married women	6,040	870	1,304	1,184	863	720	666	433
% currently married women	100.0	14.4	21.6	19.6	14.3	11.9	11.0	7.2
Individual questionnaire								
Usual residents								
No. of currently married women	5,330	635	1,116	1,075	795	679	627	403
% currently married women	100.0	11.9	20.9	20.2	14.9	12.7	11.8	7.6
Visitors								
No. of currently married women	349	129	127	52	18	8	10	5
% currently married women	100.0	37.0	36.4	14.9	5.2	2.3	2.9	1.4
Total								
No. of currently married women	5,679	764	1,243	1,127	813	687	637	408
% currently married women	100.0	13.4	21.9	19.8	14.3	12.1	11.2	7.2

The foregoing analysis leads to a number of interesting theoretical and data-analytic issues in the estimation of vital rates from survey data. It seems that the de jure or resident rates can be estimated without any bias only when data on vital events for all of the residents in the sample households are compiled in the survey and used in the analysis. When we fail to obtain data for some of the residents, and

their omission is due to nonrandom factors and particularly correlated with the vital rates that we are interested in, any estimates based on interviews of the residents present will definitely be biased. The hope has been that some of this can be offset by including data from some of the visitors available at the time of the interview, in the expectation that they would, on average, represent in number and characteristics the residents absent. Our analysis reveals that this is not the case. The definitions of visitor—"one-month stay" in the sample households in the Orissa survey and "last night slept" in the WFS—both seem to yield biased results. Thus the bias seems to be related to the duration of the reference period for which the de jure rates are computed, the reasons and duration of absence of residents, and the definition of the visitors. There appears to be no simple procedure to reconcile the differences. This type of bias is different in nature and origin from the usual errors of recall lapse or time referencing that are widely investigated in demographic studies.

In our analysis the definitions of "visitor" adopted in the Orissa survey and in the WFS resulted in underestimation of the number of eligible women per household, and in the case of Orissa, the age-specific marital fertility rate is also underestimated systematically.[4] This underestimation arises because although the household-based enumeration of resident women includes all of those considered residents at any time during the reference period (two years in the case of Orissa), the visitors include only those present at the time of survey (with a stay of one month or more) and does not include all such visitors during the reference period. Since those who are absent are likely to be so because of pregnancy-related movements, a simple procedure of prorated rates as is done in the WFS will not reduce the bias. It is possible that instead of a simple prorating of rates based on the number of women interviewed to total enumerated, a procedure of prorating based on ratios of fertility rates obtained from the household to those from the eligible-women record will be more appropriate to reduce this type of bias. This type of bias also seems to be related to the sampling design adopted in the survey. In a sample design in which whole villages are covered in the survey, the effects of movements of persons within the village will be controlled. The existence of this type of bias must be kept in mind when making cross-national comparisons of the fertility measures based on data from interviews of eligible women from sample households. The findings of comparative studies made earlier (Hanenburg, 1980) must be interpreted with caution in the presence of such biases.

It is also likely that such biases operate in the estimation of other demographic parameters associated with fertility, such as duration of breastfeeding, open birth interval, and infant mortality rate. There is a need to explore systematically the differences in the estimation of these parameters based on usual residents present, usual residents absent, and visitors before undertaking any comparative studies across a number of surveys or countries.

NOTES

[1] Large-scale sample surveys similar to the WFSs have been conducted since 1975 in the states of Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, and Uttar Pradesh.

[2] The apparently lower age-specific fertility rates for visitors interviewed compared with residents present may be explained partly by (a) a higher proportion of pregnant women among them at the time of the interview (determined by the relative duration of stay at mother's home before and after delivery), (b) the inability of the investigators to interview postpartum women for at least a fortnight after delivery because of taboos and such women being likely to be higher among visitors than among resident present, and (c) the small sample size.

[3] It is understood that in the Bangladesh Fertility Survey, in households with more than one woman

eligible and available for interview, not all were covered and that such omission based on eligibility criteria accounted for 180 women. Even excluding this number, the deficit was 247.

[4] The systematic differences between the household-based fertility rates and the eligible-women–based rates cannot be explained away by the quality of data in the context of the conceptual issue of pregnancy-related movements.

ACKNOWLEDGMENTS

This work was made possible because of the facilities extended by the Department of Demography, Australian National University, Canberra. We wish to acknowledge the support provided by J. C. Caldwell, Head of the Department, and especially the assistance extended by Jennie Widdowson in the computer analysis of the data.

REFERENCES

Hanenburg, R. 1980. *Current Fertility*. World Fertility Survey Comparative Studies, No. 11.

Potter, J. E. 1977. Problems in using birth history analysis to estimate trends in fertility. *Population Studies* 31:335–364.

Srinivasan, K., T. Kanitkar, V. Ahmed, and L. Sarangi. 1985. *Report on Baseline Survey of Fertility, Mortality and Related Factors in Orissa*. Monograph. Bombay: International Institute of Population Sciences.

World Fertility Survey. 1977a. *Modifications to the WFS Core Questionnaire and Related Documents*. Basic Documentation No. 10.

———. 1977b. *First Country Report for Nepal*.

———. 1978. *First Country Report for Bangladesh*.

———. 1984. *Major Findings and Implications*. Voorburg, Netherlands: International Statistical Institute.