

# **Comparison of Fertility Estimates from India's Sample Registration System and National Family Health Survey**

R. L. Narasimhan, Robert D. Retherford,  
Vinod Mishra, Fred Arnold, and T. K. Roy

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East-West Center Program on Population  
Honolulu, Hawaii, U.S.A.

India's National Family Health Survey (NFHS) was conducted in 1992–93 under the auspices of the Ministry of Health and Family Welfare. The survey provides national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health care, and the utilization of services available to mothers and children. The International Institute for Population Sciences, Mumbai, coordinated the project in cooperation with 18 population research centres throughout India, the East-West Center Program on Population in Honolulu, Hawaii, and Macro International in Calverton, Maryland. The United States Agency for International Development provided funding for the project.

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*Correspondence addresses:*

International Institute for Population Sciences  
Govandi Station Road, Deonar, Mumbai - 400 088, India  
Fax: 91-22-556-3257 • E-mail: [ipps@access.net.in](mailto:ipps@access.net.in)

East-West Center, Program on Population/Publications  
1601 East-West Road, Honolulu, Hawaii 96848-1601, U.S.A.  
Fax: 1-808-944-7490 • E-mail: [poppubs@ewc.hawaii.edu](mailto:poppubs@ewc.hawaii.edu)

# Comparison of Fertility Estimates from India's Sample Registration System and National Family Health Survey

**Abstract.** *This Subject Report compares fertility trends estimated alternatively from India's Sample Registration System (SRS) and the 1992–93 National Family Health Survey (NFHS). Fertility trends are estimated for the 15-year period of 1978–92. A goal of the analysis is to explain discrepancies between the two sets of estimates and to arrive at an improved assessment of the true trend in fertility.*

*The results indicate that, since the late 1970s, fertility has fallen faster than indicated by the SRS but more slowly than indicated by the NFHS. For the most recent five-year period, 1988–92, estimates of the general fertility rate derived from the two sources coincide, but for earlier years the rate estimated from the NFHS is progressively higher than the rate estimated from the SRS. The analysis suggests three main reasons for this divergence in earlier years: (1) a higher rate of underregistration of births in earlier years in the SRS, (2) backward displacement of births in the NFHS, and (3) omission of births in the NFHS in the first but not the second or third five-year periods before the survey.*

*Because of the displacement and omission of births in the first five years before the survey, the general fertility rate derived from the NFHS for this period appears to be too low. Yet it is identical to the general fertility rate estimated from the SRS for the same period. This suggests that the SRS underregistered births to the same extent that the NFHS displaced and omitted births occurring during this period. In other words, the true level of fertility during 1988–92 was probably somewhat higher than indicated by either the NFHS or the SRS.*

*The NFHS estimate of the general fertility rate for the full 15-year period of 1978–92 is affected very little, if at all, by displacement. But it is affected to some extent by the omission of births during the first five years of the period and therefore is undoubtedly somewhat too low. Despite this omission, the NFHS estimate of the general fertility rate for the 15-year period is 10 percent higher than the SRS estimate for the same period. This difference implies that the SRS underregistered births during 1978–92 by at least 10 percent. This level of underregistration is considerably higher than indicated by evaluation studies conducted by the Office of the Registrar General, and it suggests that the improvement in birth registration completeness over time in the SRS has been much greater than previously thought.*

*The curve of fertility by woman's age tends to be shifted to the right (that is, to older ages) in the SRS, relative to the NFHS. This relative shift appears to be caused mainly by greater misreporting of ages in the SRS than in the NFHS.*

*The analysis was also done for individual states. Discrepancies between the NFHS and the SRS in estimated fertility trends tend to be smaller in states with higher literacy rates than in other states.*

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***R. L. Narasimhan, Robert D. Retherford, Vinod Mishra, Fred Arnold, and T. K. Roy***

*R. L. Narasimhan is director (marketing), Ministry of Health and Family Welfare, New Delhi. Robert D. Retherford is a senior fellow and Vinod Mishra is a visiting fellow at the East-West Center's Program on Population. Fred Arnold is a senior population specialist at Macro International, Calverton, Maryland. T. K. Roy is a professor and head of the Department of Population Policies and Programmes at the International Institute for Population Sciences.*

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**F**ertility has certainly been declining in India, but there is some question about how fast it has been declining. Answering this question is important, because accurate estimates of the speed of fertility decline are needed for monitoring the progress of India's national family planning programme and for formulating India's five-year development plans, which require population projections.

This subject report addresses the question by comparing fertility estimates derived alternatively from India's Sample Registration System (SRS) and the 1992–93 National Family Health Survey (NFHS). Both sources indicate a fertility decline, but they differ in their estimates of fertility levels and the speed of fertility decline. Our analysis attempts to explain how these discrepancies are accounted for by age misreporting, SRS underregistration of births, and NFHS displacement and omission of births. The objective is to arrive at an improved assessment of the true trend in fertility in India during the 15-year period immediately preceding the NFHS. The basic NFHS reports already include some comparisons of NFHS fertility estimates with SRS fertility estimates for the three-year period immediately preceding the NFHS. In addition, Arnold (1993), Bhat (1995), and Swamy (1995) have investigated discrepancies between the two sources. Our conclusions differ somewhat from those of these earlier studies.

We begin with brief descriptions of data sources and methodology. The own-children method is our preferred method of fertility estimation, and the general fertility rate is our preferred measure of fertility, for reasons that we explain. Following a discussion of comparisons between the SRS and the NFHS in the basic NFHS reports, we compare fertility trends estimated from the two sources. As part of this comparison, we examine evidence of birth underregistration in the SRS and evidence of displacement and omission of births in the NFHS. We also compare fertility trends estimated from the SRS and the NFHS with fertility trends implied by contraceptive use rates.

## **DATA**

The principal data sources for this analysis are India's Sample Registration System and the 1992–93 National Family Health Survey. A third data source is family planning service statistics compiled by the Ministry of Health and Family Welfare. The first two of these data sources are described below.

### **Sample Registration System**

In the absence of a complete and reliable civil registration system, the Office of the Registrar General, India, established the Sample Registration System (SRS) in 1964–65 on a pilot basis. This was expanded into a full-scale system in 1969–70. Since the

early 1970s, the SRS has been the authoritative source of fertility estimates for the country.

The SRS is in essence a demographic sample survey based on a dual-record system, designed to provide national and state-level estimates of fertility and mortality on an annual basis. The system, which involves both continuous registration and a survey every six months to catch missed events, is based on a nationally representative sample of villages and urban blocks. The SRS sample currently includes 4,149 villages (or segments of villages in the case of large villages) and 2,151 urban blocks, comprising a population of about 6 million. The dual-record method for estimating fertility is described in more detail in the section on methods.

### **National Family Health Survey**

India's National Family Health Survey (NFHS), conducted during 1992–93, is our second source of information for estimating fertility trends. It is a nationally representative survey that includes both a household sample, covering everyone in the sampled households, and an individual sample, covering all ever-married women age 13–49 within those households. Corresponding to these two samples are a household questionnaire and an individual questionnaire. The household sample comprises 88,562 households, and the individual sample comprises 89,777 ever-married women age 13–49 within those households. The survey covers a range of topics in the areas of fertility, family planning, and maternal and child health.

The NFHS was designed to provide not only national estimates but also state-level estimates. In some states the sample was self-weighting, and in others it was weighted. There are two sets of weights, one set for each state and the other for the nation. The national weights take into account the state-level weights as well as the fact that overall sampling fractions vary from state to state. Results reported here are based on the weighted data.

### **METHODS**

The SRS uses a dual-record method for estimating fertility and mortality. We use two methods to derive estimates of fertility from the NFHS, the birth-history method and the own-children method.

#### **Dual-record method**

To understand how the dual-record method works, it is useful to consider the following basic characteristics of the SRS:

- Sample units are villages or urban blocks. Each unit has a local part-time enumerator.
- When a unit is first included in the system, a baseline survey is conducted. The baseline survey is a complete census of the sample unit. Staff from the state or district census directorate conduct it with assistance from the local part-time enumerator. In principle, the baseline surveys are taken on January 1. In practice, most of the baseline surveys occur in January and February, and a few take place in March. The household informant is asked to provide the ages of household members as of January 1, even if the baseline survey is taken later. Ages in the household register are subsequently updated once a year on January 1.
- The local part-time enumerator is responsible for continuously enumerating births and deaths as they occur in the sample unit. In the case of births, the recorded age of the mother at childbirth is her age as of the last update on January 1.
- Every six months an independent survey is taken in the unit for purposes of recording births and deaths in the previous six months. This survey is scheduled for January 1 and July 1.
- After the half-yearly survey takes place, events from the two sources (the continuous register and the half-yearly survey) are matched at state or district headquarters. Matching is done using information on house number, name of household head, name of mother (for births), name of deceased (for deaths), residence status (usual resident present, usual resident absent, in-migrant present, in-migrant absent, visitor), sex, and month of occurrence. All unmatched and partially matched events are verified in the field by a third person or by the supervisor and enumerator together, after which personnel from the Census Directorate prepare a final list of births and deaths.
- At the time of the half-yearly survey, the supervisor updates the house listing in the sample unit and the household registers.
- Crude birth rates are calculated by pooling births from the final list of births for two half-yearly surveys covering January through December and then dividing this estimated number of births by the estimated midyear population as obtained from the updated household registers. Crude death rates, age-specific fertility rates, and age-specific mortality rates are calculated similarly.

The half-yearly survey mentioned above is conducted in each sample unit by a full-time supervisor from state or district headquarters, who collects information about

births and deaths occurring not only to usual residents but also to visitors. However, the information about visitors is not used in the calculation of fertility and mortality rates. The supervisor records age in the half-yearly survey, simply transferring updated ages from the household register to the survey schedule. When conducting the half-yearly survey at the start of the year, the supervisor simultaneously updates the household register, including updating of the ages of household members. Ages are updated in the household register by incrementing age by one year as of January 1 (RGI 1996; personal communication from Deputy Registrar General S. K. Sinha).

As the above description of the SRS estimation procedures makes clear, age-specific fertility rates (ASFRs) in the SRS are tabulated by age at the beginning of the year. This means that a reported ASFR for a given five-year age group actually pertains to a five-year age group that is on average six months older. In tabulations of ASFRs in the SRS reports, the age groups 15–19, 20–24, . . . , 45–49 actually pertain to age groups 15.5–20.4, 20.5–25.4, . . . , 45.5–50.4. We shall return to this point when discussing discrepancies between the NFHS and the SRS in estimated patterns of fertility by age.

### **Birth-history method**

The birth history method, one of two methods by which we derive fertility estimates from the NFHS, is straightforward. One simply counts births by age of mother as reported in the birth histories for each year up to the fifteenth year before the survey. One similarly counts woman-years of exposure to the risk of birth by woman's age. One then divides births (by age of mother) by woman-years of exposure in each age group to obtain estimates of ASFRs and general fertility rates. To derive total fertility rates (TFRs) from the ASFRs, one sums the ASFRs in five-year age groups from 15–19 to 45–49 and multiplies the sum by five. In calculating these various fertility rates, which pertain to all women, not just ever-married women, it is assumed that never-married women have had no births. Base calculations are done in months. Rates are converted to a yearly basis only at the end of the calculations.

Because the NFHS collected birth histories only from ever-married women age 13–49, we cannot calculate a complete set of ASFRs for each of the 15 years before the survey. For example, the oldest women in the individual sample, who were 49 at the time of the survey, were only 44 five years earlier. Therefore, one cannot calculate an ASFR for women age 45–49 for years earlier than five years before the survey. Fifteen years ago, the oldest woman in the sample was 34 years old. If we want comparable fertility measures for each of the 15 years before the survey, we cannot make use of fertility at ages 35 and over. A suitable summary measure of fertility that is comparable over the entire period is the cumulative fertility rate up to age 35, or CFR(35). This measure is calculated by adding ASFRs in five-year age groups from 15–19 to 30–34 and multiplying the sum by five.

## Own-children method

The own-children method is a reverse-survival method for estimating ASFRs and other fertility measures for years prior to a census or household survey. In the present instance we apply the method to the NFHS household sample. The NFHS household sample includes women of all ages, which means that it is possible to calculate a full set of ASFRs out to the age group 45–49 for each of the 15 years before the survey.

In the own-children method, one first matches enumerated children to mothers within households, on the basis of respondents' answers to questions about age, sex, marital status, and relation to head of household. A computer algorithm is used for the matching. One then reverse-survives the matched (i.e., own) children, classified by their own age and mother's age, to estimate numbers of births by age of the mother in previous years. Similarly, one uses reverse-survival to estimate numbers of women by age in previous years. After making adjustments for unmatched (i.e., non-own) children, one calculates ASFRs by dividing the number of reverse-survived births by the number of reverse-survived women.

Estimates are normally computed for each of the 15 years before the survey. Estimates are not usually computed further back than 15 years because births must then be based on children age 15 or more at enumeration, a large proportion of whom do not reside in the same household as their mother and hence cannot be matched. All calculations are done initially by single years of age and time. One obtains estimates for grouped ages or grouped calendar years by appropriately aggregating single-year numerators (births) and denominators (women) and then dividing the aggregated numerator by the aggregated denominator. Such aggregation is useful for minimizing the distorting effects of age misreporting on the fertility estimates (Cho, Retherford, and Choe 1986).

Reverse-survival requires life tables, which we obtained from publications of the Registrar General, India (RGI 1986; 1990; 1995). For each state separately and for the nation as a whole, we used separate life tables for urban areas, rural areas, and both areas combined. We obtained life tables for the two time periods 1976–80 and 1988–92. In the case of Bihar and West Bengal, life tables for 1976–80 were not available, so we used life tables for 1981–85.

We considered the life tables for the two periods 1976–80 and 1988–92 to be located at the midpoints of these periods, namely 1978 and 1990. We then obtained life tables for years other than 1978 and 1990 by linearly interpolating or extrapolating age-specific probabilities of dying from the observed life tables for those two years. In the end, for each geographic unit considered, we obtained a set of 15 life tables, one for each year within the 15-year estimation period of 1978–92. We used these life tables for reverse-surviving women and children when applying the own-children method.

It should be noted that the own-children fertility estimates are not affected much by errors in the mortality estimates used for reverse-survival. One reason is that the reverse-survival ratios used to back-project children and women are both fairly close to 1.00. The other reason is that errors in the reverse-survival ratios used to back-project births based on children in the numerators of ASFRs cancel to some extent errors in the reverse-survival ratios used to back-project women in the denominators of ASFRs (Cho, Retherford, and Choe 1986).

The own-children method is our preferred method, because, unlike the birth-history method, it yields a complete set of ASFRs between ages 15–19 and 45–49 for each of the 15 years before the NFHS.

## **CHOOSING AN APPROPRIATE MEASURE OF FERTILITY**

As will be seen later, both the SRS and the NFHS are characterized by considerable age misreporting, which produces systematic biases in estimates of ASFRs and summary fertility measures such as the TFR that are calculated from ASFRs. It is therefore desirable to choose a summary measure of fertility that is less affected by age misreporting. A suitable measure is the general fertility rate (GFR), which is calculated as the number of annual births divided by the midyear number of women between ages 15 and 49. In both the SRS and the NFHS, the total number of women age 15–49 in the denominator of the GFR is biased by age misreporting only to the extent that women are moved across the age boundaries at ages 15 and 50. It is unaffected by age misreporting *within* the age range of 15–49. Moreover, the number of women transferred across the boundaries at either end of this range is small compared with the total number of women within the age range, and this further minimizes the distorting effects of transfers across the age boundaries.

In the NFHS, but not in the SRS, misreporting of children's ages affects the numerator of the GFR. In the SRS, annual births in the numerator are obtained simply as registered births, which age misreporting does not affect. In the NFHS, annual births are derived by reverse-surviving children of each single year of age. If children's ages are incorrectly reported, the estimates of annual births are biased, unless there are compensating errors stemming from children erroneously moved into an age group being balanced by children erroneously moved out of that age group.

In sum, age misreporting has little effect on GFRs estimated from the SRS. GFRs estimated from the NFHS are somewhat affected by the misreporting of children's ages but affected very little by the misreporting of women's ages. One can reduce the bias from the misreporting of children's ages by calculating the GFR for time periods longer than one year, which entails grouping children's ages.

## EARLIER COMPARISONS OF FERTILITY ESTIMATES FROM THE SRS AND THE NFHS

It is useful to reexamine comparisons of SRS and NFHS fertility estimates that were done for the three-year period immediately preceding the survey and reported in the basic NFHS report for all India (IIPS 1995, 89). That three-year period, which varied somewhat in timing from state to state because not all states were surveyed at the same time, coincides approximately with calendar years 1990–92. Accordingly, comparisons at the national level are made with an average of SRS fertility estimates over this three-year period.

Table 1, drawn from the NFHS report for all India, shows comparisons of NSHS and SRS fertility estimates for the three-year period and indicates fairly close agreement between the two sources. The last column shows that the agreement is better for the GFR and the crude birth rate (CBR) than for the TFR. This difference may occur in part because the GFR and the CBR are population-weighted averages of ASFRs, whereas ASFRs are weighted equally in the calculation of the TFR. If errors in estimating ASFRs vary by age, those errors will affect the CBR and the GFR differently from the way they affect the TFR.

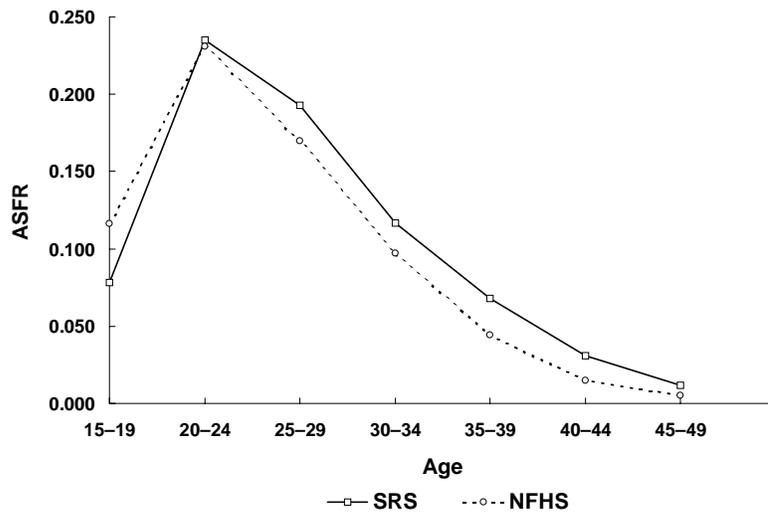
The NFHS report for all India additionally compares the age pattern of fertility derived from the NFHS and the SRS, as shown in Figure 1 for the three-year period immediately preceding the survey. The figure shows that ASFRs from the NFHS are higher than those from the SRS at ages below the peak age of fertility and lower at ages above the peak age of fertility. In effect, the age curve of fertility is shifted to the right in the SRS, relative to the NFHS. Presumably the peak of the curve also shifts to the right, but any shift in the peak is obscured by the grouping of ages into five-year age groups. The presumed shift in the peak might be revealed by a graph of ASFRs for single-year age groups, but it is not possible to produce such a graph, because ASFRs for single-year age groups are not published by the SRS.

**Table 1 Total fertility rates, general fertility rates, and crude birth rates from the NFHS and the SRS, by urban-rural residence: India, 1990–92**

Fertility measure	NFHS			SRS			NFHS/SRS		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Total fertility rates	2.70	3.67	3.39	2.71	3.99	3.67	1.00	0.92	0.92
General fertility rates	98	133	123	93	129	121	1.05	1.03	1.02
Crude birth rates	24.1	30.4	28.7	24.0	32.2	29.6	1.00	0.94	0.97

Source: IIPS (1995), Table 5.1.

Note: TFRs are expressed as births per woman. GFRs are expressed as births per 1,000 women age 15–49 per year, and CBRs are expressed as births per 1,000 population per year. The NFHS estimate of the CBR pertains to the period 1–24 months before interview.



Source: IIPS (1995), Figure 5.2.

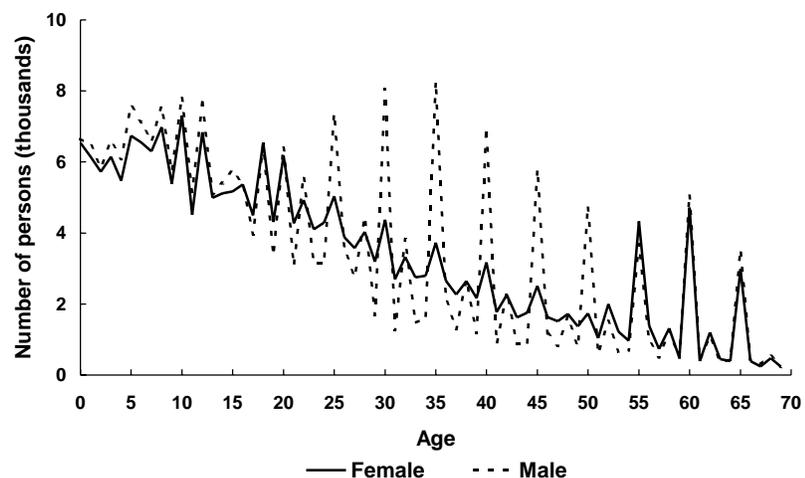
**Figure 1 Age-specific fertility rates from the NFHS and the SRS: India, 1990–92**

The NFHS report for all India hypothesizes that the higher NFHS estimate at ages 15–19 in Figure 1 may be due to the fact that the NFHS estimates are based on the *de facto* population (the population actually in the household at the time of the survey), whereas the SRS estimates are based on the *de jure* population (defined in terms of usual place of residence). The NFHS report suggests that because births often occur away from the mother’s usual place of residence, the SRS may not be able to obtain complete information about recent births to usual residents who are temporarily absent. Most, but not all, of the births initially missed in this way would probably be picked up in the next half-yearly survey. This effect could produce a downward bias in the SRS estimate of fertility at ages 15–19, when women are more likely than at older ages to return to their parents’ home for delivery. In the NFHS the percentage of births that occurred in the home of the mother’s parents during the four years immediately preceding the survey was 21 percent for women below age 20, 10 percent for women age 20–34, and 2 percent for women age 35 and above (IIPS 1995, 238). Such women typically spend an extended period away from their usual place of residence. Beyond age 20, however, the percentages are small and probably do not significantly bias the SRS estimates of fertility. In any case, after ages 20–24 the SRS estimates of fertility are higher than the NFHS estimates, not lower.

It is likely that a considerably more important cause of the observed pattern of discrepancies in Figure 1—one that can explain discrepancies at both younger and older reproductive ages—is differences between the NFHS and the SRS in the extent and pattern of age misreporting. Ages tend to be reported as either somewhat too young in the NFHS, somewhat too old in the SRS, or a mixture of the two. In the first case, the age curve of fertility from the NFHS would be shifted to the left, so that

fertility below the peak age of fertility would be too high and fertility above the peak age of fertility would be too low. In the second case, the age curve of fertility from the SRS would be shifted to the right, so that fertility below the peak age of fertility would be too low and fertility above the peak age of fertility would be too high.

Which case is more likely? In the NFHS, the training of field staff lasted for a minimum of 20 days in each state, and a considerable amount of the training focused on how to collect accurate age data. Moreover, the NFHS asked questions on age as well as the month and year of birth, which were extensively probed. Despite the fact that only 16 percent of ever-married women were able to report both the month and the year of their birth (which, when missing, were imputed from reported age or estimated by the interviewer after probing), the training appears to have had the desired effect. Figure 2, which graphs the single-year age distribution by sex for all India as derived from the NFHS, shows that in the 15–49 age range, but not outside this range, heaping on ages ending in 0 and 5 is much less marked for women than for men. Outside this range the extent of heaping is about the same for both sexes. The ages of men, unmarried persons, and persons below age 15 or over age 50 were obtained from the household schedule. The informant in that case was the household head or, in the absence of the head, any other presumably knowledgeable adult in the household. The ages of ever-married women between ages 15 and 49, on the other hand, were obtained from the individual sample, in which the women themselves reported their ages and the interviewers carefully probed them for accurate responses. We believe that women are more likely than household heads or other household informants to have accurate knowledge of their own age. Moreover, women—especially younger women—are less likely than household heads or other household informants to report themselves as older than they really are.



Source: IIPS (1995)

**Figure 2** Number of persons, by age and sex, in the NFHS: India, 1990–92

The SRS baseline surveys collect information on age in completed years but not on the month and year of birth, and interviewer training on how to collect accurate age data is less intensive than in the NFHS. Moreover, the SRS typically obtains information from the household head, who reports for the entire household. It is therefore likely that age reporting for women in the reproductive ages is less accurate in the SRS than in the NFHS. We hypothesize that the pattern of discrepancy between the NFHS-derived age curve of fertility and the SRS-derived age curve of fertility shown in Figure 1 is due in part to a greater extent of misreporting of women's ages in the SRS. This could result from a net upward bias in reported ages of women who are young but married, and of women who have a higher than average number of children relative to their true age. For example, in the case of brides, the father-in-law might report the bride as somewhat older by virtue of her being married, and in some cases also because she is under the minimum legal age of marriage for women, which is 18 in India. There may also be some downward bias in reported ages of older single women and women who have a lower than average number of children relative to their true age. For example, women who remain unmarried in their early 20s may be reported as younger than their true age because of the anxiety their parents may feel over not having already arranged a suitable match for them.

If this age-misreporting hypothesis is valid, proportions currently married at ages 15–19 and ages 20–24 should be lower in the SRS than in the NFHS. This is indeed the case. The proportion currently married at 15–19 is 38 percent in the 1992–93 NFHS, compared with 30 percent in the 1992 SRS. Comparable figures for the 20–24 age group are 80 percent in the NFHS and 75 percent in the SRS (IIPS 1995, 45; RGI 1994, 12). If our hypothesis is valid, mean parity (i.e., the mean number of children ever born to a woman) at the younger reproductive ages should also be higher in the NFHS than in the SRS. However, a direct comparison cannot be made in this case because the SRS does not tabulate mean parity by age. In sum, the available data on proportions married tend to support the hypothesis that greater age misreporting in the SRS than in the NFHS accounts for most of the rightward shift of the age curve of fertility in the SRS, relative to the NFHS.

As mentioned earlier, in the SRS a baseline survey is conducted when a village or urban block is first included in the SRS sample. Once a village or urban block is included in the SRS sample, the ages of children born after the baseline survey should be accurate. Their year of birth is obviously correctly recorded when they are born, and subsequently their ages are updated annually. However, there is scope for age misreporting for persons whose ages were obtained at the time of the baseline survey and for in-migrants (including brides) who subsequently moved into the sample unit. The SRS sample of villages and urban blocks was completely replaced with a new sample of villages and urban blocks during 1982–84. None of the births that occurred after 1982–84 had reached reproductive age by the time the NFHS was conducted in

1992–93. Therefore, the ages of women for whom birth rates were calculated after 1982–84 are all subject to age misreporting in the baseline surveys. A similar mechanism operated between 1978 and 1982–84, inasmuch as the SRS sample was expanded by about half during 1978–79. In this regard, it should be noted that when ages are updated in the half-yearly survey at the start of the year, age-reporting errors in the baseline survey are preserved. For example, if a woman’s age is exaggerated by one year in the baseline survey, it will also be exaggerated by one year in every subsequent calendar year for as long as she remains in the SRS sample.

Further indirect evidence in support of the hypothesis that age misreporting tends to shift the age curve of fertility to the right in the SRS is provided by graphs similar to Figure 1 for the states of India. The graphs for individual states, which are contained in the NFHS state reports but not reproduced here, show a pattern similar to that for all India in Figure 1: a rightward shift in the SRS curve that tends to be more marked for states with lower rates of female literacy. In Kerala, the most literate state, a rightward shift is not observed at all. Inasmuch as literacy is inversely correlated with age misreporting, the inverse correlation of percentage literate with rightward shift supports the hypothesis that age misreporting accounts for most of this shift.

To examine the state-level pattern, we grouped 16 major states into three groups: those with low literacy (below 40 percent literate among females age 6+), medium literacy (40–55 percent), and high literacy (above 55 percent). Low-literacy states (by ascending level of literacy) are Rajasthan, Bihar, Uttar Pradesh, Madhya Pradesh, and Andhra Pradesh. Medium-literacy states are Orissa, Haryana, Karnataka, Assam, Gujarat, and Punjab. High-literacy states are West Bengal, Maharashtra, Tamil Nadu, Himachal Pradesh, and Kerala. All the low-literacy states show a large shift, and three out of five high-literacy states (Tamil Nadu, Himachal Pradesh, and Kerala) show a small shift or no shift. The pattern in the middle group is variable. These state comparisons also reveal that the association between literacy and the extent of rightward shift is stronger at ages above the peak age of fertility than at ages below the peak, suggesting that age misreporting is a more predominant source of distortion at ages above the peak than below the peak. This is consistent with our earlier observation that fertility at ages 15–19 may be distorted not only by age misreporting but also (in the SRS) by unreported births to women who gave birth in their parental village.

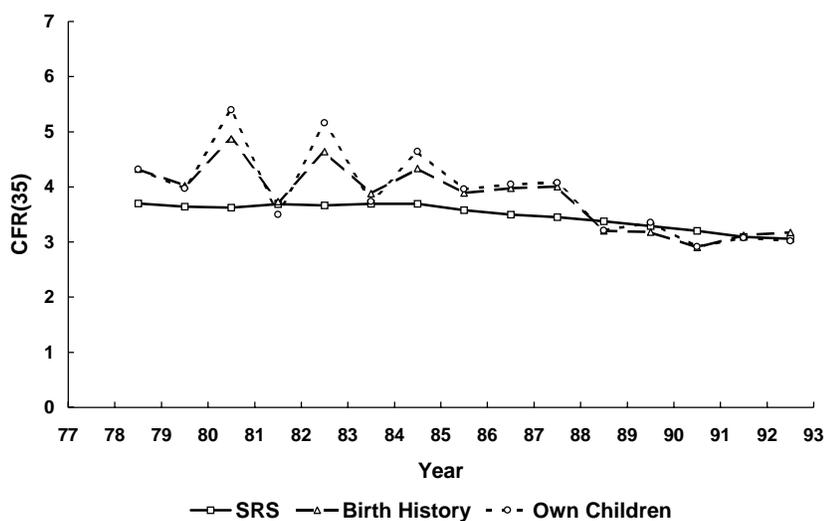
Earlier we noted that, in the SRS published reports, age groups 15–19, 20–24, . . . , 45–49 actually pertain to age groups 15.5–20.4, 20.5–25.4, . . . , 45.5–50.4. Fertility in the age group 15–19 is lower than fertility in the age group 15.5–20.4, and the differential goes the other way at ages above the peak age of fertility. Thus the six-month offset tends to bias the SRS estimates of ASFRs in the direction of being too high at ages below the peak age of fertility and too low at ages above the peak age of

fertility. This pattern is the reverse of what we observe in the comparison of SRS estimates of ASFRs with parallel estimates from the NFHS. Thus the six-month offset cannot explain the pattern of discrepancies shown in Figure 1. Evidently the bias caused by the six-month offset is more than compensated by the other sources of bias (mainly age misreporting) that act in the opposite direction. This evidence on how age misreporting distorts the age curve of fertility justifies our choice of the general fertility rate as our preferred measure of fertility.

## **COMPARING BIRTH-HISTORY ESTIMATES WITH OWN-CHILDREN ESTIMATES OF FERTILITY TRENDS**

Next we compare fertility trends estimated by the birth-history method with fertility trends estimated by the own-children method in order to validate the use of the own-children method. If the two methods give similar results, we shall consider that the own-children method may be used in place of the birth-history method. As discussed earlier, estimating a 15-year trend restricts the birth-history estimates of fertility to ages below 35, so that the GFR cannot be used for this comparison. We therefore use the cumulative fertility rate up to age 35, CFR(35), for this purpose.

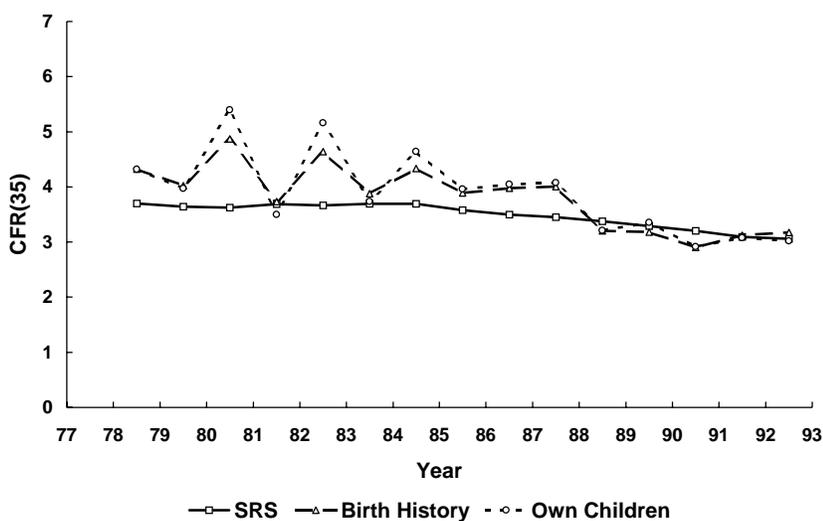
Figures 3–5 show birth-history and own-children estimates of the trend in CFR(35) for all India and for urban and rural areas. They also show SRS estimates of CFR(35). Several features are immediately evident from the graphs. The SRS trend is smooth, whereas the birth-history and own-children trends show systematic fluctuations. The fluctuations in the birth-history and own-children trends are similar, but those in the own-children trends are somewhat greater. This greater exaggeration occurs because interviewers in the NFHS were not required to probe extensively for age in the initial household interview. In addition, they were instructed not to correct ages in the household questionnaire on the basis of probed information obtained in the individual questionnaire unless a woman's reported age in the individual interview was outside the eligible age range of 13–49. Ages of children from the household questionnaire therefore do not necessarily agree with ages of children implied by birth dates in the birth histories obtained from the individual questionnaire. Consequently, ages of children in the NFHS suffer from misreporting to a greater extent in the household data used to obtain the own-children estimates than in the individual data used to obtain the birth-history estimates. (As we discussed earlier, ages of ever-married women age 13–49 are identical in the household data and the individual data used in our analysis. An additional age variable was created in the household data set, which is the same as the original age variable in the household data set except that ages of ever-married women age 13–49 are replaced with corresponding ages collected for these women in the individual questionnaire. We have used this additional age variable in place of the original age variable obtained from the household questionnaire.)



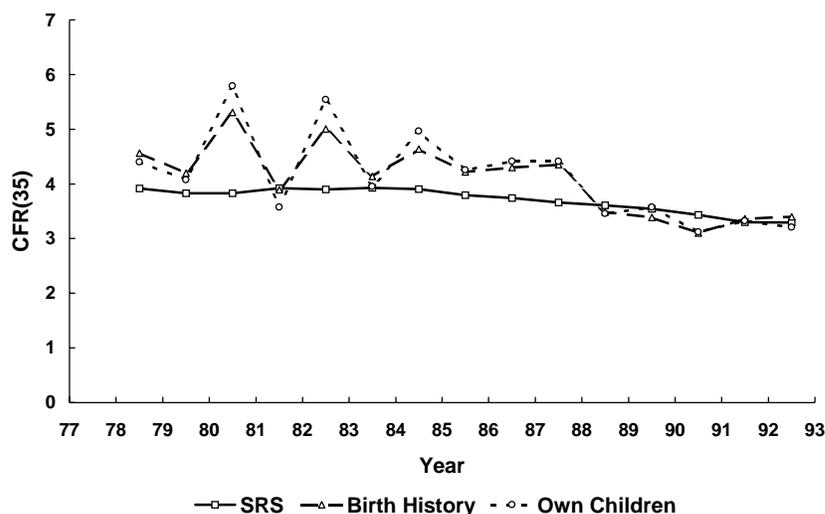
**Figure 3** Cumulative fertility rates, CFR(35), from the NFHS (birth-history and own-children estimates) and the SRS: India, 1978–92

The own-children estimates of CFR(35) tend to exceed slightly the birth-history estimates of CFR(35) during the earlier half of the estimation period. On the whole, however, there is quite close agreement between the birth-history and own-children trends in CFR(35), in both urban and rural areas.

The fluctuations in the trends derived from birth histories and those derived from the own-children-method reflect patterns of misreporting of children's ages in



**Figure 4** Cumulative fertility rates, CFR(35), from the NFHS (birth-history and own-children estimates) and the SRS: Urban areas, 1978–92



**Figure 5 Cumulative fertility rates, CFR(35), from the NFHS (birth-history and own-children estimates) and the SRS: Rural areas, 1978–92**

the NFHS. Births in the first year before the survey, whether obtained from the birth histories or by reverse-survival of children, are based on children age 0 (i.e., under age 1) at the time of the survey. Similarly, births in the second year before the survey are based on children age 1 at the time of the survey, and so on. The upward jump in the sixth year before the survey may be due to a tendency of NFHS interviewers to shift some children under five years of age to age 5 or older in order to avoid having to ask a large block of questions pertaining only to children born since January 1 of the fourth full calendar year before the start of the survey in any given state. It is also possible that interviewers sometimes omitted children under age 5 and the births corresponding to them in the birth histories in order to avoid having to ask this same block of questions. Some of the upward jump in the sixth year before the survey may also be due to heaping on age 5.

The peaks in the birth-history-derived trends and own-children-derived trends in the 9<sup>th</sup>, 11<sup>th</sup>, and 13<sup>th</sup> years before the survey reflect heaping of children's ages respectively on 8, 10, and 12 at the time of survey. This pattern of heaping is found in many developing countries, including other countries of South Asia (Cho, Retherford, and Choe 1986; Retherford and Alam 1985). The effects of heaping are slightly more evident in the own-children estimates than in the birth-history estimates because, as already mentioned, the children's ages on which the own-children estimates are based are taken from the household schedule, whereas the children's ages implicit in the birth histories were obtained by a more involved process of dating birth events that has no parallel in the household sample. In the individual sample, a mother reported a child's month and year of birth, whereas in the household sample the

household head or another household informant reported a child's age only in completed years.

Graphs similar to Figures 3–5 for age-specific fertility rates (not shown) indicate that the ASFRs primarily responsible for raising the CFR(35) based on the NFHS above the CFR(35) based on the SRS are those at 15–19 and, to a lesser extent, at 20–24. In the above analysis, the close agreement between the birth-history estimates and the own-children estimates of CFR(35) validates our use of the own-children method for generating trends in the GFR from the NFHS. These we present in the next section.

### **COMPARING TRENDS IN SRS AND NFHS ESTIMATES OF THE GENERAL FERTILITY RATE**

Earlier we mentioned that the problem of misreported children's ages can be reduced by calculating fertility estimates for periods longer than one year, which entails grouping children's ages. This problem can be minimized further by calculating a single general fertility rate for the entire 15-year estimation period from 1978 to 1992 (1977 to 1991 for some states and 1979 to 1993 for one state). This we do by calculating, first, the total number of births over the 15-year time period and, second, the number of person-years of exposure of women age 15–49 over this same period, and then dividing the number of births by the person-years of exposure to obtain an estimate of the GFR for the entire 15-year period. Births in this aggregated GFR are derived from children age 0–14. The number of net transfers across the boundary at age 15 is probably quite small in percentage terms, inasmuch as there is almost no heaping on age 15, as shown earlier in Figure 2. Thus the estimated number of births in the numerator of this aggregated GFR, and hence the estimate of the GFR itself, should be quite accurate, except for births corresponding to children who are missed or intentionally omitted by interviewers to lighten their workload.

In the case of the SRS, we were not able to aggregate numerators and denominators separately over the 15-year period, because the SRS does not publish estimates of the numerators and denominators separately—only the rates. Therefore, for the SRS we simply calculated a 15-year average of GFRs for single calendar years.

Table 2 shows estimates of the GFR derived alternatively from the SRS and the NFHS, by urban-rural residence, for the 15-year period 1978–92 as a whole and also for three component five-year periods, 1978–82, 1983–87, and 1988–92. For all India, the SRS estimate of the GFR for the entire 15-year estimation period is 134 and the NFHS (own-children) estimate is 148. The NFHS/SRS ratio of GFRs is 1.10. Thus the NFHS estimate is 10 percent higher than the SRS estimate. How shall we interpret this?

**Table 2 Estimates of the general fertility rate (GFR) from the NFHS and the SRS, by urban-rural residence: India, 1978–92**

Time period	NFHS			SRS			NFHS/SRS		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
1978–92	122	158	148	107	143	134	1.14	1.11	1.10
1978–82	143	174	167	111	147	140	1.28	1.18	1.19
1983–87	128	171	159	113	148	140	1.14	1.16	1.14
1988–92	101	134	124	96	133	124	1.05	1.01	1.00

Note: GFRs are expressed as births per 1,000 women age 15–49 per year.

## EVIDENCE OF BIRTH UNDERREGISTRATION IN THE SRS

We can think of no reason why the NFHS estimate of the GFR for 1978–92 in Table 2 should be biased upward. On the contrary, the NFHS estimate may be too low because of omission of births during the first five years before the survey. The SRS estimate may also be too low because of underregistration of births. The results therefore suggest that, for the period 1978–92 as a whole, SRS births are underregistered by at least 10 percent. This minimal figure of 10 percent appears robust, given the negligible effects of age misreporting on the underlying calculations.

If the discrepancies in GFR between the SRS and the NFHS stem from greater underregistration of births in the SRS than undercoverage of births in the NFHS, we would expect the magnitude of the discrepancy to be greater in earlier years, when the SRS did not cover events as completely as it does today. Table 2 shows that this is indeed the case. The NFHS/SRS ratio of GFRs is 1.19 for 1978–82, 1.14 for 1983–87, and 1.00 for 1988–92. The value of 1.00 for 1988–92 indicates that in this most recent period, the registration of births in the SRS is as complete as birth coverage in the NFHS. However, the precipitous drop from 1.14 to 1.00 between 1983–87 and 1988–92 seems too large to be caused by more complete birth registration in the SRS alone. It suggests that omission of births in the NFHS during the five years before the survey and displacement of births in the NFHS from the first five years to earlier periods may also have played a role. This possibility is consistent with evidence discussed earlier that there was some intentional omission and displacement of births in the first five years before the NFHS on the part of some NFHS interviewers. We shall discuss omission and displacement of births in the NFHS in more detail later.

Several previous studies that evaluated the completeness of registration in the SRS also indicate that birth registration in the SRS has improved over time. All of these studies were based on special surveys conducted by the Office of the Registrar General in a subsample of SRS sample units. One such study, based on the 1972 Fertility Survey conducted in a 25 percent subsample of the SRS for 1971–72, concluded that the SRS underregistered births in 1972 by about 8 percent (Mishra 1988;

see also RGI 1976; 1983). Two subsequent inquiries concluded that the SRS underregistered births by 3.2 percent in 1980–81 and by 1.8 percent in 1985 (RGI 1984; 1988). Taken together, these studies also indicate that completeness of birth registration in the SRS has been improving, although not as much as our own analysis indicates.

If underregistration in the SRS was a problem in earlier years, we would expect the problem to be somewhat worse in urban areas than in rural areas, because of well-known difficulties of completely enumerating persons and events in urban areas. Table 2 confirms this expectation. The urban-rural differences are not large, however, perhaps because the registration difficulties posed by the population's greater anonymity in urban areas tend to be offset by higher levels of education and a greater need for a birth certificate (e.g., for entering school). For the entire estimation period 1978–92, urban births appear to be underregistered by 14 percent and rural births by 11 percent, relative to the NFHS. (It may seem odd that 14 percent and 11 percent do not bracket the overall figure of 10 percent for urban and rural combined, but this can happen computationally.) The picture is similar but not entirely consistent when we look at component five-year time periods. The urban ratio exceeds the rural ratio for the first and third periods, but not for the second period.

The Registrar General, India, has recently reported sex ratios at birth in the SRS for the period 1981–90 as a whole (RGI 1997). For all India the reported sex ratio at birth is 110. Among 15 major states, the sex ratio at birth is 105 in Andhra Pradesh and Tamil Nadu; 106 in Assam, Orissa, Kerala, and West Bengal; 107 in Karnataka; 108 in Madhya Pradesh; 109 in Maharashtra; and 110 or higher in Bihar, Gujarat, Haryana, Punjab, Rajasthan, and Uttar Pradesh. Sex ratios are highest in the northern states: 112 in Bihar and Uttar Pradesh, 113 in Punjab, 114 in Rajasthan, and 115 in Haryana. The high sex ratios in these northern states indicate substantial underregistration of female births in the SRS during the period 1981–90. If birth registration in the SRS were becoming more complete over time, one would expect the SRS estimates of the sex ratio at birth to be moving in the direction of 105. However, it is not possible to ascertain whether this has been happening because the SRS has not published annual estimates of the sex ratio at birth. The high sex ratio at birth in the SRS for the period 1981–90 constitutes additional evidence of substantial underregistration of births in the SRS in the past.

## **EVIDENCE OF DISPLACEMENT AND OMISSION OF BIRTHS IN THE NFHS**

At several points in earlier sections we noted an apparent deficit of births in the first five years before the NFHS. This deficit could be due to displacement of births from the first to the second five years before the survey, or to omission of births during the

first five years before the survey. Some interviewers were undoubtedly motivated to displace or omit births in order to avoid having to ask a large block of questions about children under a cutoff age (approximately age 5).

If interviewers consciously displace births from time to time to avoid having to ask a block of questions, an obvious way to do it would be to report a child of age 4 as age 5, and to do this on both the household interview and the individual interview to be consistent and thus avoid detection. The result would be a noticeable deficit of children at age 4 and a noticeable surplus at age 5. It would show up in the age distribution as a downward spike in the fifth year before the survey and an upward spike in the sixth year before survey. This is indeed indicated by Figure 2. The two-spike pattern is still present but less noticeable in the NFHS-derived CFR(35) and GFR trends in Figures 3 and 6. Overall, these results suggest that some intentional displacement occurred. As mentioned earlier, however, some of the surplus at age 5 may be due instead to a simple digit preference for age 5 on the part of respondents.

There may also be some unintended displacement. Children about to reach a birthday in one or two months may tend to be rounded up to the next age in completed years, especially by persons who do not recall the exact birth dates and ages of their children. For example, children whose true ages are 2 years and 11 months might be reported as age 3 in a substantial percentage of cases. If this kind of upward rounding of ages occurred, there would be displacement of births from the first five years into the second five years before the survey, but without downward and upward spikes in the fifth and sixth years before the survey.

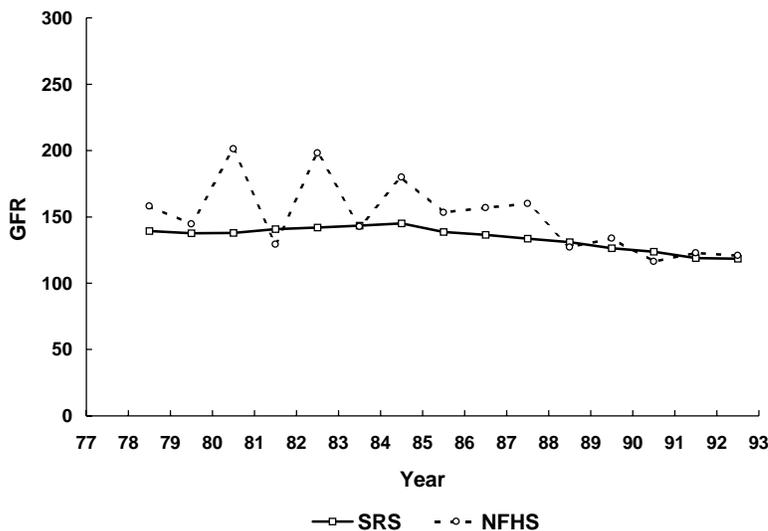


Figure 6 General fertility rates from the NFHS and the SRS: India, 1978–92

It is also likely that another kind of unintentional displacement, resulting from heaping on age 10 but not on age 15 (as seen in Figure 2), has tended to inflate fertility estimates in the third five years before the survey. In effect, this pattern of age heaping shifts births from the second five years before the survey to the third five years before the survey, but not from the third five years before the survey to the fourth five years before the survey. The result is a bunching of births in the third five years before the survey.

In Table 2, moving backward over time, the NFHS/SRS ratios of GFRs increase from 1.00 to 1.14 to 1.19 over three five-year periods before the survey. The value of 1.14 for the second period seems too large to be explained by only displacement of births, inasmuch as the displacement from the first five years to the second five years is balanced to some extent by the displacement from the second five years to the third five years. This is additional evidence that some interviewers omitted a birth from time to time in the first five years before the survey to lighten their workload. The ratio of 1.00 for the first five years before the survey indicates that the combined effects of displacement and omission in the NFHS are balanced by an equal extent of underregistration of births in the SRS during the same period.

In the NFHS there appears to be little omission of births by respondents (as opposed to interviewers). This is indicated by an examination of the trend in the estimated sex ratio at birth during the 20 years preceding the survey. If respondents were omitting births, female births would be more likely to be omitted than male births, given the high degree of preference for sons in India, and the distortion would become worse further back in time. But in the NFHS the sex ratio at birth is virtually constant over this 20-year period. It becomes heavily male only when one goes back more than 20 years. In the absence of large-scale sex-selective abortion, the sex ratio at birth is biologically determined and should be in the range of 105 to 107 male births per 100 female births. In the NFHS the sex ratio at birth is 106.3 males per 100 females in 1987–91, 106.3 in 1982–86, 106.6 in 1977–81, 106.6 in 1972–76, and 112.0 in 1971 or earlier (IIPS 1995, 325). These results indicate that, if significant numbers of births were missed in the NFHS during the 20 years before the survey, it is not because respondents did not report them. It is because interviewers who wanted to lighten their workload intentionally omitted some births during the first five years before the survey. The results indicate that such intentional omissions, to the extent that they occurred, were random with regard to sex. That is, an interviewer was no more likely to omit a female birth intentionally than a male birth.

## **FERTILITY TRENDS IMPLIED BY CONTRACEPTIVE USE RATES**

The trend in fertility can also be estimated from a third source of information, contraceptive use rates from family planning service statistics. The Ministry of

Health and Family Welfare provides information on couple protection rates (CPRs) among currently married women age 15–49. (See MOHFW 1994 for a discussion of the births-averted methodology that is used to estimate these rates.) In India as a whole, the CPR increased from 23 percent in 1978 to 44 percent in 1992.

The annual series of CPRs can be used to predict total fertility rates using a statistical model based on data from more than 90 countries around the world (Ross and Frankenberg 1993). We use the TFR here because a similar model is not available for the GFR. The model is

$$\text{TFR} = 7.2931 - 0.0700 \text{ CPR} \quad (1)$$

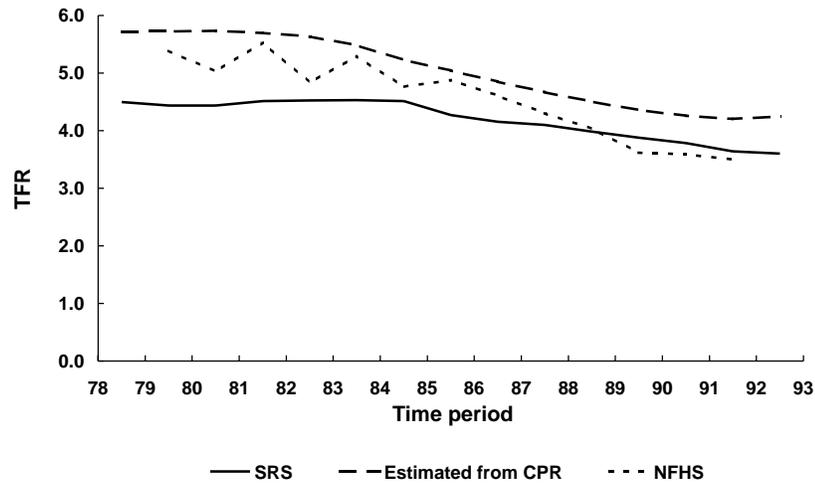
Despite the fact that other variables known to affect fertility are not included on the right side of this equation, this “international regression line” fits the data remarkably well:  $R^2 = 0.88$ , indicating that the regression line explains 88 percent of the variation in the TFR.

In the original formulation of this model, the acronym CPR denotes the contraceptive prevalence rate, which is the proportion of currently married women age 15–49 who are using contraception. This is not quite the same as the couple protection rate, which is calculated in a different way. However, in the present analysis we treat these two measures as equivalent and use the acronym to denote the couple protection rate.

Figure 7 compares the trend in TFRs predicted from CPRs with the trends in TFRs estimated from the SRS and the NFHS. The NFHS estimates of the TFR, which are derived by the own-children method, are three-year moving averages of single-year estimates. The moving averages smooth to some extent irregularities in the single-year estimates stemming from the misreporting of children’s ages and thereby clarify the analysis.

The TFRs estimated from the SRS and the NFHS converge over time much like the GFRs shown in Figure 6. The TFRs predicted from CPRs decline more steeply than the TFRs estimated from the SRS but not as steeply as those estimated from the NFHS. This finding constitutes additional indirect evidence that registration of births in the SRS has improved in recent years, and that the NFHS omitted some recent births and displaced some to previous years.

The TFRs predicted from CPRs are higher than those estimated from either the SRS or the NFHS. Contraceptive users in India rely more heavily on sterilization than do users in other countries (Jain 1996). This implies that a given level of contraceptive use results in lower fertility in India than elsewhere, as sterilization is more effective than other methods. Thus in India the fertility rates predicted from CPRs are probably too high.



Note: CPR denotes the couple protection rate among currently married women age 15–49, as calculated by the Ministry of Health and Family Welfare from family planning service statistics.

**Figure 7 Total fertility rates estimated by alternative methods: India, 1978–92**

In Figure 7 the difference between the TFR predicted from the international regression line of TFR on CPR and the SRS-derived TFR decreases markedly over time, from about 1.2 children per woman in 1978 to about 0.6 children per woman in 1992. (The slight divergence after 1990 may be due to a change in methodology used by the Ministry of Health and Family Welfare to estimate the CPR.) Part of the decrease is probably due to increases over time in the use of temporary methods, which are less effective than sterilization. However, at the time of the 1992–93 NFHS, sterilization still accounted for 76 percent of all contraceptive use in India, compared with only 14 percent for modern temporary methods (Ramesh, Gulati, and Retherford 1996).

It therefore seems unlikely that increased use of temporary methods can account for much of the convergence of the two curves. Probably the main reason for the convergence is that birth-registration completeness in the SRS improved over time, thereby tending to increase the SRS estimate of the TFR. This conclusion is consistent with evidence we presented in earlier sections that also indicates that the SRS underestimates the speed of fertility decline because of increasingly complete registration of births.

In addition to the international regression line specified by equation (1), two other international regression lines of TFR on CPR are available—from Mauldin and Ross (1991) and from Westoff (1990). They yield TFR trends that are virtually identical to the trend derived from equation (1) and shown in Figure 7. Results from these other two lines are not shown.

## NFHS/SRS COMPARISONS OF TRENDS IN THE GENERAL FERTILITY RATE FOR STATES

Figures 8–23 show trends in the GFR for 16 major states, estimated alternatively from the NFHS by the own-children method and from the SRS. The figures are supplemented by Table 3, which shows NFHS/SRS ratios of GFRs for three five-year periods for the same states. Haryana, Maharashtra, Orissa, Uttar Pradesh, and West Bengal show a pattern of discrepancy between the NFHS- and SRS-derived estimates that resembles (roughly) the pattern for all India in Figure 6. In Madhya Pradesh, Punjab, and Rajasthan the NFHS-derived estimates are lower than the SRS-derived estimates during the first five years before the NFHS and higher during the preceding 10 years. In Assam and Karnataka the NFHS-derived estimates tend to be higher than the SRS-derived estimates throughout the entire estimation period, but the magnitude of the difference is much greater for Assam than for Karnataka. Assam and Karnataka are also the states for which the 1980–81 SRS evaluation study observed the highest levels of underregistered births—9 percent and 11 percent, respectively (RGI 1984). The remaining states show still other patterns.

The upward jump in the NFHS-derived GFR curve between the fifth and sixth years before the survey is particularly pronounced in Bihar, Orissa, and Rajasthan. The jump is also quite substantial in Assam, Gujarat, Madhya Pradesh, Punjab, and West Bengal. These results suggest that displacement and omission of births in the NFHS occurred more frequently in those states than in other states. Himachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu, and Uttar Pradesh do not show an appreciable jump. With the exception of Uttar Pradesh, all states in this latter group have relatively high literacy rates and tend to be generally more advanced than the other states. The GFR curves from the NFHS and the SRS coincide quite closely for Himachal Pradesh, Kerala, and Tamil Nadu.

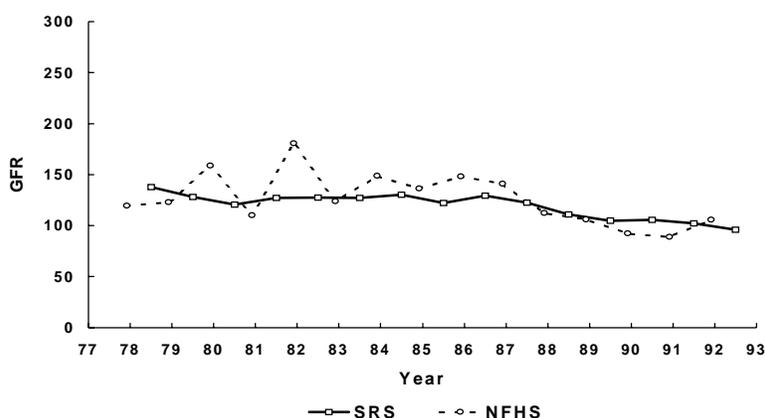


Figure 8 General fertility rates from the NFHS and the SRS: Andhra Pradesh, 1978–92

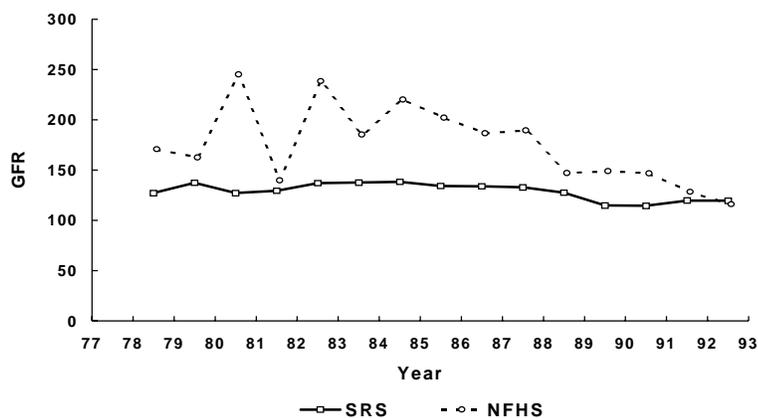


Figure 9 General fertility rates from the NFHS and the SRS: Assam, 1978–92

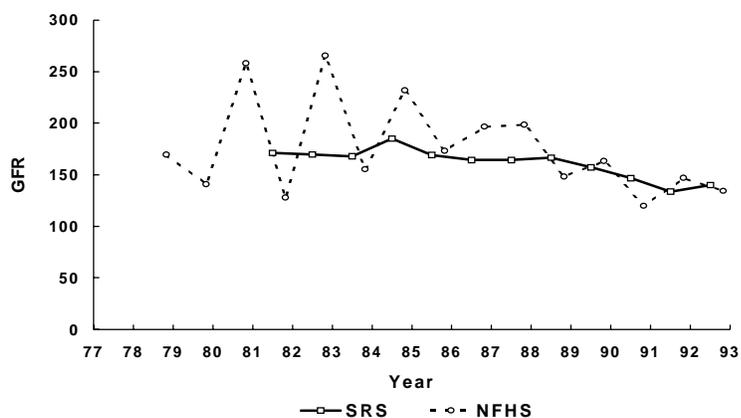


Figure 10 General fertility rates from the NFHS and the SRS: Bihar, 1978–92

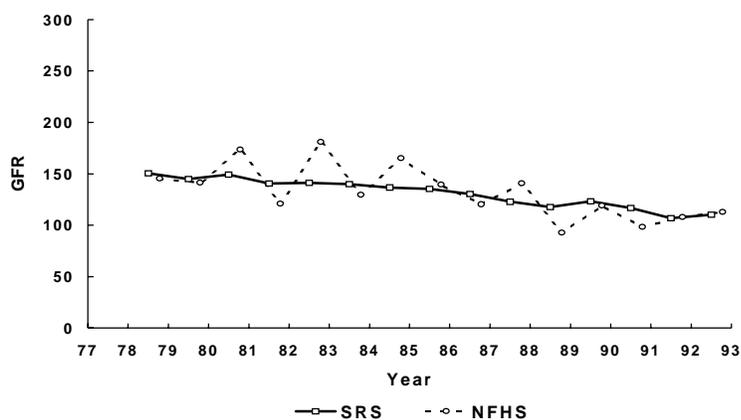


Figure 11 General fertility rates from the NFHS and the SRS: Gujarat, 1978–92

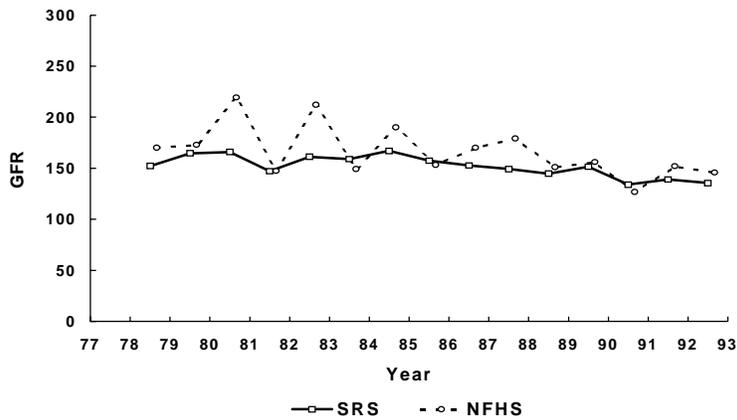


Figure 12 General fertility rates from the NFHS and the SRS: Haryana, 1978-92

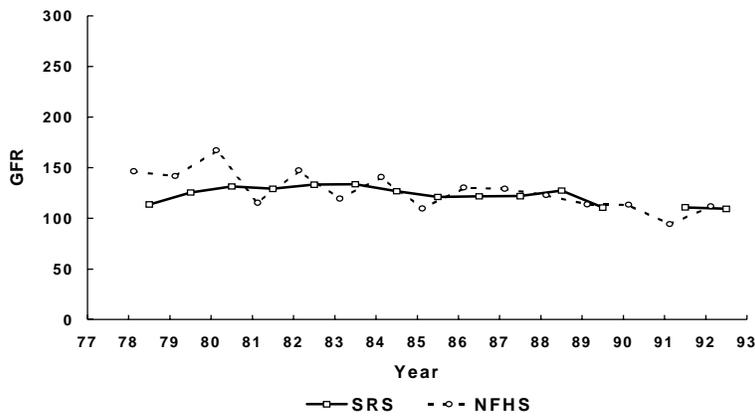


Figure 13 General fertility rates from the NFHS and the SRS: Himachal Pradesh, 1978-92

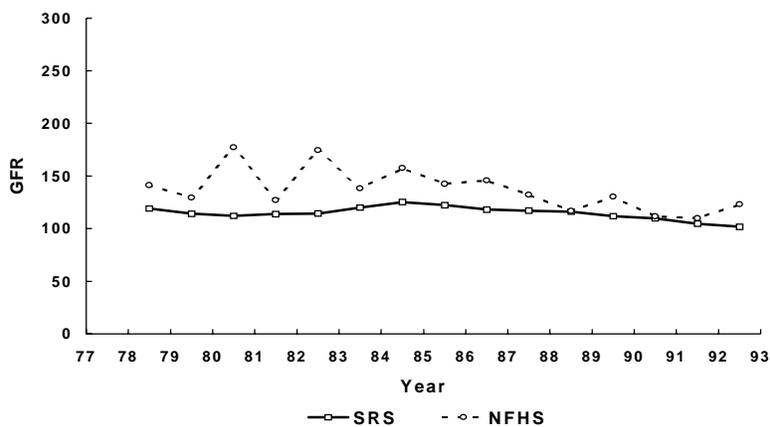


Figure 14 General fertility rates from the NFHS and the SRS: Karnataka, 1978-92

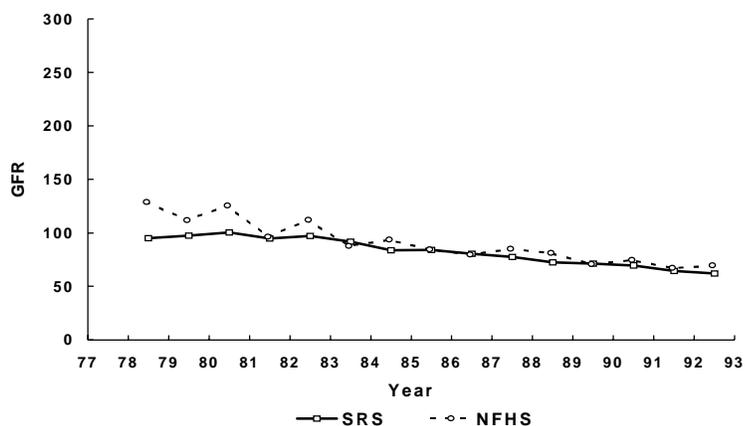


Figure 15 General fertility rates from the NFHS and the SRS: Kerala, 1978-92

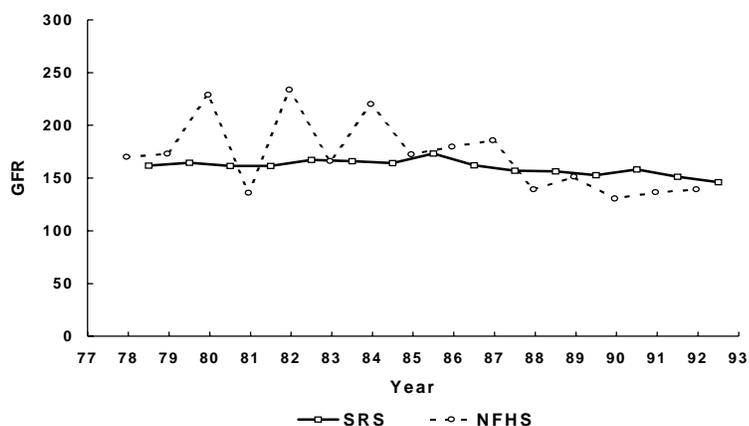


Figure 16 General fertility rates from the NFHS and the SRS: Madhya Pradesh, 1978-92

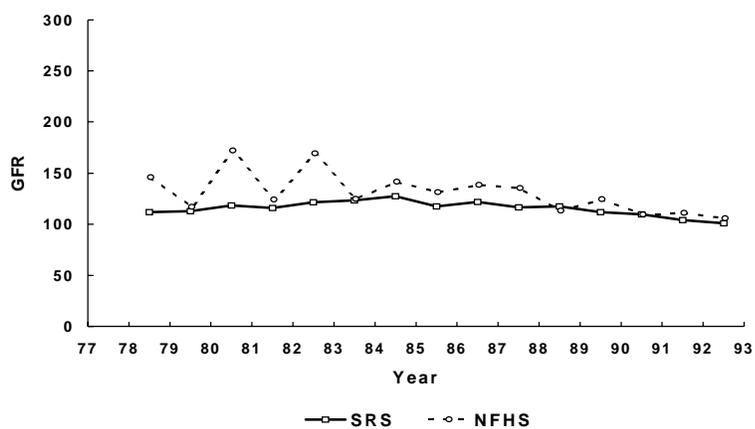


Figure 17 General fertility rates from the NFHS and the SRS: Maharashtra, 1978-92

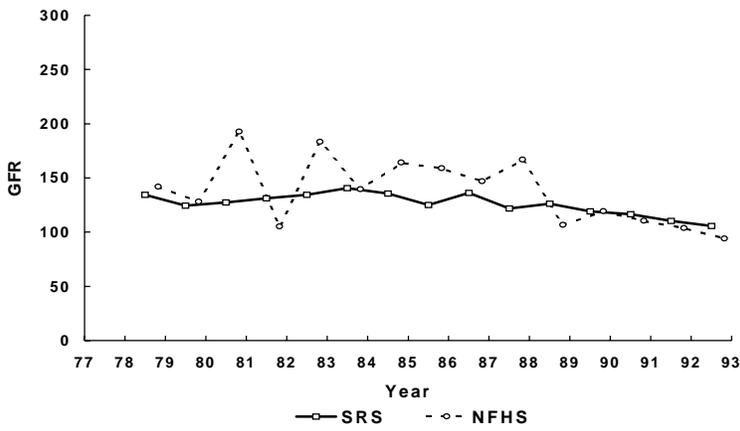


Figure 18 General fertility rates from the NFHS and the SRS: Orissa, 1978–92

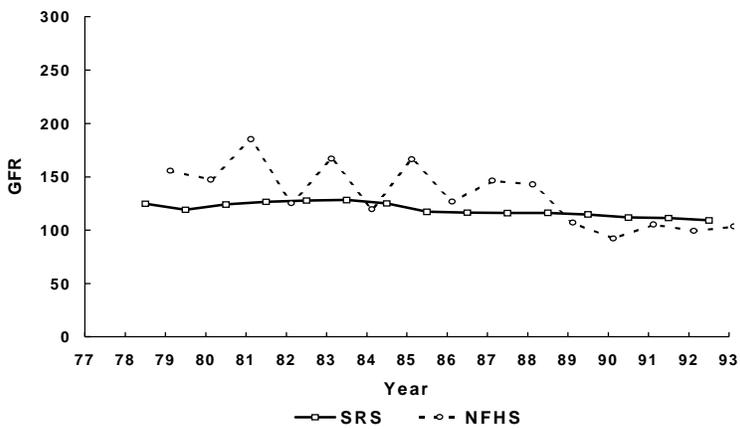


Figure 19 General fertility rates from the NFHS and the SRS: Punjab, 1978–92

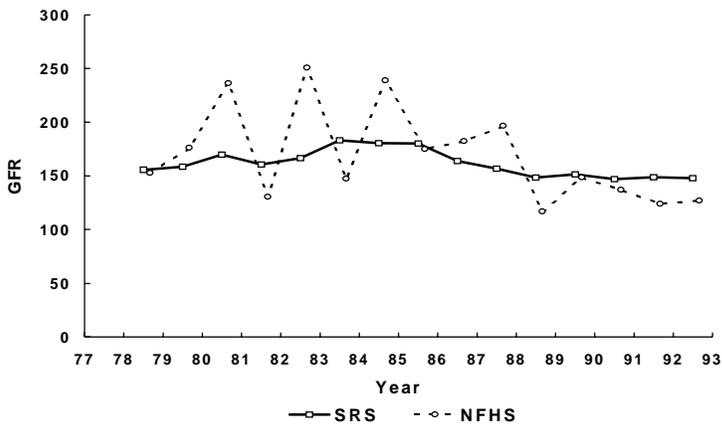


Figure 20 General fertility rates from the NFHS and the SRS: Rajasthan, 1978–92

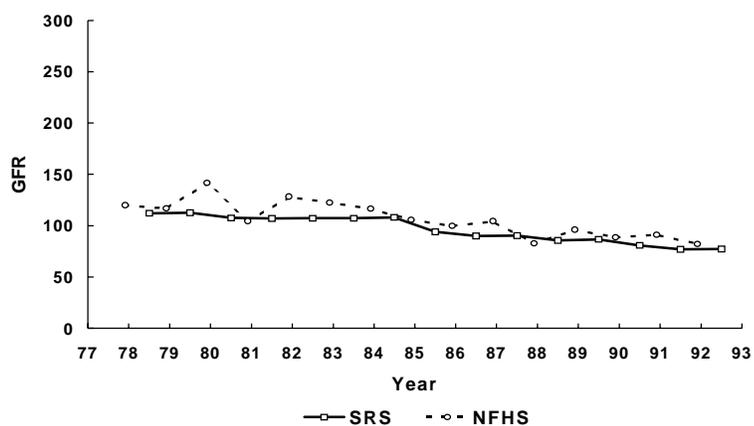


Figure 21 General fertility rates from the NFHS and the SRS: Tamil Nadu, 1978–92

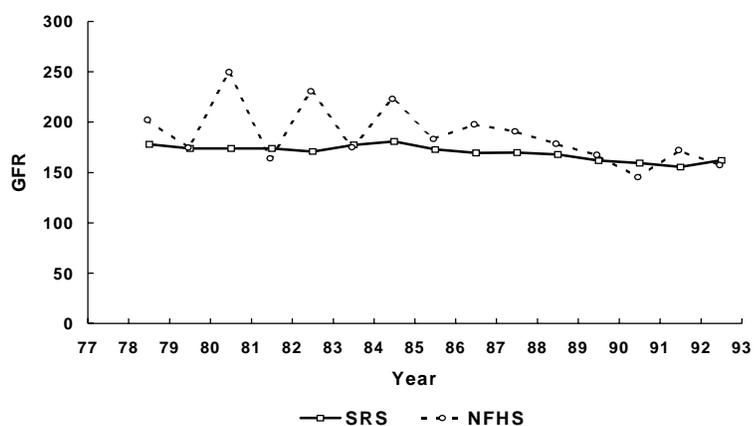


Figure 22 General fertility rates from the NFHS and the SRS: Uttar Pradesh, 1978–92

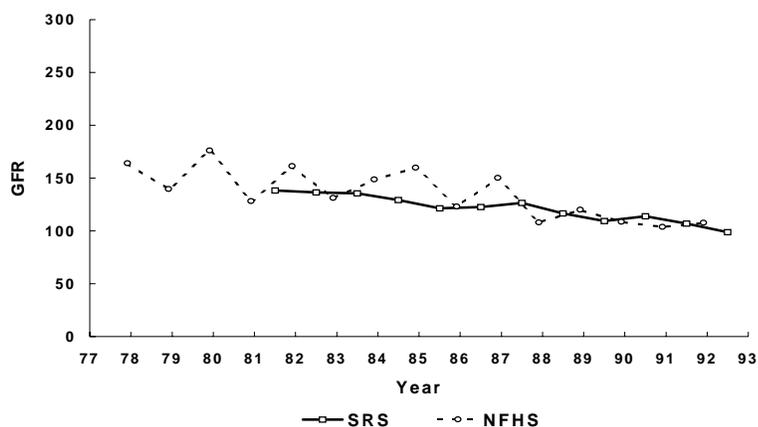


Figure 23 General fertility rates from the NFHS and the SRS: West Bengal, 1978–92

**Table 3 NFHS/SRS ratios of estimates of the general fertility rate, by state: 1978–92**

All India and states	1978–82	1983–87	1988–92	1978–92
India	1.19	1.14	1.00	1.10
Andhra Pradesh	1.08	1.11	0.97	1.04
Assam	1.46	1.45	1.15	1.34
Bihar	1.13	1.12	0.96	1.07
Gujarat	1.05	1.04	0.92	0.99
Haryana	1.17	1.07	1.04	1.08
Himachal Pradesh	1.13	1.01	0.97	1.02
Karnataka	1.31	1.19	1.09	1.18
Kerala	1.18	1.03	1.06	1.08
Madhya Pradesh	1.15	1.12	0.91	1.05
Maharashtra	1.25	1.11	1.03	1.12
Orissa	1.15	1.18	0.92	1.07
Punjab	1.25	1.16	0.90	1.09
Rajasthan	1.17	1.09	0.88	1.04
Tamil Nadu	1.12	1.12	1.08	1.10
Uttar Pradesh	1.17	1.11	1.01	1.09
West Bengal	1.12	1.12	1.00	1.10

Peaks in the NFHS-derived GFR curve in years corresponding to ages 8, 10, and 12 are especially sharp in Assam, Bihar, Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh. Greater age heaping in these states is not surprising, given their relatively low rates of literacy.

Overall, there is considerable variation among the states. Evidently the various problems with the data, both from the NFHS and the SRS, vary in intensity from state to state. It should also be noted that, at the state level, the NFHS estimates of fertility for years before the survey may be biased slightly by selective migration in and out of states. This problem does not arise at the national level, however, because international migration is negligible in comparison with India's total population.

### WHAT DO THE COMPARISONS TELL US?

Taken together, the various pieces of evidence indicate three main reasons why the fertility estimates from the NFHS are progressively higher than those from the SRS as one moves backward in time over the period 1978–92. They are: first, a higher rate of underregistration of births in earlier years of the SRS; second, backward displacement of births in the NFHS; and, third, omission of births in the NFHS in the first, but not in the second or third, five-year period before the survey.

If these explanations are correct, the fertility decline estimated from the NFHS is too steep, and the fertility decline estimated from the SRS is not steep enough. The fertility trend predicted by the trend in contraceptive use provides further evidence that the speed of fertility decline is underestimated by the SRS but overestimated by the NFHS.

The general fertility rate estimated from the NFHS for 1988–92 appears to be too low, yet it is identical to the GFR estimated from the SRS for the same period. This result suggests that the SRS underregistered births during that period to the same extent that the NFHS displaced and omitted births. The true level of fertility during 1988–92 was probably somewhat higher than indicated by either the SRS or the NFHS.

The NFHS estimated the general fertility rate for the period 1978–92 at 148 births per 1,000 women age 15–49. We estimated the number of births used to calculate this rate by reverse-surviving children age 0–14 at the time of the survey back to births. We found no heaping of children’s ages on age 15, which suggests that few births were shifted from those 15 years back to an earlier period. This result means that the general fertility rate estimated for the full 15-year period should be affected little, if at all, by displacement of births. The rate is undoubtedly somewhat too low, however, because of the omission of births during the most recent five-year period.

Nevertheless, the NFHS estimate of the general fertility rate for the full 15-year period is 10 percent higher than the SRS estimate. This suggests that the SRS underregistered births during that period by at least 10 percent. This level of underregistration is considerably higher than indicated by earlier evaluation studies conducted by the Office of the Registrar General. This finding, together with the finding that the NFHS/SRS ratio of GFRs converges to unity in the most recent five-year period, suggests that birth-registration completeness in the SRS has improved much more sharply over time than previously thought.

The comparisons also indicate that the curve of fertility by woman’s age tends to be shifted to the right—that is, to older ages—in the SRS, relative to the NFHS. The main cause of this relative shift appears to be greater misreporting of ages in the SRS than in the NFHS.

Our analysis also examined individual states. Discrepancies between the NFHS and the SRS in estimated fertility trends tend to be smaller in states with higher literacy rates, reflecting better data quality in those states.

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