Fertility Trends in Nepal, 1977-1995

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Introduction

This article presents estimates of fertility trends in Nepal over the period 1977-95, derived from data from two national surveys—the 1991 Nepal Fertility, Family Planning and Health Survey (NFFPHS) and the 1996 Nepal Family Health Survey (NFHS). Both of these surveys were conducted as part of the worldwide Demographic and Health Surveys (DHS) program. Each of the two surveys yields an estimated fertility trend during the 15-year period (or, in the case of some measures, the 10-year period) preceding the survey. The two trends overlap during some of those years. If the data are of high quality, the two trends should coincide during this period of overlap. In fact they do not coincide. Analysis of the pattern of discrepancies provides insight into the nature of reporting errors in each of the two surveys and a more accurate assessment of the true trend of fertility than can be obtained from either survey alone.

The fertility measures for which trends are estimated include age-specific fertility rates (ASFRs), the conventional total fertility rate calculated from ASFRs (TFR), period parity progression ratios (PPPRs), the total fertility rate calculated from PPPRs (TFR_p), and the total marital fertility rate calculated from PPPRs ($TMFR_p$). The part of the analysis that deals with trends in the TFR and ASFRs builds on an earlier article written before the 1996 NFHS data became available (Dangol, Retherford, and Thapa, 1997).

Data

The 1991 Nepal Fertility, Family Planning and Health Survey

The NFFPHS was a national survey based on a representative sample of households throughout the country (Ministry of Health, 1993). The sample included completed interviews for 24,745 households, and, within these households, 25,384 ever-married women. The sample was *de facto*, meaning that persons who slept in the household the night before the interview, including visitors, were interviewed. The survey included a household schedule, with the household head or any other knowledgeable adult in the household responding for the entire household. It also included an individual schedule administered to individual ever-married women age 15-49 within the sampled households.

The NFFPHS was conducted over a seven-month period, from August 1991 to February 1992. Most of the interviewing was conducted during late 1991. The year before the survey falls mainly in 1991 and is labeled as such in tables that identify time periods before the survey.

The 1996 Nepal Family Health Survey

The NFHS was also a national survey based on a representative sample of households throughout the country (Ministry of Health, 1997). The sample for this survey was considerably smaller than the sample for the 1991 survey. The 1996 sample included completed interviews for 8,082 households, and, within these households, 8,429 ever-married women age 15-49. The sample was again *de facto*, and the survey again included a household schedule and an individual schedule.

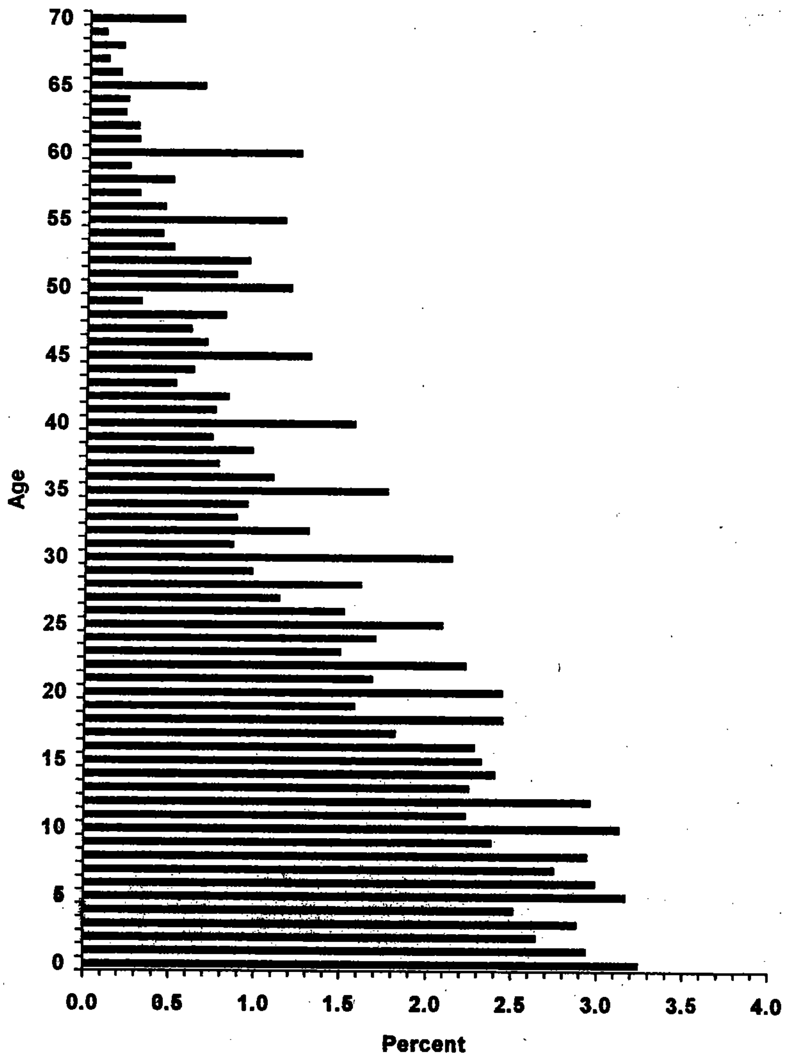
The NFHS was conducted over a six-month period, from mid-January to mid-June 1996. The year before the survey falls mainly in 1995 and is labeled as such in tables that identify time periods before the survey.

Quality of Data on the Ages of Women and Children

Accurate reporting of ages—especially children's ages—is essential for accurate estimation of past fertility trends from a single survey. This is easily seen by considering as an example the impact of heaping on age 10 on the fertility estimates. Because children age 10 were born during the 11th year before the survey, heaping on age 10 results in an overestimate of births during the 11th year before the survey, so that the fertility estimates for that year are too high.

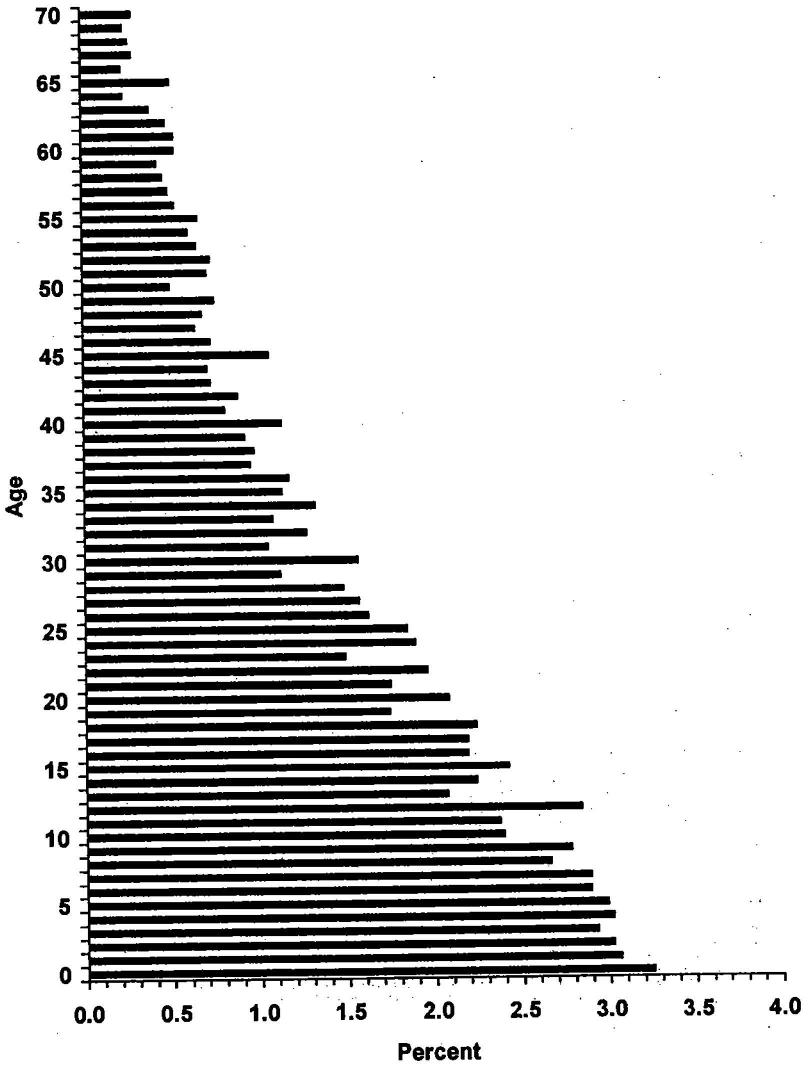
Figures 1 and 2 graph the age distribution for females for the 1991 NFFPHS and the 1996 NFHS. Females are shown because age-specific fertility rates are calculated for women. In both surveys, the proportion of infants (children below one year of age) is considerably higher than the proportions of children age 1, 2, 3, or 4, as shown in

Figure 1 Female age distribution: 1991 NFFPHS



Figures 1 and 2. This may occur not only because of population growth and the cumulative effects of infant and child mortality over successive ages, but also because of emphasis during the training of interviewers on the importance of complete and accurate identification of infants for purposes of computing infant mortality rates and other health indicators for infants. It is likely that the number of children age zero (below one year of age) is reported fairly accurately in both surveys.

Figure 2 Female age distribution: 1996 NFHS



Figures 1 and 2 show considerable age heaping on ages 8, 10, and 12 in the 1991 survey and, to a much lesser extent, on ages 9 and 12 in the 1996 survey. Heaping on ages 8, 10, and 12 is commonly observed in south Asian countries (Retherford and Alam, 1985), and in this respect the 1991 NFFPHS is fairly typical. The heaping on age 9 in the 1996 NFHS is not typical. At ages beyond 12 there is a consistent pattern of heaping on ages ending in the digits 0 or 5 in the 1991 survey, but not nearly as much in the 1996 survey.

The 1996 survey shows no heaping at all on ages 10 and 50, which is surprising, inasmuch as most surveys show considerable heaping on these ages. A reasonable interpretation of this finding is that, in the 1996 survey, the training of interviewers placed more than the usual amount of emphasis on the importance of accurate age reporting. Indeed, the moderate heaping on ages 9 and 49 in the 1996 survey suggests a tendency on the part of interviewers to overcompensate by moving some girls reported as age 10 to age 9 in order to avoid heaping on age 10, and some women reported as age 50 to age 49 in order to avoid heaping on age 50. Discussions with personnel from New ERA, the agency that collected the data for the 1991 and 1996 surveys, confirm that the training on how to collect accurate age data was much more intensive in the 1996 survey than in the 1991 survey.

There is a big jump in the proportion at age five in the 1991 survey but not in the 1996 survey. Some of the heaping on age five in the 1991 survey may simply reflect the same kind of preference for ages ending in 0 and 5 that is so evident at adult ages. However, heaping on age five may also occur partly because some interviewers in the 1991 survey may have tended occasionally to move a child below age five to age five in order to avoid having to ask a large block of questions asked about births since a cutoff date. This block of questions pertains to breastfeeding, health, and vaccinations, and the group of births about whom these questions were asked corresponds approximately to children below age five at the time of the 1991 survey.

In the 1996 survey the cutoff age for asking this block of questions corresponds to children who ranged in age from three years and nine months to four years and three months at the time of the survey. If interviewers occasionally moved a child up in age in order to avoid asking this block of questions, there should be a deficit at three and some heaping on ages four and five. This pattern is observed in Figure 2, but it is not very pronounced.

One reason why heaping on ages four and five is so modest in the 1996 survey may be that in the 1996 survey, unlike the 1991 survey and most DHS surveys in other countries, the household interview and the individual interview were conducted by different interviewers. In the 1996 survey, each team comprised three female interviewers, a male interviewer, a female field editor, and a field supervisor who was either male or female. The male interviewer administered the household questionnaire, and the female interviewers administered the individual questionnaire. Interviewers were instructed not to compare results from the two interviews. The use of different interviewers for the household interview and the individual interview was intended to discourage interviewers from displacing births to earlier years (equivalent to shifting children to older ages) in order to avoid having to ask the block of questions pertaining to births since the cutoff date in the individual questionnaire. It was reasoned that interviewers would be less likely to shift births, because such shifting might produce a detectable difference between a child's age recorded in the household listing during the household interview and the age implied by the child's birth date in the birth history recorded during the individual interview. The lack of significant heaping on ages four and five in the 1996 survey suggests that interviewers' awareness of possible cross-checks had the desired effect.

In general, Figures 1 and 2 indicate that age reporting was considerably more accurate in the 1996 survey than in the 1991 survey, not only at childhood ages but also at adult ages. Because the improvement in age reporting is observed throughout the age distribution, and because the time interval between the two surveys is so short, this improvement cannot be attributed to respondents' rising educational levels or to their improving knowledge of their own ages. The only plausible explanation is improvements in the way the 1996 survey was organized and run. Again, a contributing reason for the better reporting of adult ages may be the use of separate interviewers for the household interview and the individual interview. Interviewers were aware that discrepancies in reported age between the household schedule and the individual schedule would be apparent not only for young children but also for older children and ever-married women.

The trend in the sex ratio at birth is another useful indicator of data quality. Because there is considerable preference for sons in Nepal, women who forget to mention children who have died or moved away are more likely to omit girls than boys. If such omissions are a problem, then one expects the sex ratio at birth, as ascertained from the birth histories, to become progressively more male in earlier years when omissions are more likely to occur. The sex ratio at birth is largely biologically determined and is usually close to 1.05 male births for every female birth. If female births are omitted, the ratio should be higher than 1.05. Table 1 shows that in both the 1991 survey and the 1996 survey the sex ratio at birth does not become progressively more male in earlier years. For the 15-year period as a whole preceding each survey, the sex ratio at birth is 1.04, the same in each survey. This finding suggests that few births during this period were omitted by respondents in either survey.

It is still possible that interviewers (rather than respondents) occasionally omitted births since the cutoff date, without regard to the sex of these births, in order to avoid asking the large block of questions referred to earlier. Sex ratios at birth would not detect this kind of omission by interviewers. However, such omissions are unlikely in the 1996 survey, because the use of separate interviewers for the household interview and the individual interview meant that such omissions might be detected. All in all, it appears that the strategy of using separate interviewers for the household interview and individual interview probably helped to prevent displacement and omission of births and generally to improve the quality of the age data in the 1996 survey.

Table 1 Male births, female births, and the sex ratio at birth during the 15-year period before each survey: 1991 NFFPHS and 1996 NFHS

Survey and year	Male births	Female births	Sex ratio at birth
1991 NFFPHS			
1977-81	9919	9619	1.03
1982-86	11945	11339	1.05
1987-91	11013	10533	1.05
1977-91	32877	31492	1.04
1996 NFHS			
1981-85	3060	2999	1.02
1986-90	3582	3406	1.05
1991-95	3698	3574	1.03
1981-95	10340	9978	1.04

There are additional reasons, equally and perhaps even more important, why the age data are so much better in the 1996 survey than in the 1991 survey. The training of interviewers in the 1996 survey lasted one month and, as already mentioned, strongly emphasized the importance of collecting accurate age data. Trainees were drilled at length on probing for age when respondents initially reported ages ending in 0 or 5. This was followed up during the field work with extensive use of "field check" tables, which provided quick feedback to interviewers on problems, such as excessive age heaping, while interviewers were still in the field. This kind of close and continual monitoring was probably a very important factor contributing to the comparatively high quality of the age data in the 1996 survey. The 1996 survey was also characterized by much closer supervision of interviewers, which was possible because of the much smaller sample size. Moreover, editors and supervisors were selected on the basis of best performance in the training rather than being pre-selected, and this probably added to the quality of supervision. Also, again partly because of the smaller size of the 1996 survey sample, a much higher proportion of interviewers in the 1996 survey were already experienced in the collection of survey data (Ban, 1997).

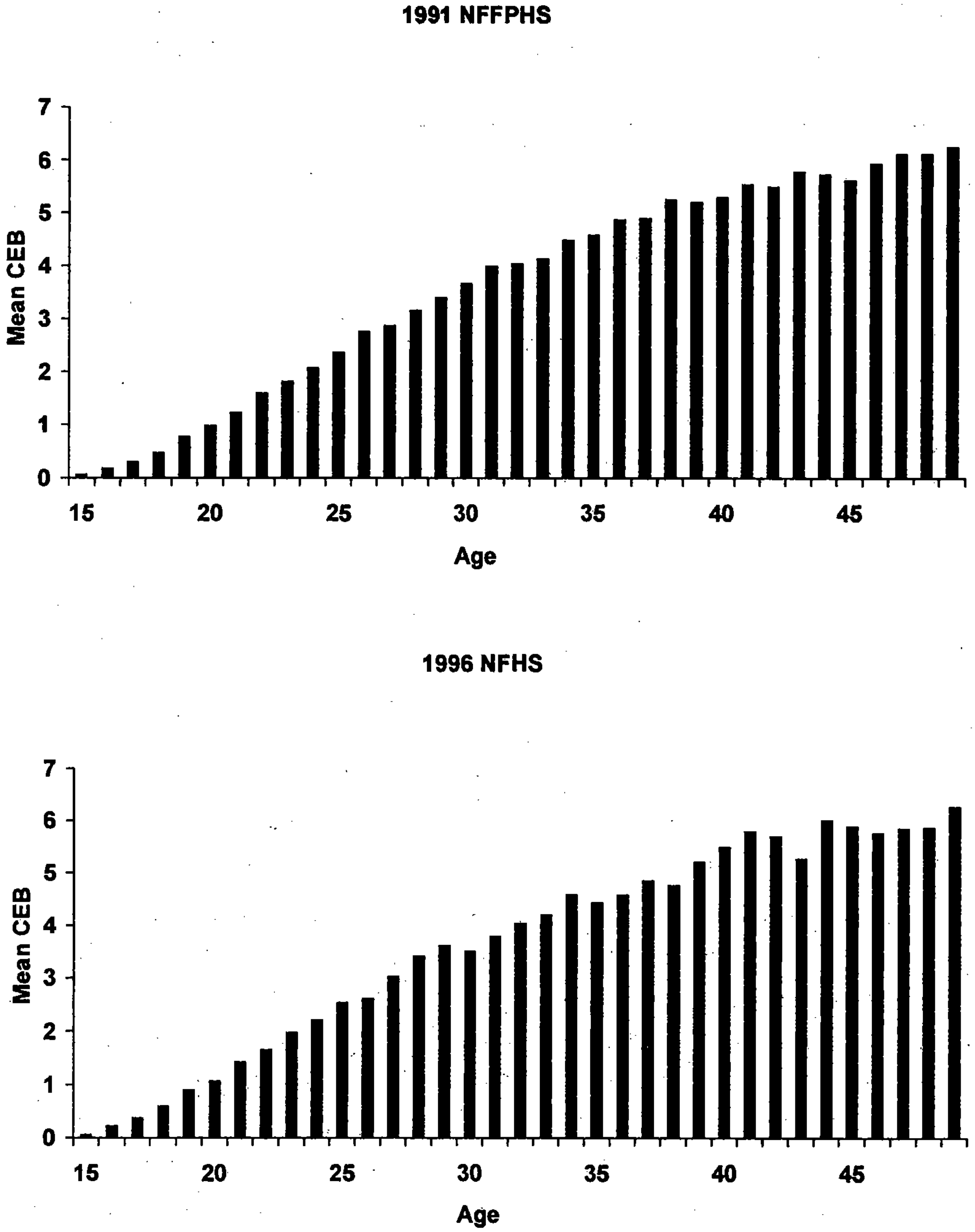
Figure 3 examines the quality of reporting of the number of children ever born in the two surveys. If women forget to mention some children (e.g., children who have died or moved away), one expects this to occur more frequently among older women than among younger women. Such omissions are sometimes reflected in a mean number of children that declines with age after about age 40. Figure 3 suggests that omissions are not a serious problem in either the 1991 or the 1996 survey, inasmuch as the mean number of children ever born attains a maximum at age 49 in both surveys. Moreover, this maximum is slightly above six children per woman, somewhat higher than the current level of the total fertility rate, as one would expect if fertility is declining. (The total fertility rate is a period measure that reflects recent fertility, whereas mean number of children ever born at age 49 reflects fertility that mostly occurred in the more distant past.) As we shall see later, the total fertility rate in recent years is estimated to be well below six children per woman.

In closing this section, it should be noted that a recent assessment of the quality of age data in DHS surveys in 40 countries ranks the 1996 Nepal Family Health Survey fifth best (i.e., fifth lowest score on Myers' index) (Ayad et al., 1997). Because of the relatively high quality of the age data in the 1996 NFHS, we expect fertility trends estimated from the 1996 NFHS to be more accurate than fertility trends estimated from the 1991 NFFPHS.

Distribution of the Sample by Residence and Education

In this article we estimate fertility trends not only for the total population but also by urban-rural residence and by education. Table 2 shows that, among women age 15-49, the proportion urban was 8 percent in 1991 and 9 percent in 1996. Over the same period, the proportion with no education decreased from 79 to 73 percent. The

Figure 3 Mean number of children ever born to ever-married women by single years of age: 1991 NFFPHS and 1996 NFHS



proportion with at least some primary education increased from 9 to 12 percent, and the proportion with at least some education beyond the primary level increased from 12 to 15 percent.

Both surveys over sampled the small urban population in order to obtain adequate numbers of respondents for analysis. The correct proportions were restored by means of weights during the course of the analysis. The percentages in Table 2 and all subsequent tables and graphs in this article are based on the weighted sample.

Table 2 Distribution of the sample by residence and by education: women age 15-49 (both never-married and ever-married), 1991 NFFPHS and 1996 NFHS

Characteristic	1991 NFFPHS	1996 NFHS
Residence		
Urban	8	9
Rural	92	91
Education		
No education	79	73
Primary	9	12
Beyond primary	12	15

Methodology

Our main methods for estimating fertility are the birth history method and the own-children method. In addition, we use methodology developed by Feeney to estimate period parity progression ratios (PPPRs) and total fertility rates and total marital fertility rates derived from PPPRs (Feeney, 1986; and Feeney and Saito, 1985).

Birth History Method

In the birth history method, as applied here, 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. Similarly, woman-years of exposure to the risk of birth are counted by woman's age for each year up to the fifteenth year before the survey. The births by age of mother in any given year are then divided by woman-years of exposure by woman's age in that same year to yield estimates of age-specific fertility rates (ASFRs) for that year. Total fertility rates (TFRs) are obtained by summing ASFRs in five-year age groups and multiplying the sum by five. ASFRs can similarly be calculated for longer time periods, such as five-year time periods.

Birth histories were collected only for ever-married women age 15-49. When calculating ASFRs for all women, regardless of marital status, it was assumed that never-married women have had no births. This assumption is reasonable for Nepal, where very few births occur outside marriage. In the present application of the birth history method, base calculations were done in months. Rates were converted to a yearly basis only at the end of the calculations.

Because birth histories were collected from women only up to the age of 49, we cannot calculate a complete set of ASFRs for earlier years. For example, the oldest women in the sample, who were age 49 at the time of the survey, were only 44 five years earlier. Therefore, one cannot calculate an ASFR for women 45-49 for years earlier than five years before the survey. In this article, we are interested in estimating fertility during the 15-year period preceding the survey. Fifteen years previously, 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 older. A suitable summary measure of fertility that is comparable over the entire period is CFR(35), i.e., the cumulative fertility rate up to age 35. This measure is calculated by summing 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 for years prior to a census or household survey. In the present instance, the method is applied to the NFFPHS and NFHS household samples. Enumerated children are first matched to mothers within households, based on answers to questions on age, sex, marital status, and relation to head of household. A computer algorithm is used for matching. The matched (i.e., own) children, classified by their own age and mother's age, are then reverse-survived to estimate the number of births by age of mother in each of the 15 years before the survey. Reverse-survival is similarly used to estimate the number of women by age in previous years. After adjustments are made for unmatched (i.e., non-own) children, age-specific birth rates are calculated 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 or groups of 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 older at the time of enumeration, a substantial proportion of whom (especially girls who leave the household upon marriage) 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. Estimates for grouped ages or calendar years are obtained 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 et al., 1986).

Reverse-survival requires life tables. Life tables are available for 1981 and 1991 (CBS, 1995). Life tables for other years were obtained by linearly interpolating or extrapolating life-table age-specific probabilities of dying which were then used to calculate complete life tables. Life tables for 1981 and 1991 are published for males and females separately but not for both sexes combined, so we calculated the combined life table from the male and female life tables. Life tables by urban-rural residence and education are not available, so we used the same life tables regardless of urban-rural residence or education. We did not make any adjustments for age misreporting.

The own-children method, which is based on data from the household sample, is not constrained by the problem of age truncation at age 50. It allows estimation of TFRs for each of the 15 years prior to each survey. For this reason, it is our preferred method for estimating fertility trends from the 1991 NFFPHS and the 1996 NFHS.

Method for Estimating Period Parity Progression Ratios and Derived Measures

We also make use of period parity progression ratios, which are useful for analyzing the family-building process. A woman's parity is defined as the number of children that she has ever borne. A parity progression ratio (PPR) is defined as the proportion of women of specified parity who eventually go on to have another child. Although the concept of parity is normally defined in terms of birth events, it may be extended to include the event of a woman's own birth and the event of her own first marriage. This extension enables us to analyze "parity" transitions from birth to marriage and marriage to first birth as well as transitions from first birth to second birth, second birth to third birth, and so on.

A period parity progression ratio (PPPR) is a parity progression ratio that is calculated from a set of birth probabilities pertaining to a particular time period, which may be a single calendar year or a group of calendar years before the survey. The birth probabilities are specified by duration in parity. A birth probability for women of specified parity and duration in parity (with duration measured in years) is estimated as the proportion of such women who progress to the next parity in one year. A period parity progression ratio is computed from these duration-specific birth probabilities by life table methods, in the same way that the probability of dying by a specified age is calculated from age-specific death probabilities in an ordinary period life table. (For methodological details, see Feeney, 1986; Feeney and Saito, 1985). To summarize, in this article a PPPR indicates the proportion of a synthetic cohort of women of specified parity who would ultimately progress to next parity if they were to experience the duration-in-parity-specific birth probabilities observed in the population during the time period under consideration.

The calculation of PPPRs incorporates the following simplifications: To count as progressing to first marriage, a woman must marry by age 40; to count as progressing from marriage to first birth, the first birth must take place within 13 years of marriage; and to count as progressing from any given birth to the next, the next birth must take place within 10 years of the preceding birth. Thirteen years was chosen as the cutting point for marriage to first birth in order to allow for delays in consummation of early marriages. The assumption is that women who do not have a first marriage or birth within the specified cut-offs are at negligible risk of having a first marriage or birth subsequently.

As discussed earlier, the total fertility rate (TFR) is conventionally calculated from age-specific fertility rates. A total fertility rate can also be calculated from a set of PPPRs as

$$\mathrm{TFR_p} = p_B p_M + p_B p_M p_1 + p_B p_M p_1 p_2 + \ldots \quad (1)$$

where p_B denotes the proportion who progress from birth to first marriage, p_M denotes proportion who progress from first marriage to first birth, and p_i denotes the proportion who progress from the ith to the $(i+1)$th birth, i = 1, 2, ... In the application of this formula to Nepal data, this calculation is truncated at parity transition 15 to 16. Because of potential problems with small numbers of cases, the last three transitions (13→14, 14→15, and 15→16) are averaged, and these average values are substituted for the original values for these transitions. The total fertility rate calculated from PPPRs ($\mathrm{TFR_p}$) usually differs somewhat from the total fertility rate calculated from age-specific fertility rates (TFR). Differences between $\mathrm{TFR_p}$ and TFR have been studied in depth by Feeney and Yu (1987).

A total marital fertility rate may be calculated from PPPRs as

$$\mathrm{TMFR_p} = p_M + p_M p_1 + p_M p_1 p_2 + \ldots \qquad (2)$$

A potential problem in estimating PPPR-based fertility measures from the NFFPHS or the NFHS is that, except for the PPPR for the transition from birth to marriage (p_B), PPPRs are derived entirely from information in the individual questionnaire. Hence, these PPPRs, when estimated for several years back from the survey date, are subject to bias stemming from truncation of the individual sample of ever-married women at age 50.

In trying to understand how this bias manifests itself, let us suppose that we wish to estimate a set of PPPRs for the 15th year before either survey. Women age 49 at the time of the survey were age 34 in the 15th year before the survey, implying truncation at age 35. The question is, does this truncation at age 35 cause any difficulties in estimating PPPRs for that year? There would seem to be little problem in estimating PPPRs for transitions M→1, 1→2, and 2→3, since very few of these transitions take place after age 35. But higher-order transitions are more problematic. Consider, for example, the transition 6→7. The only women we can consider at starting parity 6 are women who reach this parity before their 35th birthday. Such women tend to be more fecund than women who reached parity 6 after their 35th birthday. Therefore, women who reached parity 6 before their 35th birthday can be expected to have a higher than average probability of going on to have a seventh child. This line of reasoning suggests that the effect of age truncation at age 50 at the time of the survey is to bias upward the estimates of parity progression ratios for higher-order transitions in earlier years. This upward bias is progressively greater the higher the starting parity and the further back the calendar year for which PPPRs are estimated. Thus, at these higher parities, our estimated declines in PPPRs will tend to be too steep.

It therefore seems prudent to extend the estimates backward in time only ten years instead of 15 years. Ten years ago, the oldest woman was age 39, implying truncation at exact age 40. Most women have completed childbearing by this age, so that the bias described above should be small, with the possible exception of PPPRs with very high starting parities of perhaps seven or higher. The formulae for $\mathrm{TFR_p}$ and $\mathrm{TMFR_p}$ suggest that the effect of such estimation errors on $\mathrm{TFR_p}$ and $\mathrm{TMFR_p}$ should be fairly small.

Findings

The analysis is organized as follows: First we will compare trends in CFR(35) during the 15-year period preceding each survey, estimated alternatively by the own-children method and the birth history method. The purpose of this comparison is to validate the subsequent use of the own-children method. As explained earlier, we prefer the own-children method over the birth history method, because results from the own-children method are not constrained by the problem of age truncation at age 50. Having validated the own-children method, we will move on to present results of applying the own-children method to the 1991 NFFPHS and the 1996 NFHS. This part of the article will include an analysis of overlapping trends in TFRs and ASFRs estimated from the two surveys. It also will include breakdowns of the fertility estimates by urban-rural residence and by education. Next we will combine each pair of overlapping TFR trends into a single trend, in an attempt to minimize the biases contained in the two trends estimated from each survey separately.

The remainder of the article will repeat much of the preceding analysis, using period parity progression ratios (PPPRs) in place of ASFRs, and the total fertility rate and the total marital fertility rate calculated from PPPRs (TFR_p and $TMFR_p$) in place of the conventional TFR. It turns out that the PPPR-based analysis provides some insights not afforded by the ASFR-based analysis.

Trends in CFR(35), Estimated Alternatively by the Birth History Method and the Own-children Method

Figure 4 shows trends in the cumulative fertility rate up to age 35 [CFR(35)], estimated alternatively by the birth history method and the own-children method applied to the 1991 NFFPHS and to the 1996 NFHS. Figure 4 shows that the two methods yield substantially the same trend in CFR(35). The agreement is not quite as good 10-14 years before each survey as it is in years closer to the survey, indicating that results presented below for the period 10-14 years before the survey must be interpreted more cautiously than results for more recent years.

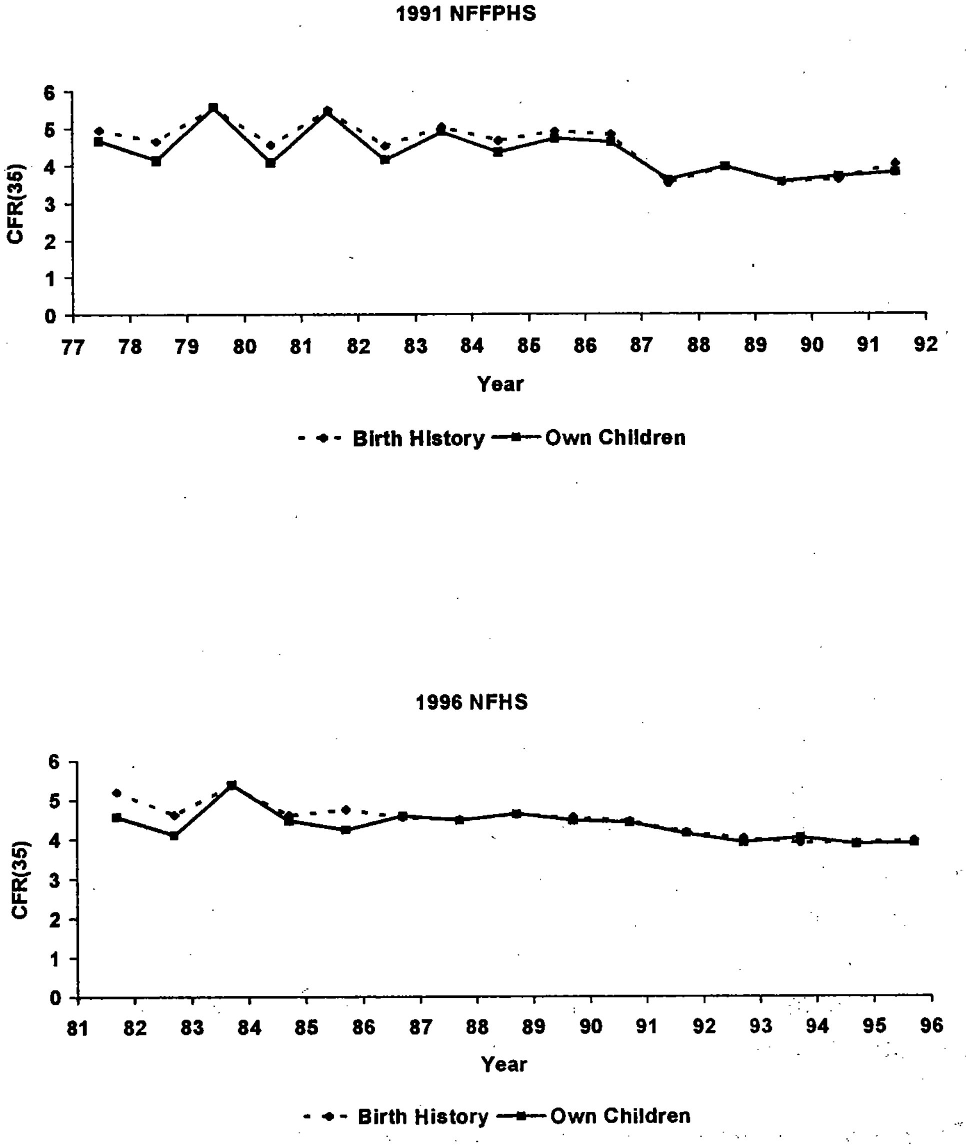
In the remainder of this article, ASFRs and conventional TFRs are estimated by the own-children method.

Trends in ASFRs and TFRs for the Whole Country

Table 3 shows trends in ASFRs and TFRs for the whole country, derived from the 1991 NFFPHS and the 1996 NFHS. The table shows estimates for three 5-year time periods as well as the combined 15-year period immediately preceding each survey.

Looking first at the estimates of the TFR, we see that each survey separately yields a fairly steep decline in the TFR. The NFFPHS indicates that the TFR fell from 6.11 in 1977-81 to 4.71 in 1987-91, a decline of 1.40 children in only ten years. The NFHS indicates that the TFR fell from 5.68 in 1981-85 to 4.77 in 1991-95, a decline of 0.92

Figure 4 Trend in CFR(35), estimated alternatively by the birth history method and the own-children method: 1991 NFFPHS and 1996 NFHS



child in ten years. However, comparing the 15-year estimate of the TFR derived from the NFFPHS with the 15-year estimate of the TFR derived from the NFHS, we see that the TFR declined from 5.47 in 1977-91 to 5.27 in 1981-95, a decline of only 0.20 child in 4.2 years. The separation of 4.2 years is derived as the difference between the mean dates of interview in the two surveys. The between-survey estimate of the rate of decline in the TFR (.05 child per year) is considerably lower than either of the within-survey estimates of the rate of decline of the TFR (.14 child per year from the 1991 survey and .09 child per year from the 1996 survey). (Henceforth we shall refer to estimated trends based on 15-year aggregations from the two surveys as between-survey estimates.)

Table 3 also shows trends in ASFRs, which are graphed in Figure 5 in the case of ASFRs aggregated over 15 calendar years. Each survey separately shows a substantial decline in the ASFR at 15-19 (the

Table 3 Trends in age-specific birth rates and total fertility rates for the whole country, estimated from the 1991 NFFPHS and the 1996 NFHS

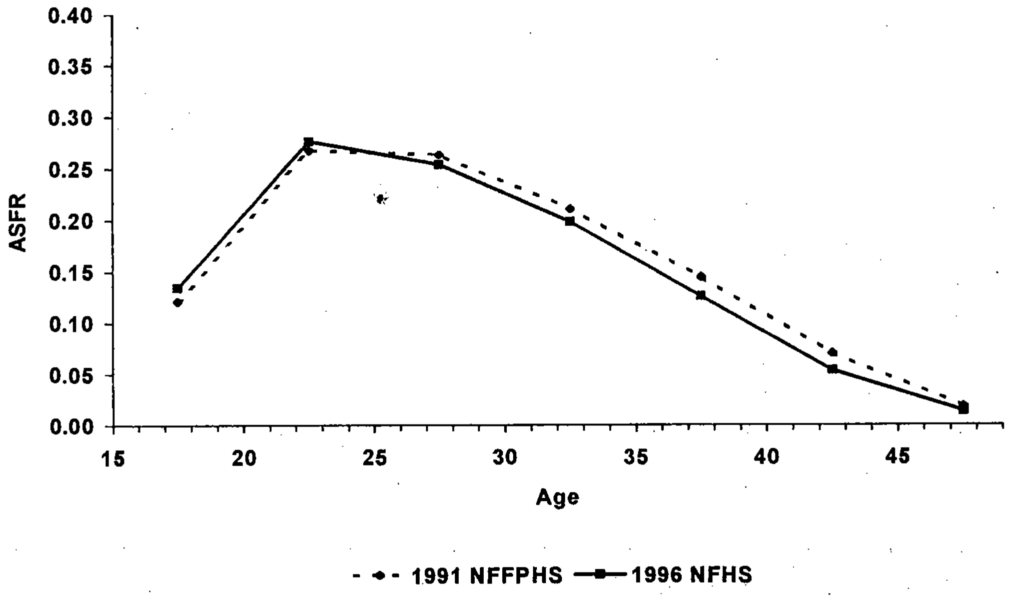
	1991 NFFPHS				1996 NFHS			
Fertility measure	1977 -1981	1982 -1986	1987 -1991	1977 -1991	1981 -1985	1986 -1990	1991 -1995	1981 -1995
ASFRs								
15-19	141	132	97	121	140	143	121	134
20-24	282	283	244	267	271	290	268	276
25-29	289	276	231	263	277	260	230	254
30-34	245	220	176	211	221	208	172	198
35-39	161	156	119	144	146	126	109	126
40-44	82	69	61	70	65	56	41	54
45-49	22	19	15	18	16	11	13	14
TFR	6.11	5.77	4.71	5.47	5.68	5.48	4.77	5.27

Note: The estimates of TFRs and ASFRs in this table and in all subsequent tables are derived by the own-children method. TFRs are per woman, and ASFRs are per thousand women. The trends over five-year periods, as estimated from each survey separately, are biased and should not be regarded as true trends. See text for explanation.

decline derived from the 1991 NFFPHS is especially steep), but the between-survey estimate of this ASFR, based on 15-year aggregations, increased between the surveys. The same kind of opposite movement is shown to a lesser extent in the estimates of the trend in the ASFR at 20-24. At ages 25-29 and older, the trends in ASFRs are all downward, but the within-survey estimates indicate a much steeper decline than do the between-survey estimates. And the within-survey estimates of decline derived from the 1991 survey are considerably steeper than the within-survey estimates of decline derived from the 1996 survey.

It is likely that the inconsistencies in Table 3 and Figure 5 result from displacement of births and age misreporting that are worse in the 1991 survey than in the 1996 survey, combined with some real fertility decline at the older reproductive ages. In each survey, the estimated TFR trends clearly indicate some displacement of births from the first five years before the survey to the second five years before the survey, and from the second five years to the third five years before the survey. This displacement of births appears to be considerably greater in the 1991 survey than in the 1996 survey, consistent with the lesser quality of age reporting in the 1991 survey. At the same time, there does not appear to be much displacement from the third five years to the fourth five years before either survey, inasmuch as there is no heaping on age 15 in the 1991 survey and only moderate heaping on age 15 in the 1996 survey, as seen earlier in Figures 1 and 2.

Figure 5 Age-specific fertility rates for the 15-year period preceding each survey: 1991 NFFPHS and 1996 NFHS



Note: In this figure and all subsequent figures, ASFRs and derived TFRs are estimated by the own-children method.

Some of this displacement of births (which, in the case of living children, is equivalent to exaggerating children's ages at the time of the survey) is due to intentional displacement on the part of interviewers who wish to avoid asking the block of questions asked of young children. But some unintentional displacement in the form of upward rounding of children's ages by survey respondents no doubt also occurs. As already mentioned, the reported number of children age zero (infants below one year of age) is probably fairly accurate in both surveys. However, some children age one year and 11 months may be reported as age 2, and, more generally, some older children about to reach a birthday in one or two months may be reported at the next higher age in completed years, especially by persons who do not remember the exact birth dates and ages of their children. This kind of upward rounding of ages of children effectively displaces their births further into the past.

If respondents do not have accurate knowledge of their ages, there may be an additional type of age misreporting that has the effect of shifting the entire age distribution of fertility (i.e., the graph of ASFRs against age, as in Figure 5) to the right—i.e., to older ages. In this type of age misreporting, there is a net upward bias in reported ages of women who are young but married, and of married women who have a higher than average number of children relative to their true age. There may also be some downward bias in reported ages of older single women and married women who have a lower than average number of children relative to their true age. For example, a young bride might be reported as somewhat older by virtue of her being married, and women who remain unmarried in their early twenties 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. The rightward shift of the age curve of fertility that results from this kind of age misreporting has been observed in India (Narasimhan et al., 1997a, 1997b) and may occur in Nepal as well. It should be noted that shifting the age curve of fertility to the right has little effect on the estimate of the TFR, because ASFRs still add up to approximately the same number of children.

If fertility were constant over time in Nepal (which is not true), then, with this kind of age misreporting, the greater misreporting in the 1991 NFFPHS than in the 1996 NFHS would result in more of a rightward shift of the age curve of fertility derived from the 1991 survey than in the age curve of fertility derived from the 1996 survey, resulting in spurious increases in estimated ASFRs below the peak age of fertility (which in Nepal is around age 25) and excessively large declines in estimated ASFRs above this peak age. It is likely that this mechanism partly explains the pattern of between-survey changes in ASFRs shown in Figure 5, which, however, also reflects some real fertility decline at ages above 25.

One way to test whether this kind of age misreporting is present is to compare age-specific proportions married in the two surveys. If there is a tendency of young married women to be moved up in age and a tendency of unmarried women to be moved down in age, and if these tendencies are greater in the 1991 survey than in the 1996 survey, then proportions married at the young reproductive ages should be higher in the 1996 survey than in the 1991 survey. Figure 6 shows that this is indeed the case at ages 15-19 but not at higher ages. When proportions married are calculated for five-year age groups, it is found that proportions married in the 1991 and 1996 surveys are 0.33 and 0.43 at 15-19, 0.83 and 0.84 at 20-24. and 0.94 and 0.93 at 25-29. At ages above 30, there is a slight tendency for the proportion calculated from the 1991 survey to exceed the proportion calculated from the 1996 survey. The estimated increase in the proportion married at 15-19 is, of course, implausible, inasmuch as one expects age at marriage to be increasing over time.

Another way to test for this kind of age misreporting is to compare mean parity at each age in the two surveys. If there is a tendency for women with a higher than average number of children relative to their true age to be moved up in age and a tendency of women with a lower than average number of children relative to their true age to be moved down in age, and if these tendencies are greater in the 1991 survey than in the 1996 survey, then mean parity at each age should be higher in the 1996 survey than in the 1991 survey. Figure 7 shows that this is indeed the case at the younger reproductive ages. When mean parities are calculated for five-year age groups, it is found that mean parities in the 1991 and 1996 surveys are 0.15 and 0.23 at 15-19, 1.28 and 1.43 at 20-24, and 2.72 and 2.85 at 25-29. The two mean parities differ little in each higher five-year age group. Thus the comparison of mean parities by age indicates that most of this kind of age misreporting occurs at ages below 30.

Note that the apparent increases in ASFRs at 15-19 and 20-24 in Figure 5 cannot be explained by declining age at marriage, shorter breastfeeding, or improved fecundity due to better nutrition. The median age at first marriage among women age 20-49 hardly changed between the two surveys. Median age at first union was 16.4 in 1991 and median age at first marriage was 16.4 in 1996. The median duration of breastfeeding actually increased slightly between the 1991 and 1996 surveys, from 30.4 to 31.0 months (Ministry of Health, 1993, 1997).

And the period of 4.2 years between the two surveys is much too short for a significant change in average fecundity to have occurred.

Although the ASFR curves in Figure 5, pertaining to 15-year periods, are evidently shifted somewhat to the right because of misreporting of women's ages—more so in the case of the curve derived from the 1991 survey than in the case of the curve derived from the 1996 survey—these curves appear to be less affected by displacement of

Figure 6 Proportion married by single years of age: 1991 NFFPHS and 1996 NFHS

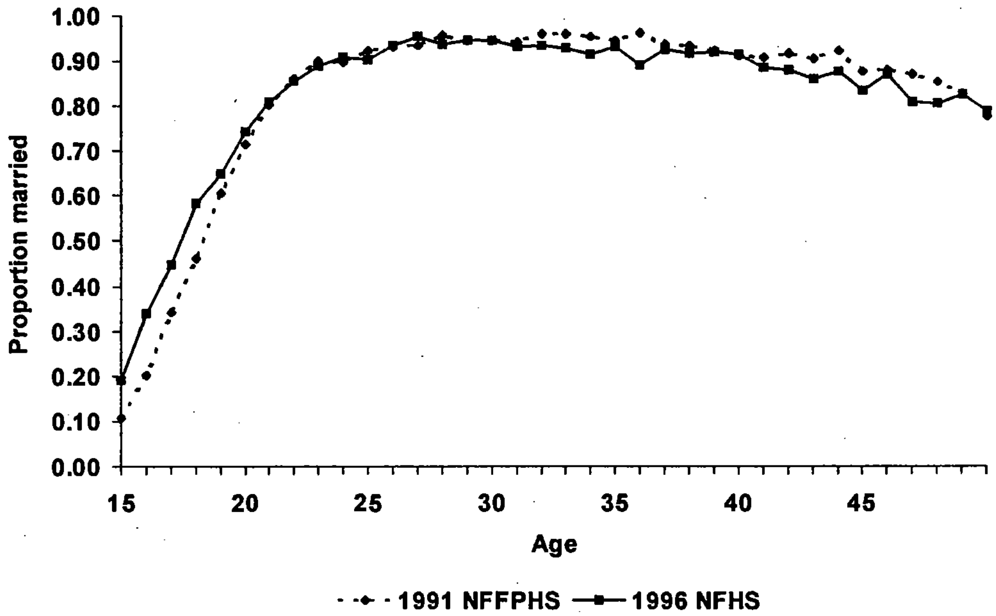
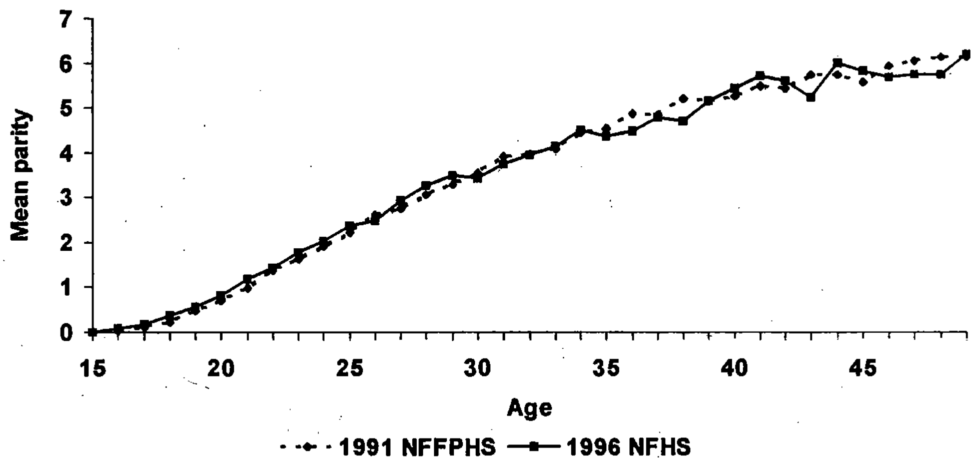


Figure 7 Mean parity by single years of age among all women, regardless of marital status: 1991 NFFPHS and 1996 NFHS



births, which tends to shift the curves to the left. Moreover, since the few births displaced over the time boundary 15 years before the survey are a small proportion of the large number of births that occurred during the following 15 years, displacement across this time boundary, to the extent that it occurs, has a minimal distorting effect on the estimate of the TFR for the 15-year time period.

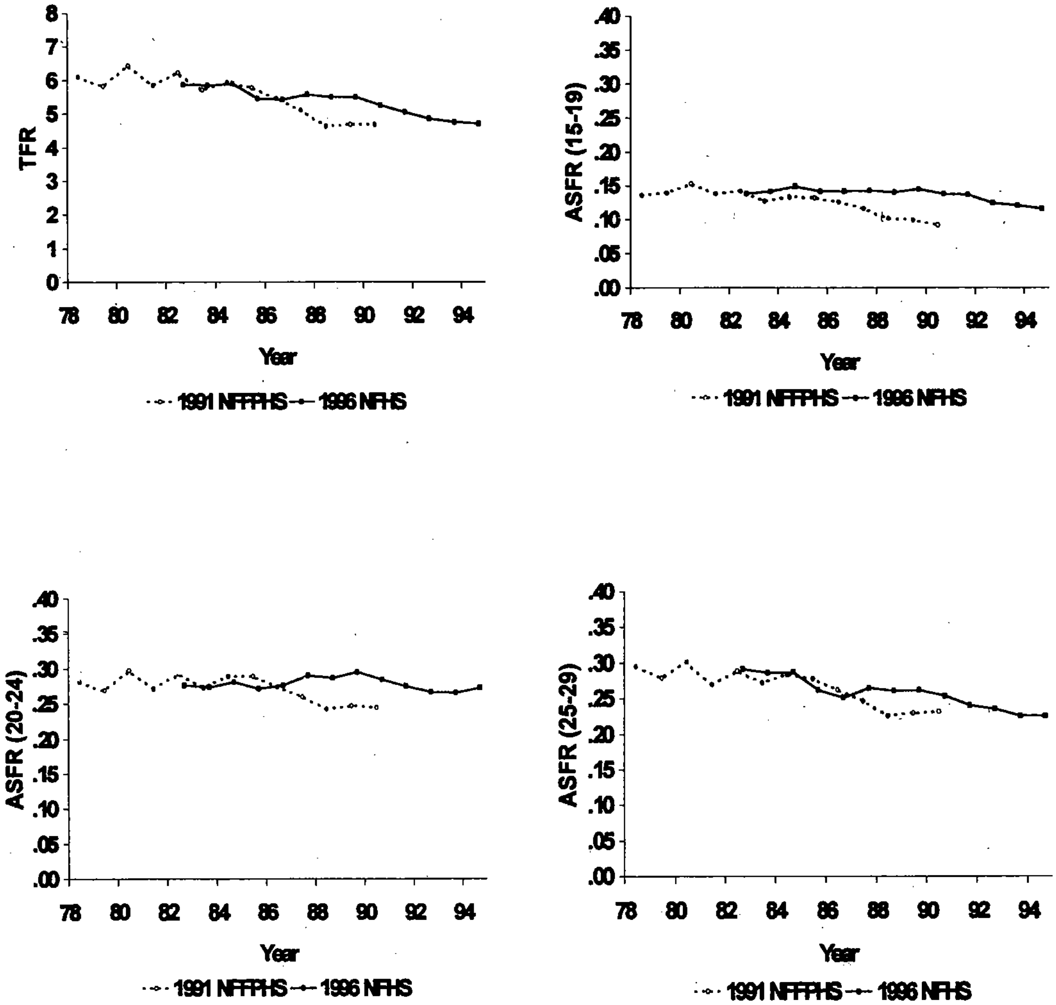
The above discussion implies that TFRs calculated for 15-year time periods are not appreciably affected either by displacement or by misreporting of women's ages. Therefore, the between-survey estimates of the trend in the TFR based on these 15-year aggregations should be fairly accurate.

To summarize the above lines of argument, the various types of age misreporting, combined with some real fertility decline, could have resulted in precisely the pattern observed in Table 3 and Figure 5—namely (1) within-survey estimates of TFR decline that are too steep; (2) a between-survey estimate of TFR decline, based on 15-year time aggregations, that may be fairly accurate; (3) within-survey estimates of declines and between-survey estimates of increases in ASFRs at 15-19 and 20-24 that are probably both spurious, inasmuch as these ASFRs probably changed hardly at all between the two surveys; and (4) between-survey estimates of declines in ASFRs at 25-29 and older that are probably too steep because of a rightward shift of the age curves of fertility that is greater for the curve derived from the 1991 survey than for the curve derived from the 1996 survey.

Further light can be shed on the nature of the estimation errors by examining overlapping trends in the TFR and in ASFRs estimated from the two surveys. Figure 8 shows overlapping trends in the TFR and in ASFRs. Plotted points are three-year moving averages of TFRs or ASFRs originally estimated for single calendar years. The pattern of discrepancies during the period of overlap provides clear evidence of displacement of births from the first five years to the second five years before the 1991 survey. The steepness of TFR decline is clearly overestimated by the 1991 survey and probably also by the 1996 survey, though to a lesser extent. These plots provide further support for the argument that the between-survey estimate of the trend in the TFR is more accurate than either of the two within-survey estimates of this trend.

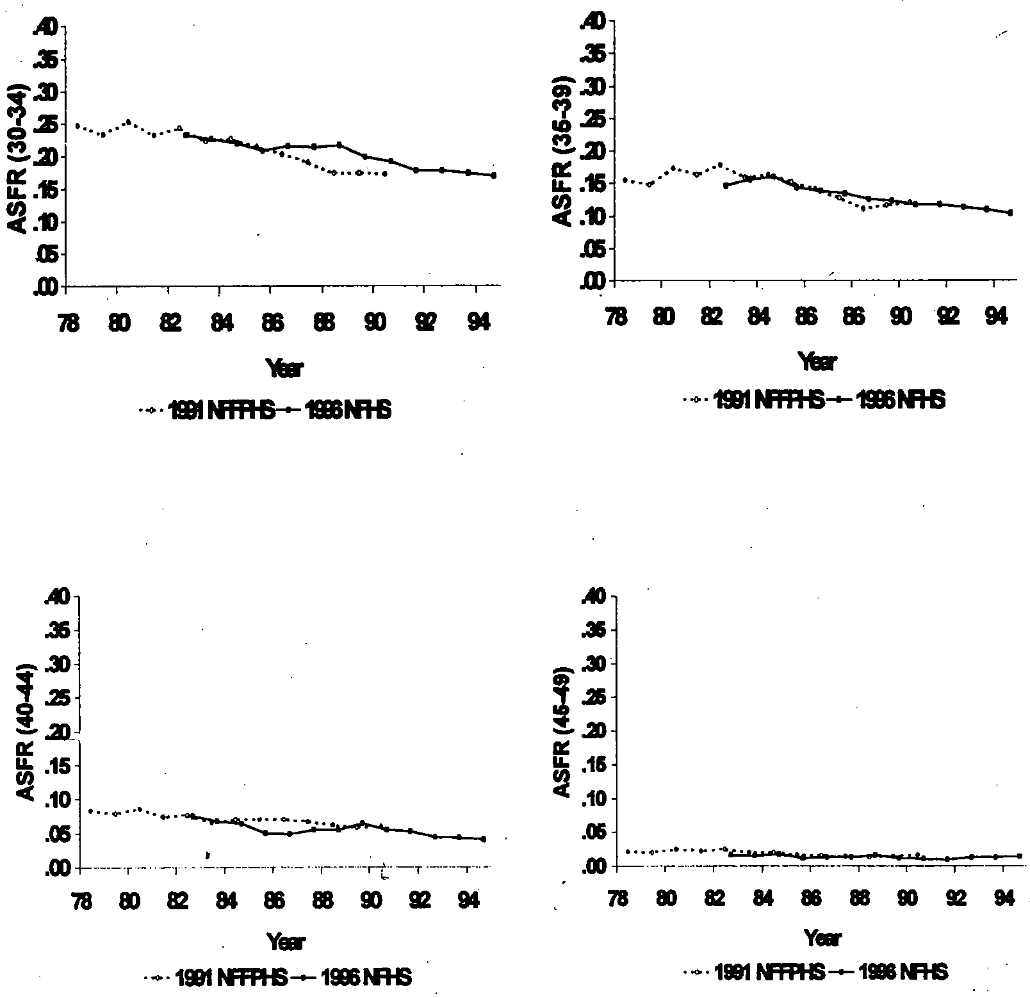
Figure 8 also shows overlapping trends in ASFRs. The overlapping trends coincide rather poorly at ages 15-19, 20-24, 25-29, and 30-34, but rather closely at ages 35-39, 40-44, and 45-49. We suspect that the pattern of misstatement of women's ages, discussed earlier in connection with Figures 6 and 7, provides the main explanation of why the overlap of ASFR trends in Figure 8 is worse at the younger reproductive ages.

Figure 8 Overlapping trends in the TFR and ASFRs, estimated from the 1991 NFFPHS and 1996 NFHS



It is clear from examination of the overlapping trends of ASFRs in Figure 8 that fertility hardly changed at ages 15-19 and 20-24 and declined only modestly at ages 25-29, 30-34, 35-39, and 40-44. This conclusion is similar to that reached in the earlier discussion of Table 3 and Figure 5.

Figure 8 Overlapping trends in the TFR and ASFRs, estimated from the1991 NFFPHS and 1996 NFHS (continued)



Trends in ASFRs and TFRs by Urban-Rural Residence

Table 4 shows estimates of ASFRs and TFRs for urban and rural areas, aggregated over 15-year time periods, as estimated from the 1991 and 1996 surveys. (Estimates for five-year periods are not shown because they are clearly biased, as seen earlier in the analysis of fertility trends in the country as a whole.) In urban areas, the TFR declined substantially, from 4.30 to 3.88. In rural areas, the TFR declined only slightly, from 5.57 to 5.42.

Table 4 Fertility by residence, estimated for the 15-year period preceding each survey: 1991 NFFPHS and 1996 NFHS

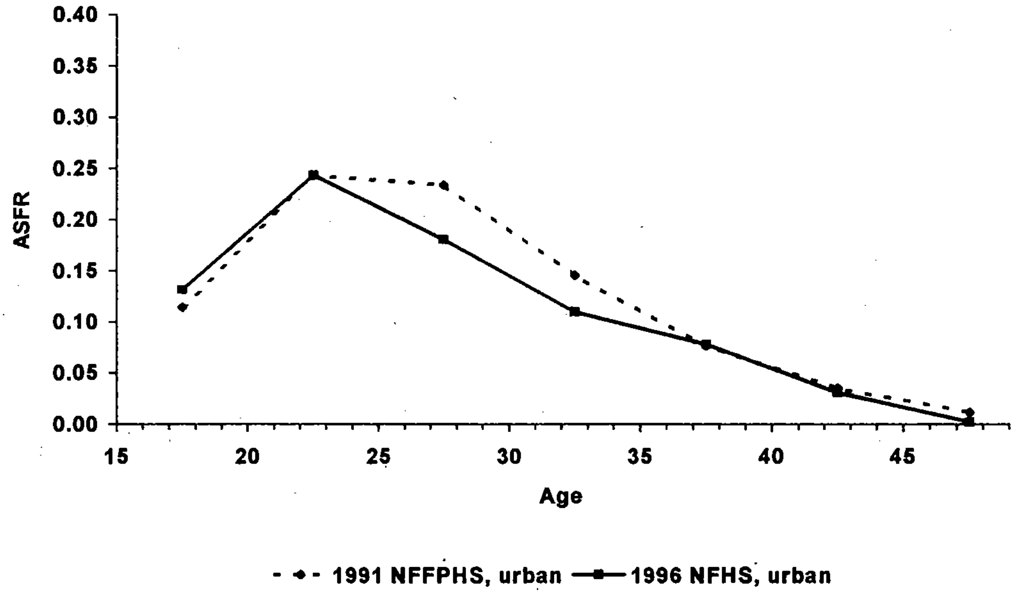
	Urban		Rural	
Fertility measure	1977-91	1981-95	1977-91	1981-95
ASFRs				
15-19	114	132	122	135
20-24	243	243	269	280
25-29	234	181	266	262
30-34	145	110	216	207
35-39	77	78	150	130
40-44	35	31	73	56
45-49	12	2	19	14
TFR	4.30	3.88	5.57	5.42

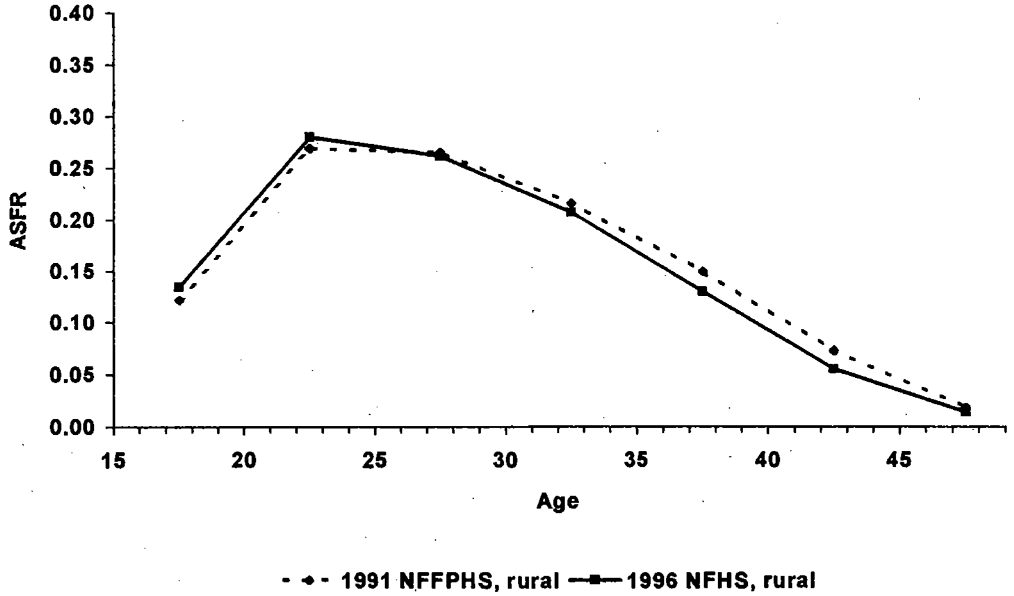
Note: The estimates for 1977-91 are derived from the 1991 NFFPHS, and the estimates for 1981-95 are derived from the 1996 NFHS. TFRs are per woman, and ASFRs are per thousand women.

Both Table 4 and Figure 9 show trends in ASFRs aggregated over 15-year time periods, by residence. The ASFR at 15-19 rose slightly in both urban and rural areas. This rise is probably spurious, for reasons discussed earlier. The ASFR at 20-24 did not change in urban areas, but it rose slightly in rural areas. ASFRs declined sharply at ages 25-29 and 30-34 in urban areas and modestly at ages 30-34, 35-39, and 40-44 in rural areas. These declines are probably overestimated, for reasons discussed earlier.

Figure 10 elaborates on the findings by residence by showing overlapping trends in TFRs for urban areas and rural areas. There is clear evidence of displacement of births in the 1991 survey in rural areas. The estimated trends for urban areas are unusual in that the rate of fertility decline is about the same in the two overlapping trends, but the trend derived from the 1996 survey is consistently and substantially higher than the trend estimated from the 1991 survey during the period of overlap. Urban-rural migration may partially account for this, inasmuch as the own-children method tabulates fertility estimates in earlier years by residence at the time of the survey, not at the time the births occurred. Many women who were urban at the time of the survey were rural several years ago. This means that the fertility estimates for urban areas are progressively overestimated in earlier years. This kind of bias does not affect the rural estimates because there is very little urban-to-rural migration and because the number of rural-to-urban migrants is

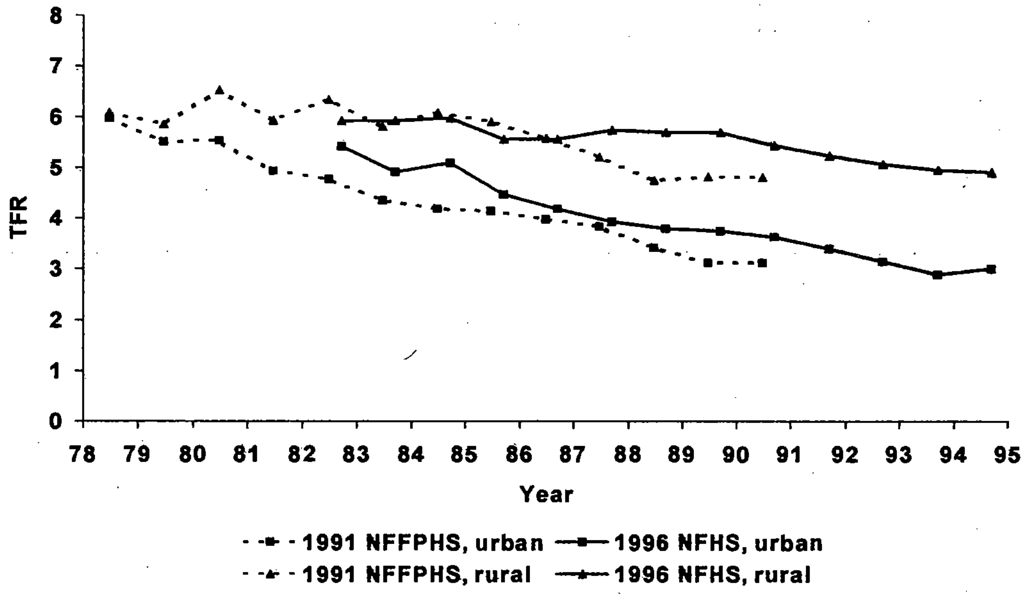
Figure 9 Age-specific fertility rates for the 15-year period preceding each survey, by residence: 1991 NFFPHS and 1996 NFHS





proportionately very small compared with the large rural population but proportionately much larger compared with the small urban population. In sum, rural-urban migration can produce a noticeable upward bias in the fertility estimates for urban areas in earlier years, producing an estimated fertility decline in urban areas that is too steep when this decline is estimated from a single survey. When the trend in the TFR for urban areas is calculated from the 15-year aggregations, the rate of decline should be accurate, but the level of the trend is probably somewhat too high.

Figure 10 Overlapping trends in the TFR, by urban-rural residence, estimated from the 1991 NFFPHS and the 1996 NFHS



Trends in ASFRs and TFRs by Education

Table 5 shows estimates of ASFRs and TFRs by education, for the categories of no education, at least some primary education, and beyond primary education. The estimates are again aggregated over 15-year time periods preceding the 1991 and 1996 surveys. Among women with no education, the TFR declined slightly, from 5.65 to 5.53. Among women with primary education, the TFR hardly changed, falling very slightly from 4.69 to 4.64. Among women with more than a primary education, the TFR fell more substantially, from 3.26 to 3.03. It should be noted that education has contributed to overall fertility decline not only via fertility declines within education categories but also via a decline in the proportion of women who have no education and increases in the proportions of women who have a primary education or more than a primary education, as seen earlier in Table 2.

Table 5 and Figure 11 show trends in ASFRs aggregated over 15-year time periods, by education. The ASFR at 15-19 rose (probably spuriously, for reasons explained earlier) among women with no education or a primary education but hardly changed among women with more than a

Table 5 Fertility by education, estimated for the 15-year period preceding each survey: 1991 NFFPHS and 1996 NFHS

Fertility measure	No education 1977-91	No education 1981-95	Primary 1977-91	Primary 1981-95	Beyond primary 1977-91	Beyond primary 1981-95
ASFRs						
15-19	131	151	111	132	75	73
20-24	272	282	272	301	216	216
25-29	269	264	236	231	193	164
30-34	219	208	138	137	98	89
35-39	149	131	97	76	56	46
40-44	72	55	57	37	12	13
45-49	18	14	27	13	2	7
TFR	5.65	5.53	4.69	4.64	3.26	3.03

Note: The estimates for 1977-91 are derived from the 1991 NFFPHS, and the estimates for 1981-95 are derived from the 1996 NFHS. TFRs are per woman, and ASFRs are per thousand women.

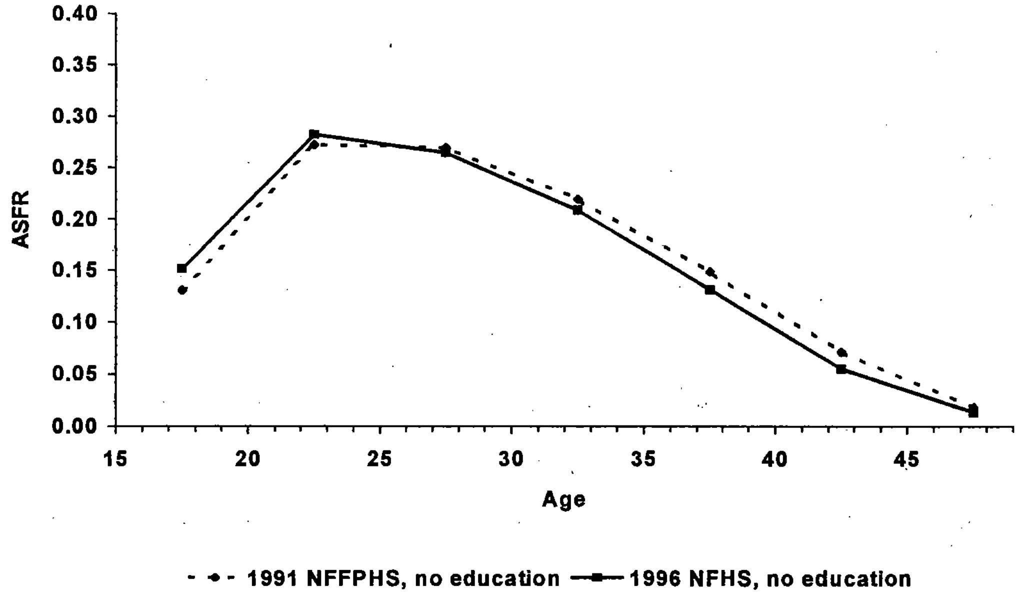
primary education (probably because of better age reporting in this group). The ASFR at 20-24 remained virtually unchanged among women with no education and women with more than a primary education but increased among women with a primary education (again probably spuriously). At older reproductive ages, fertility fell in all three education groups. Among women with more than a primary education, the decline was concentrated at ages 25-29.

Figure 12 elaborates this picture by showing overlapping trends in TFRs for each of the three education groups. There is clear evidence of displacement of births in the 1991 survey in all three education groups, but less in the beyond-primary group, as expected because of better age reporting in this group. Evidence of fertility decline is clearer for the beyond-primary group than for the other two less-educated groups.

Combining Each Pair of Overlapping Trends into a Single Trend

The analysis of overlapping trends indicates that the 1991 survey suffers from considerable displacement of births from the first five years before the survey to earlier years. There appears to be some displacement of births in the 1996 survey as well, but not nearly as much. On the other hand, the problem of displacement mostly disappears when TFRs are calculated for a 15-year aggregation of calendar years before each survey. The TFRs for 15-year time periods are also affected very little by rightward shifts of the age distribution of fertility. From our analysis, we have two such TFRs, one pertaining to the 15-year period before the 1991 survey, and the other pertaining to the 15-year period before the 1996 survey.

Figure 11 Age-specific fertility rates for the 15-year period preceding each survey, by education: 1991 NFFPHS and 1996 NFHS



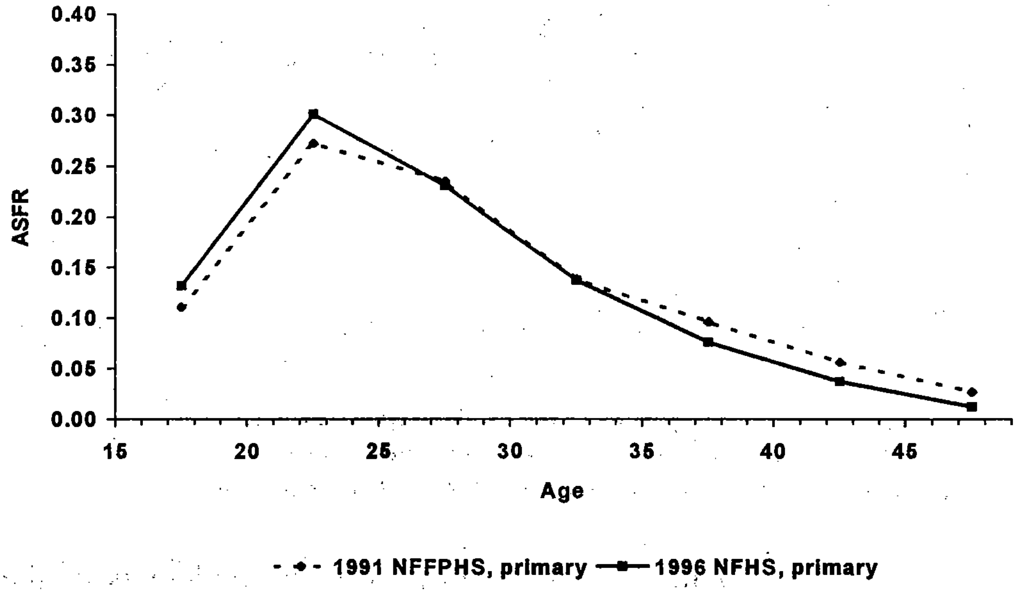


Figure 11 Age-specific fertility rates for the 15-year period preceding each survey, by education: 1991 NFFPHS and 1996 NFHS (continued)

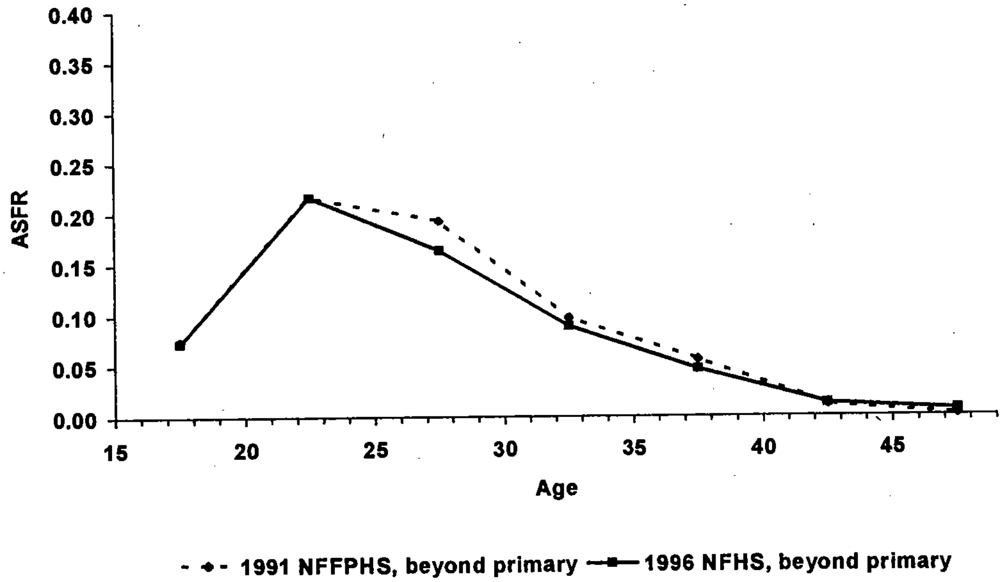
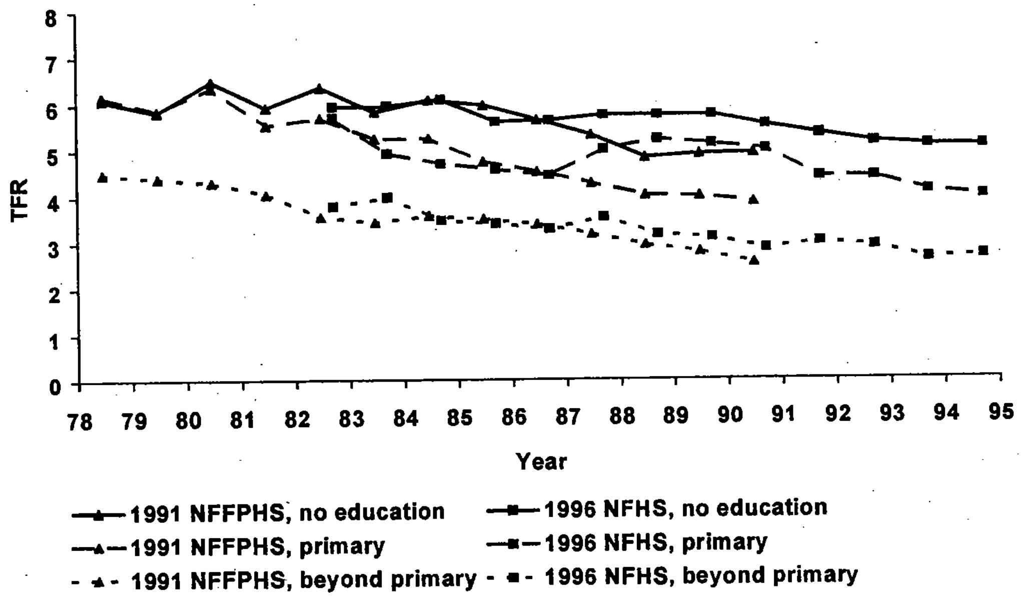
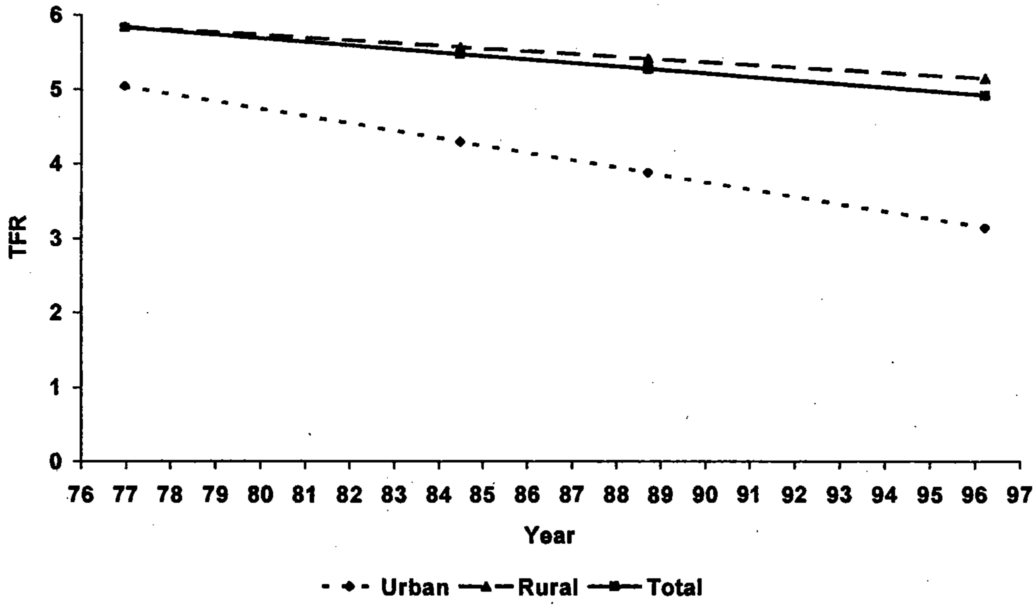


Figure 12 Overlapping trends in the TFR, by education, estimated from the 1991 NFFPHS and the 1996 NFHS



If we consider these TFRs as located at the midpoints of their respective 15-year periods, the two TFRs pertain to 1984.47 and 1988.70. These values are obtained by averaging dates of interview for ever-married women in each survey and are 4.23 years apart. A simple linear trend in the TFR can be calculated from the 15-year-aggregated TFRs by plotting them on a graph at 1984.47 and 1988.70 and drawing a line through the two points, as in Figure 13, which shows lines obtained in this way for the whole country, urban areas, and rural areas. The lines may be extrapolated back to 1977 and forward to 1995, reflecting the time range of the data on which the two initial TFRs are based. From the equations of the lines, it can be calculated that, between 1977 and 1995, the TFR declined from 5.80 to 4.95 in the country as a whole, from 5.82 to 5.17 in rural areas, and from 4.98 to 3.22 in urban areas. As explained earlier, the rate of decline of the rural TFR should be reasonably accurate, but levels of the urban TFR are probably somewhat too high. Linear trends are not shown for ASFRs, because these trends are severely biased, for reasons discussed earlier.

Figure 13 Linear trends in the TFR, for the whole country and by residence



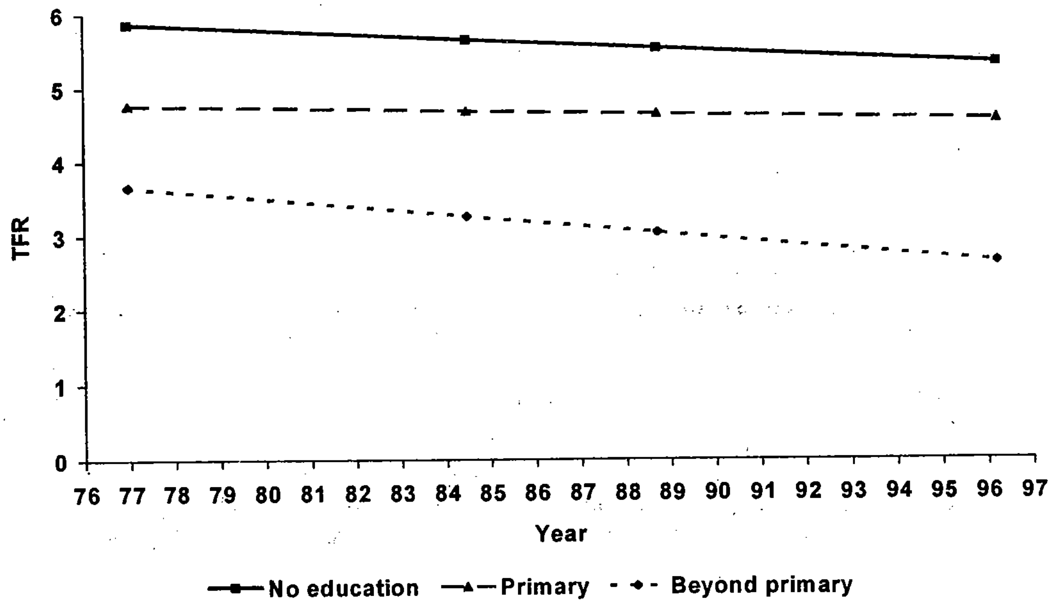
Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 1. Dots and other symbols on the lines indicate the midpoint of the 15-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

In interpreting these results, it should be borne in mind that fertility did not necessarily decline linearly between 1977 and 1995. This is a simplifying assumption that we have imposed on the data. The fitted lines simply represent estimates of average levels and rates of decline of fertility over the period 1977-95.

Figure 14 shows similar trend lines for TFRs for education groups. The fitted lines imply that, between 1977 and 1995, the TFR declined from 5.84 to 5.34 among women with no education, from 4.76 to 4.57 among women with at least some primary education, and from 3.63 to 2.67 among women with more than a primary education. Interestingly, fertility appears to have fallen more rapidly among women with no education than among women with at least some primary education. The reasons for this are not clear.

Table 6 summarizes in tabular form the results of the straight-line fits for trends in the TFR for the whole country and by residence and education. Results are presented for 1977 and 1995, again reflecting the time range of the data on which the estimates are based. The equations of the lines on which these estimates are based are given in Appendix Table 1. These simple linear trends are our "best estimates" of the trend in the TFR that we are able to derive from the 1991 and 1996 surveys.

Figure 14 Linear trends in the TFR, by education



Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 1. Dots and other symbols on the lines indicate the midpoint of the 15-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

Table 6 Linear trend estimates of TFRs for the whole country, by residence, and by education

Characteristic	1977	1995
Total	5.80	4.95
Residence		
Urban	4.98	3.22
Rural	5.82	5.17
Education		
No education	5.84	5.34
Primary	4.76	4.57
Beyond primary	3.63	2.67

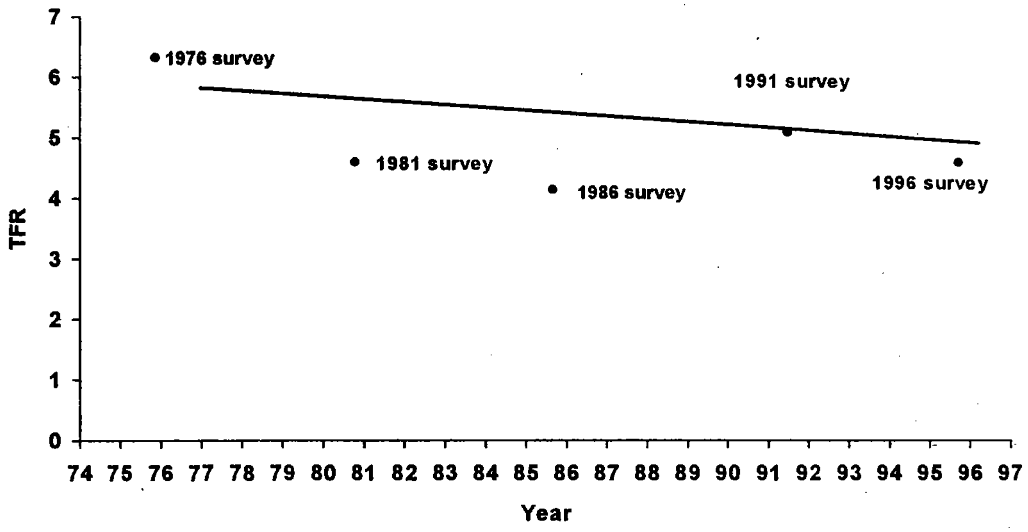
Note: TFRs are per woman. Values for 1977 and 1995 are calculated by substituting 77.5 and 95.5 into equations for the straight-line fits. These equations are given in Appendix Table 1.

Comparing with Fertility Trends Derived from Other Sources

Figure 15 compares the linear trend in the TFR estimated from 15-year-aggregated estimates from the 1991 NFFPHS and the 1996 NFHS with TFR estimates from three other surveys: the 1976 Nepal Fertility Survey, the 1981 Nepal Contraceptive Prevalence Survey, and the 1986 Fertility and Family Planning Survey. Each of the five point estimates of the TFR shown in the graph pertains to the year before the survey from which the point estimate was derived. The year before the survey is used because births in the year before the survey correspond to children below age one at the time of the survey, whose age is thought to be reported more accurately than the ages of older children. The TFR point estimates derived from the surveys of 1976, 1991, and 1996 are all fairly close to the linear trend line derived from the 1991 and 1996 surveys. However, the TFR point estimates derived from the 1981 and 1986 surveys both fall well below the linear trend line. It is generally thought that data quality is not nearly as good in the 1981 and 1986 surveys as in the 1976, 1991, and 1996 surveys.

The linear trend line suggests that fertility has been falling somewhat more slowly than indicated by the point estimates from the 1976 and 1996 surveys, which are thought to be the two surveys with the highest data quality.

Figure 15 Comparison of the linear trend in the TFR estimated from the 1991 NFFPHS and the 1996 NFHS with estimates from other sources



• Point estimates pertain to the year before each survey

Trends in PPPRs, TFR_p, and $TMFR_p$

Period parity progression ratios (PPPRs) can be derived from both the 1991 NFFPHS and the 1996 NFHS. PPPRs are useful because they directly describe the family-building process. In this respect they are also useful for evaluating the performance of family planning programmes. For example, if the slogan of the family planning programme is "stop at three," the trend in p_3 provides a means of measuring directly how well the program is doing.

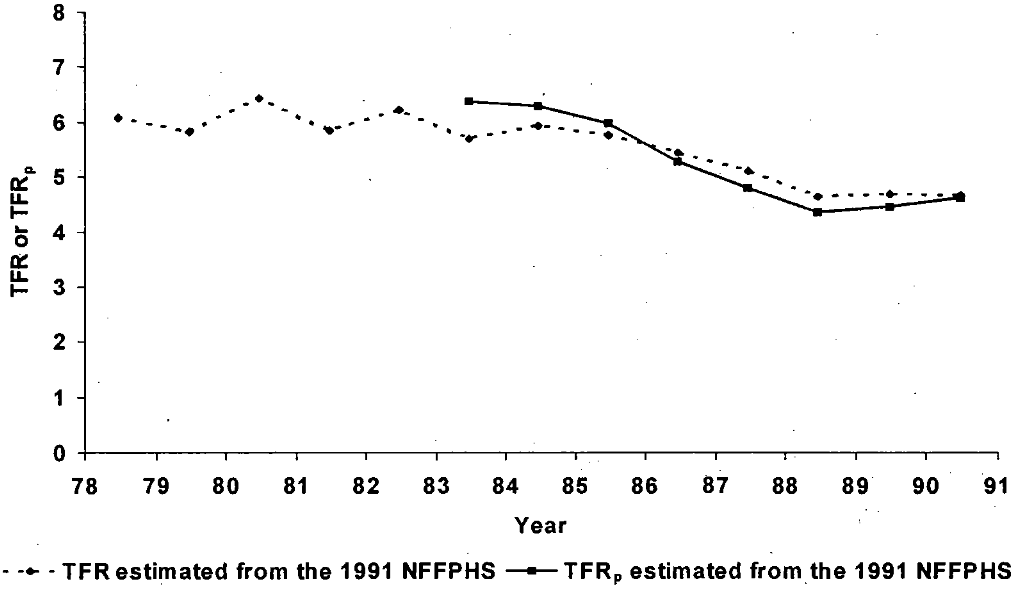
As discussed earlier, it is possible to calculate a total fertility rate, TFR_p, and a total marital fertility rate, $TMFR_p$, from a set of PPPRs. We first look at how well the trend in TFR_p agrees with the trend in TFR, where TFR denotes the conventional age-based total fertility rate discussed earlier. This comparison is shown in Figure 16. In this figure, the values of TFR_p are calculated for overlapping three-year time periods and are plotted at the midpoints of those time periods. (This is a slightly different procedure than that used in the age-based analysis, where we have calculated three-year moving averages of estimates of TFRs for single calendar years.) Figure 16 shows that the trend in TFR_p agrees quite well with the trend in TFR. The agreement is better for trends estimated from the 1996 survey than for the trends estimated from the 1991 survey. As discussed earlier in the section on methodology, one does not expect the two trends to coincide precisely.

Figure 17 shows overlapping trends in TFR_p and in $TMFR_p$, as estimated from the 1991 and 1996 surveys. As in the earlier analysis of TFR trends, the overlaps indicate considerable displacement of births in the 1991 survey.

Figure 18 shows overlapping trends in PPPRs, starting with B→M (birth to marriage) and ending with 7+→8+ (parity 7 or more to next birth). Over the entire estimation period, the progression ratio from birth to marriage, p_B, decreased somewhat, but was still very high at about 95 percent at the end of the estimation period. p_M increased slightly, and in this case the two curves coincide almost perfectly during the period of overlap. p_1 also increased slightly; in this case, discrepancies during the period of overlap are more noticeable but still small. p_2 declines over time, and discrepancies during the period of overlap are larger. p_3 also declines, and discrepancies during the period of overlap are slightly smaller than in the case of p_2. The progression ratios p_4, p_5, p_6, and p_{7+} show steeper declines, and discrepancies during the period of overlap are quite large.

In Figure 18, the overlap is worse the higher the starting parity. There appear to be two reasons for this: (1) greater displacement of births among higher parity women, and (2) a greater tendency to overestimate the steepness of PPPR decline at higher parities because of the age truncation bias discussed earlier. Because of the reverse-J-shaped pattern that is increasingly evident at higher parities in the PPPR trends derived from the 1991 survey, we suspect that greater displacement of births is the more serious problem. We argued earlier that infants were probably enumerated fairly accurately in both surveys, implying little displacement of births from the first year before the survey to the second year before the survey. We also argued that some children age one year and eleven months are rounded up to age two, implying some displacement of births from the second year before the survey to the third year before the survey. But children age one were born recently enough that women still remember their date of birth fairly accurately, so that the amount of such displacement is probably modest. Upward rounding may be considerably more common at age two than age one, in which case the net deficit of births in the third year before the survey (calculated as births displaced out to age three minus births displaced in from age one) might be particularly large. This net deficit may become smaller at progressively higher ages of children, as outgoing and incoming displaced births come into approximate balance.

Figure 16 Comparison of the trend in the total fertility rate calculated from age-specific fertility rates (TFR) with the trend in the total fertility rate calculated from period parity progression ratios (TFR_p): 1991 NFFPHS and 1996 NFHS



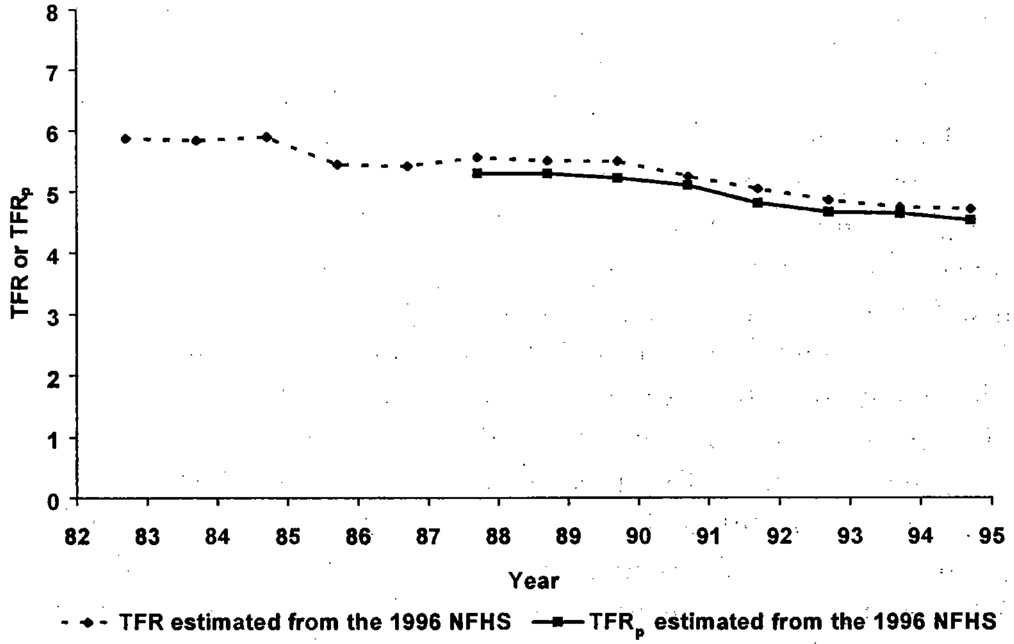
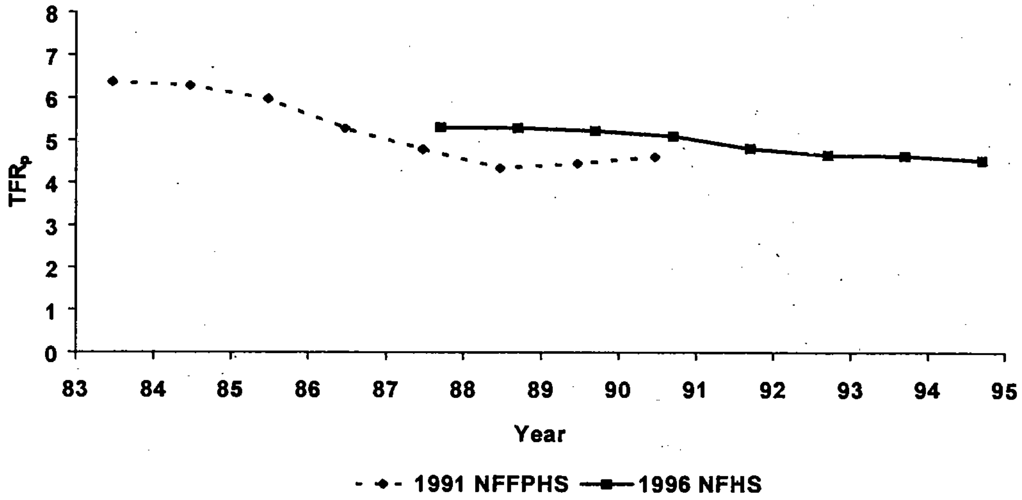


Figure 17 Overlapping trends in TFR_p and in $TMFR_p$, estimated from the 1991 NFFPHS and the 1996 NFHS



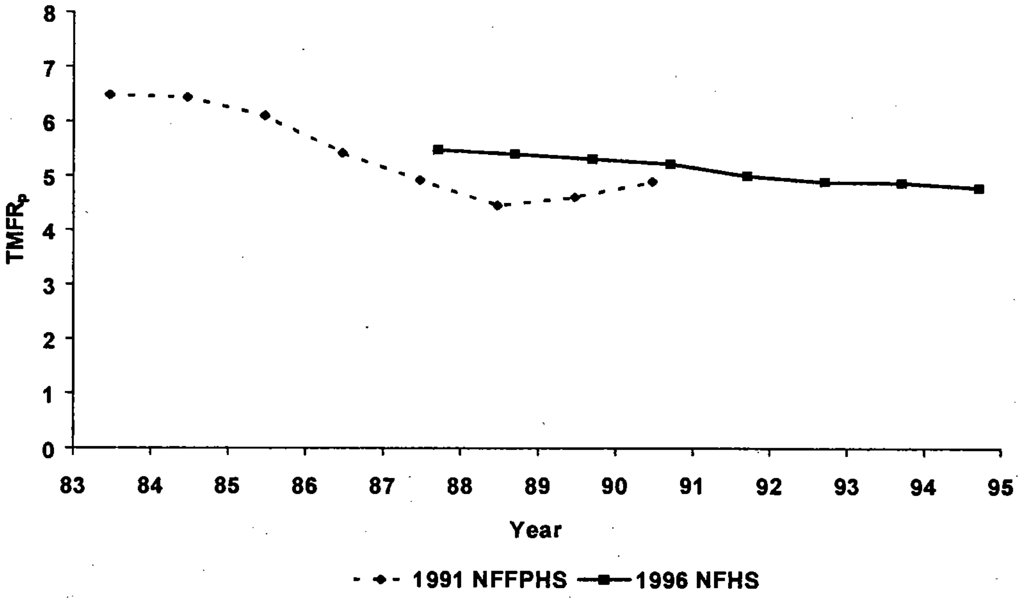


Figure 18 Overlapping trends in PPPRs, estimated from the 1991 NFFPHS and the 1996 NFHS

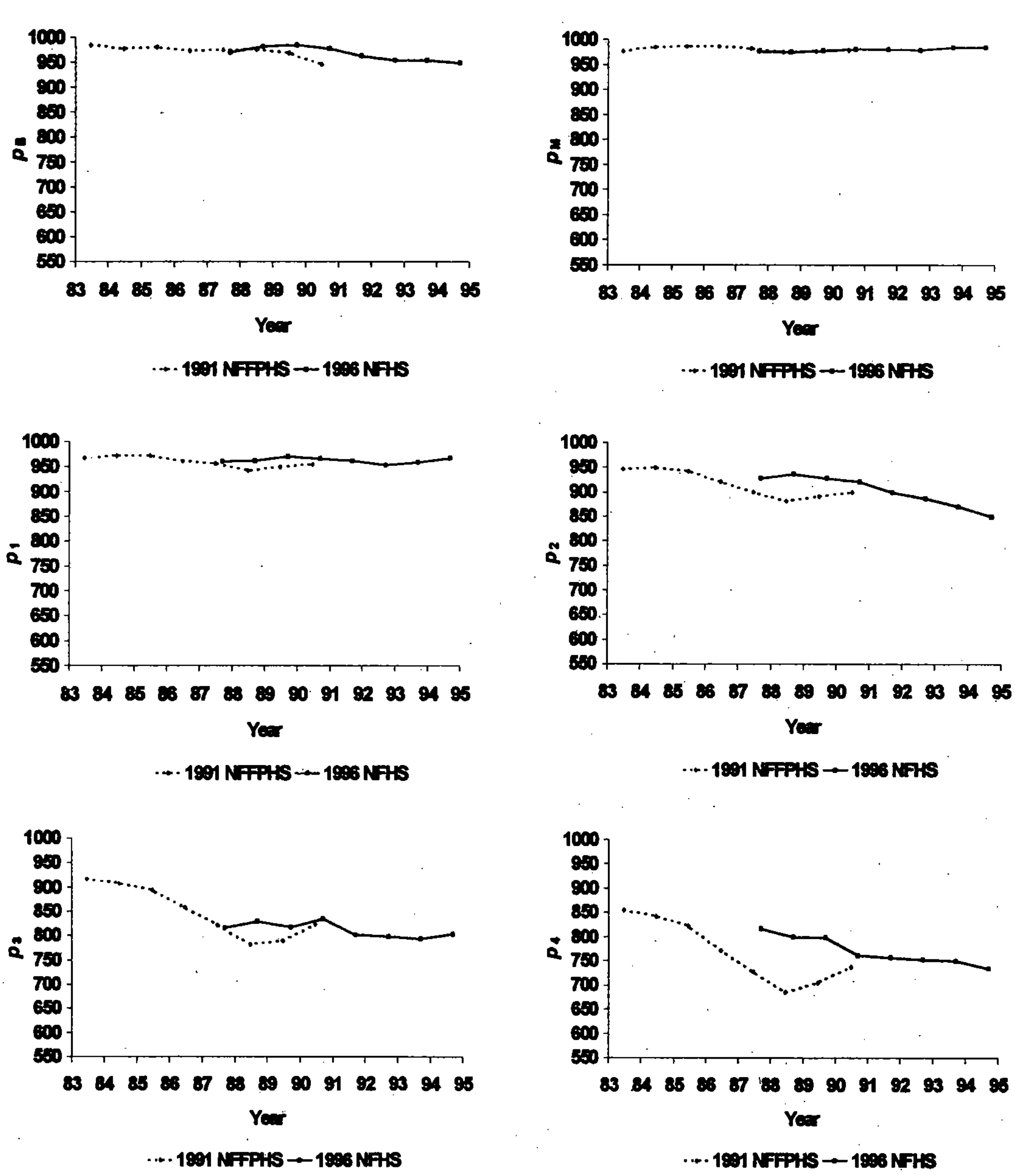
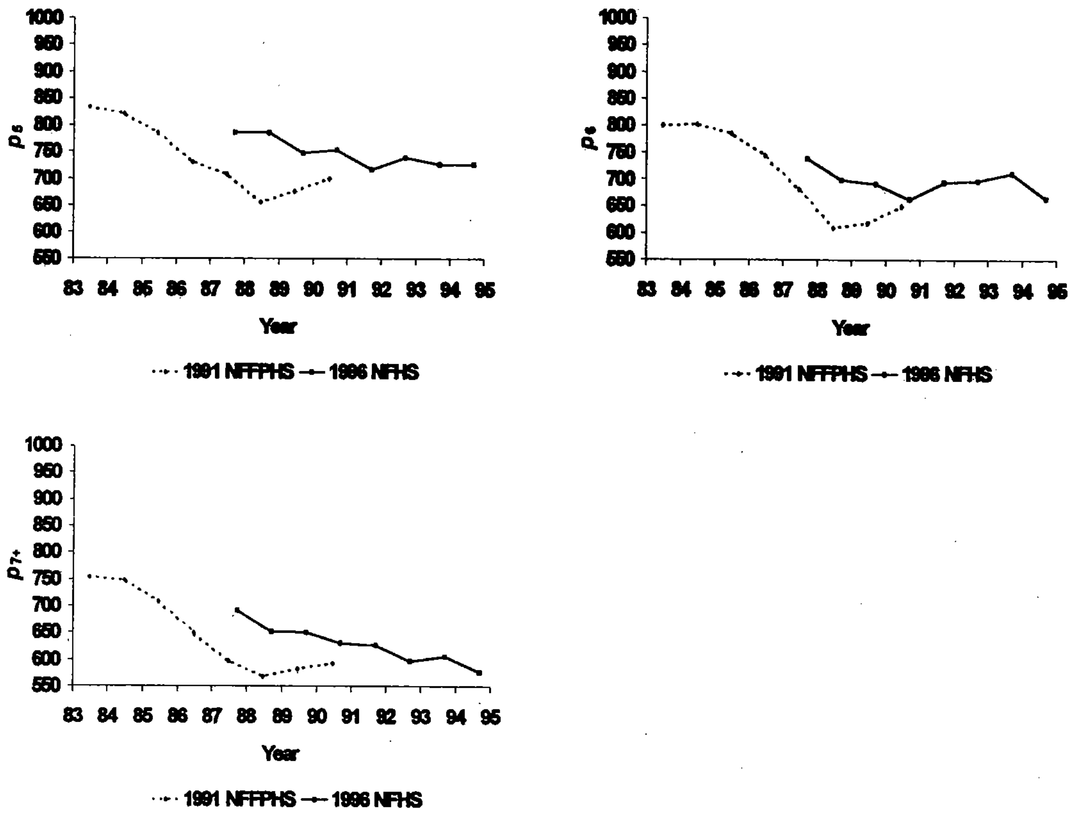


Figure 18 Overlapping trends of PPPRs, estimated from the 1991 NFFPHS and the 1996 NFHS (continued)



If this is what is really happening, we would expect to see the reverse-J-shaped trend that is observed in the estimates derived from the 1991 survey. Because the reversed-J shape is so pronounced in the trends in p_3, p_4, p_5, p_6, and p_{7+}, we conclude that there was considerable displacement of births to women of parity 3 or higher. The other reason why we think displacement is a more serious problem than the bias from age truncation is that the PPPR trends at higher parities estimated from the 1996 survey are not steeply downward, except for the steeply downward trend in p_{7+}, which might even be mostly real.

Table 7 provides additional information with which to test of the hypothesis that births in the year before the survey tend to be displaced backward in time to a much lesser extent than births that occurred in earlier years. If the hypothesis is true, then one expects the interval between next-to-last and last birth to be longer if the last birth occurred in the year before the survey than if the last birth occurred in an earlier year. The unadjusted mean birth intervals in the left half of Table 7 provide some support for this expectation, but these unadjusted results are somewhat inconclusive because they lack a control for mother's age at the time of the survey. Such a control is needed, because mothers whose last birth occurred more than one year before the survey tend to be older than mothers whose last birth occurred in the year before the survey, and because older mothers tend to have longer birth intervals.

The adjusted values in the right half of Table 7 control for mother's age at the time of the survey by means of multiple regression. At any given parity, the interval between next-to-last and last birth is first regressed on two predictor variables: mother's age at the time of the survey and a dummy variable indicating whether the last birth occurred in the year before the survey. The fitted regression equation is then used to predict two values of mean birth interval (one value for mothers who had their last birth during the year before the survey, and the other value for mothers who had their last birth in an earlier year) by substituting in the mean value of mother's age at the time of the survey while setting the dummy variable alternatively to one or zero. Mother's age at the time of the survey is thus controlled by holding it constant at its mean value for mothers of the specified parity. This procedure is repeated at other parities, yielding the adjusted values shown. The adjusted values of mean last birth interval are considerably and consistently longer for mothers whose last birth occurred during the year before the survey,

Table 7 Mean interval between next-to-last and last birth (in months), by parity

	Unadjusted				Adjusted for mother's age at the time of the survey			
	1991 NFFPHS		1996 NFHS		1991 NFFPHS		1996 NFHS	
Parity	Had last birth during year before survey	Had Last Birth During Earlier Year	Had last birth during year before survey	Had last birth during earlier year	Had last birth during year before survey	Had last birth during earlier year	Had last birth during year before survey	Had last birth during earlier year
2	37.2	38.2	36.4	38.2	42.3	36.3	42.7	36.1
3	38.0	39.0	35.1	37.7	42.5	37.6	40.3	36.4
4	40.4	37.4	40.0	37.6	44.7	36.4	45.1	36.3
5	41.7	38.1	35.6	36.5	45.3	37.2	39.2	35.7
6+	41.7	36.5	38.3	35.9	44.2	36.0	41.0	35.5

Note: Women whose last birth was a multiple birth are omitted from this table. Multiple regression was used to control for mother's age at the time of the survey, as explained in the text.

consistent with the hypothesis that births in the year before the survey are displaced backward in time to a much lesser extent than births occurring in earlier years. The results also indicate that, while there is considerable backward displacement of births in both surveys, there tends to be more displacement in the 1991 survey than in the 1996 survey.

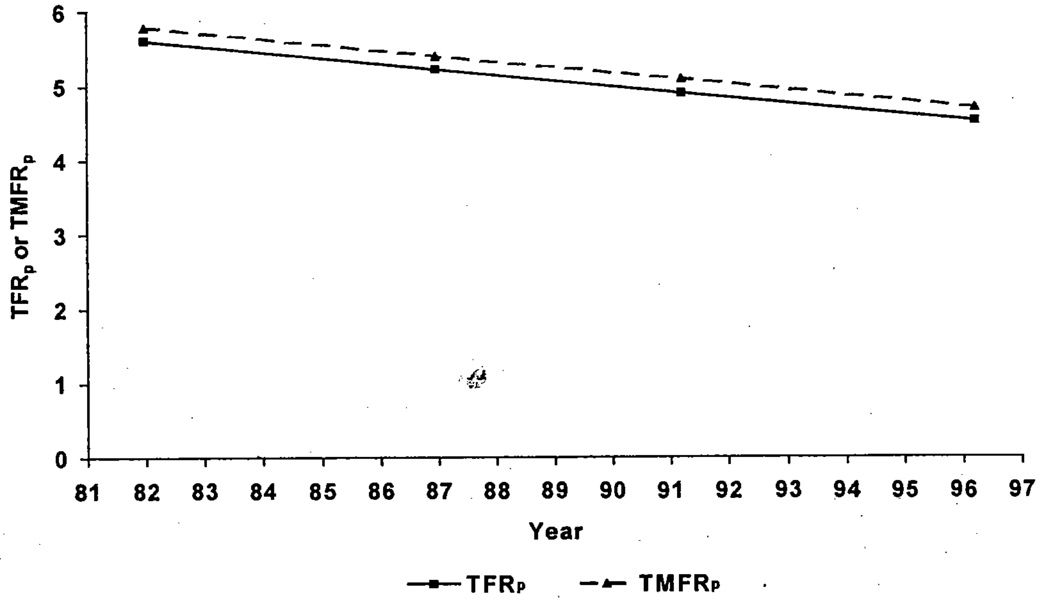
Interestingly, the reverse-J-shaped trends that are commonly associated with displacement, so marked in the 1991 survey, are mostly lacking in the 1996 survey (Figure 18), even though there is considerable displacement of births also in the 1996 survey, as indicated by Table 7. It may be that interviewers in the 1996 survey, but not in the 1991 survey, were trained to watch out for unusually long birth intervals and to spread births evenly over time when in doubt about precise birth dates. In that case, one would not expect to see reverse-J-shaped trends derived from the 1996 survey, despite the presence of displacement.

Because of the bias from displacement, we again consider it prudent to base our "best estimates" of trends in PPPRs, TFR_p, and $TMFR_p$ on aggregated data for broad time periods, in this case the 10-year time period preceding each of the two surveys. These estimates for broad periods can be used to derive straight-line trends. The approach used to derive these straight-line trends is similar to that used earlier to estimate straight-line trends in the TFR, except that the base data are for 10-year time periods instead of 15-year time periods preceding each survey. We obtain one such estimate (TFR_p, $TMFR_p$, or PPPR) from each survey, plot the two points at the midpoints of the two 10-year time periods, and fit a line through the two points to estimate a simple linear trend extending from 1982-1995, reflecting the time range of the underlying data. Results are shown in Figures 19-22 and Tables 8 and 9. The equations for the straight-line fits are given in Appendix Tables 2 and 3.

Figure 19 shows that TFR_p and $TMFR_p$ declined at the same rate in the country as a whole, reflecting the fact that the PPPR from birth to marriage hardly changed between the two surveys, as shown in Figure 20. Figure 20 also shows that PPPRs for transitions M→1 and 1→2 also hardly changed. p_2 declined, and p_3 declined considerably more—in fact more rapidly than any other PPPR. The progression ratios p_4 and p_5 hardly changed. The progression ratios p_6 and p_{7+} also declined, but somewhat less rapidly than p_3.

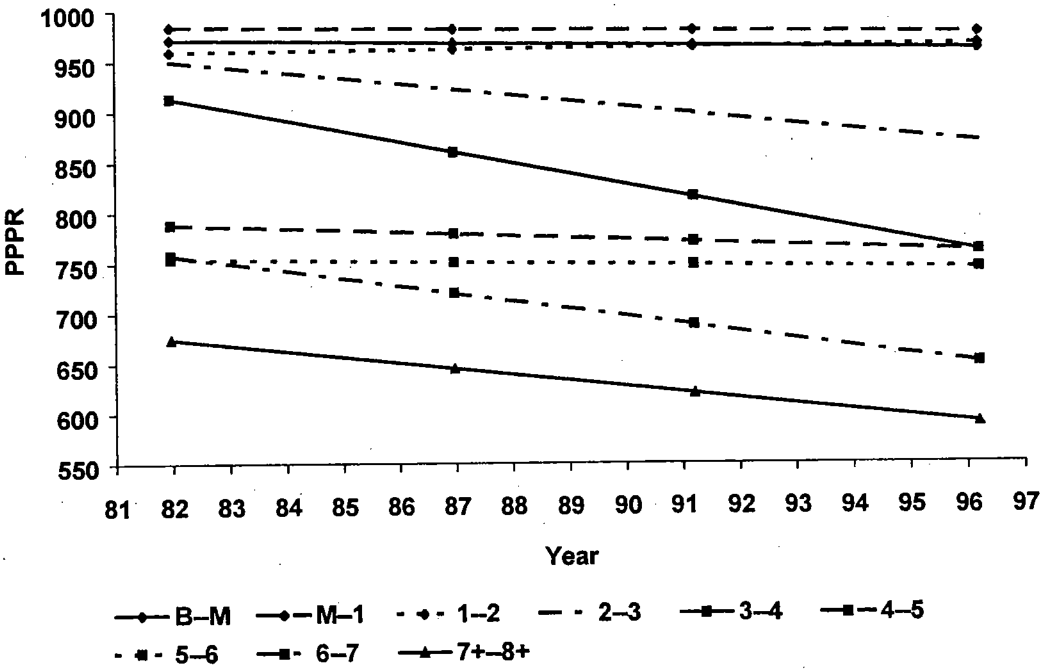
Figure 21 indicates that TFR_p declined at about the same rate in urban and rural areas. However, $TMFR_p$ declined considerably faster in urban than in rural areas, as shown in Table 9. The inconsistency between these two trends stems from an exceptionally low urban value of p_B estimated from the 1991 survey, which produces an exceptionally low urban estimate of p_B in 1982 (not shown), possibly reflecting a quirk in the 1991 sample. The resulting sharp and probably spurious rise in the urban estimate of p_B may explain why TFR_p does not fall more rapidly in urban areas than in rural areas (Figure 21), whereas TFR, calculated from ASFRs, does fall more rapidly in urban than in rural areas (Figure 13). By education, TFR_p declined slightly faster among those with more than a primary education than among those with either no education or primary education (Figure 22).

Figure 19 Linear trends in TFR_p and $TMFR_p$



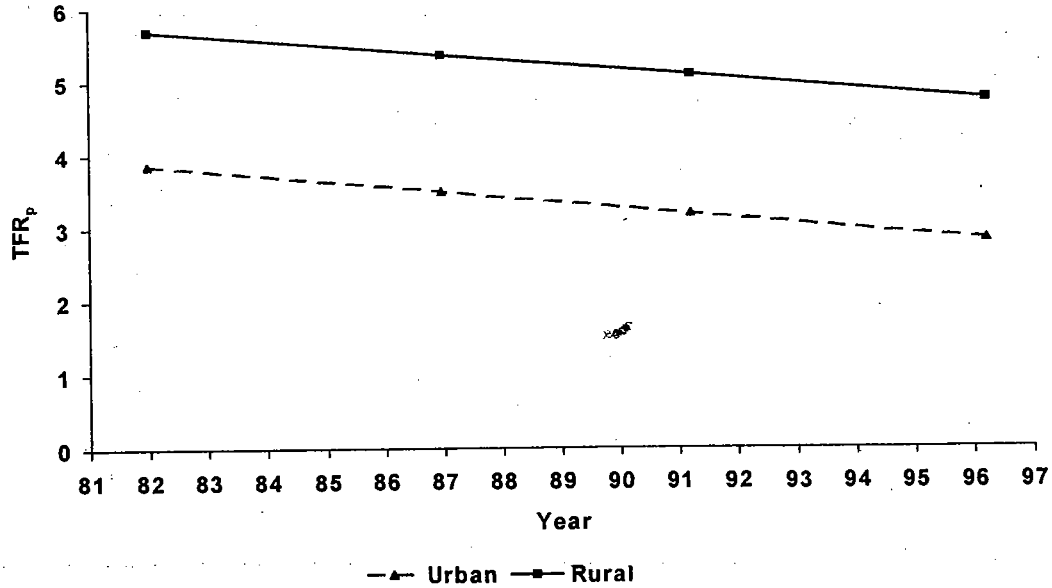
Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 2. Dots and other symbols on the lines indicate the midpoint of the 10-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

Figure 20 Linear trends in PPPRs



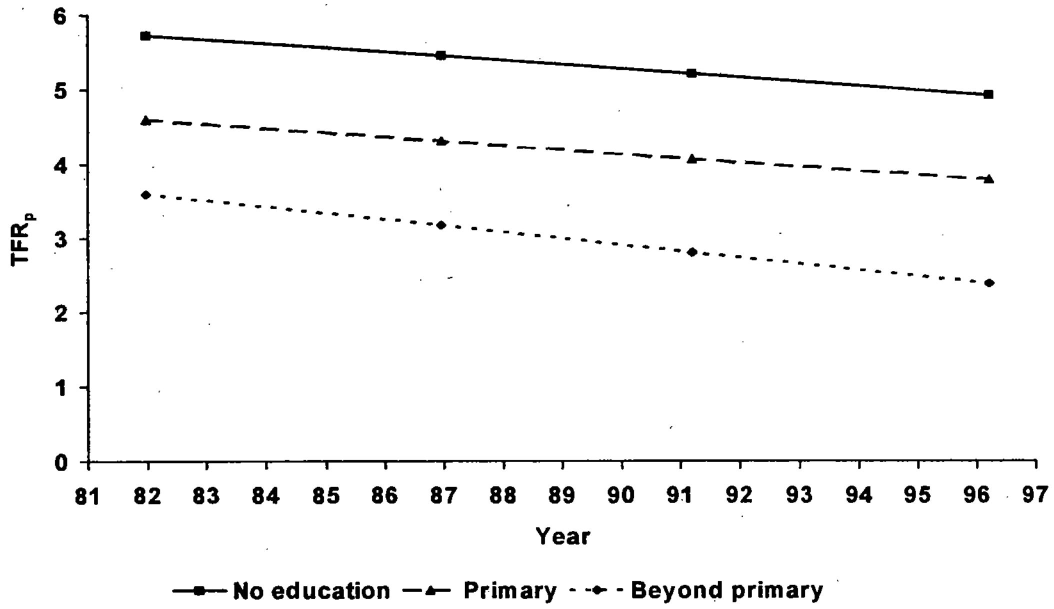
Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 2. Dots and other symbols on the lines indicate the midpoint of the 10-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

Figure 21 Linear trends in $TFR_{p,}$ by residence



Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 3. Dots and other symbols on the lines indicate the midpoint of the 10-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

Figure 22 Linear trends in TFR_p, by education



Notes: Values are calculated from the equations for the straight-line fits. These equations are given in Appendix Table 3. Dots and other symbols on the lines indicate the midpoint of the 10-year period preceding each survey and the end points of the time range of the underlying data on which the estimates are based.

Table 8 Linear trend estimates of PPPRs, TFR_p, and $TMFR_p$ for the whole country

Fertility measure	1982	1995
PPPRs		
B→M	971	962
M→1	984	978
1→2	960	966
2→3	947	874
3→4	908	769
4→5	787	763
5→6	754	745
6→7	754	655
7+→8+	671	595
TFR_p	5.57	4.58
$TMFR_p$	5.75	4.76

Note: TFR_p and $TMFR_p$ are per woman, and PPPRs are per thousand women. Values for 1982 and 1995 are calculated by substituting 82.5 and 95.5 into the equations for the straight-line fits. These equations are given in Appendix Table 2.

Table 9 Linear trend estimates of TFR_p and $TMFR_p$ for the whole country by residence and by education

Characteristic	TFR_p 1982	TFR_p 1995	$TMFR_p$ 1982	$TMFR_p$ 1995
Residence				
Urban	3.82	2.90	4.61	2.89
Rural	5.67	4.81	5.80	5.01
Education				
No education	5.70	4.97	5.84	5.05
Primary	4.56	3.83	4.89	3.81
Beyond primary	3.55	2.44	3.83	2.72

Note: TFR_p and $TMFR_p$ are per woman. Values for 1982 and 1995 are calculated by ubstituting 82.5 and 95.5 into the equations for the straight-line fits. These equations are given in Appendix Table 3.

Conclusion

The analysis in this study shows that fertility trends estimated separately from the 1991 Nepal Fertility, Family Planning and Health Survey and the 1996 Nepal Family Health Survey suffer from various distortions due to errors in the data. These distortions have much to do with the quality of age reporting, both for women and for children. Ages are reported much more accurately in the 1996 survey than in the 1991 survey. In both surveys, but much more so in the 1991 survey, children tend to be reported as older than they really are. Reflecting this, the 1991 survey shows evidence of considerable displacement of births to earlier years, whereas the 1996 survey shows less displacement. As a consequence, the decline in the total fertility rate estimated from the 1991 survey is much steeper than the fertility decline estimated from the 1996 survey.

The nature of the distortion of women's ages appears to be that women who are young and married tend to be reported as older than they really are by virtue of their being married, and women who have a higher than average number of children relative to their true age tend to be reported as older than they really are. It also appears that young single women tend to reported as younger than they really are, and women with a smaller than average number of children relative to their true age tend to be reported as younger than they really are. The net result of this misreporting of women's ages is to shift the age curve of fertility (ASFRs plotted against age) to the right. Because misreporting of women's ages is more severe in the 1991 survey than in the 1996 survey, this spurious shifting of the age curve of fertility to the right is more evident in the 1991 survey than in the 1996 survey. As a result, trends in ASFRs derived by comparing ASFRs from the 1991 survey with ASFRs from the 1996 survey are severely distorted.

To neutralize the effects of displacement and age misreporting, fertility is estimated for the entire 15-year period before each survey. The aggregation over fifteen years eliminates for the most part the effect of displacement on the estimates of the total fertility rate, because fifteen years of births correspond to children age 0-14 at the time of the survey, implying that misreporting of children's ages within this age group has virtually no effect on the estimated number of births during the previous fifteen years. Displacement can only occur if children are moved across the age boundary at age 15. The fact that there is not much heaping on age 15 in either survey suggests that the net number of children who are erroneously moved across this age boundary is small. Moreover, the number of such children is quite small as a proportion of the total number of children age 0-14.

But misreporting of women's ages distorts ASFRs even when they are calculated for the entire 15-year period. The age curve of fertility is still shifted to the right. Because there is not much fertility after age 40, and very little after age 45, the shift to the right has very little effect on the estimates of the total fertility rate, inasmuch as ASFRs still add up to approximately the same number. Therefore, our estimates of the total fertility rate for the 15-year period preceding each survey are affected very little by either displacement or misreporting of women's ages, and we consider that these estimates of the TFR are reasonably accurate.

By plotting the estimates of the total fertility rate for the two 15-year time periods at the midpoints of those time periods and drawing a line between the two points, we obtain a reasonably accurate estimate of the trend in the total fertility rate over time. The trends so obtained suggest that current fertility is somewhat higher than commonly thought, and that fertility has been declining somewhat more slowly than commonly thought. Our best estimates indicate that, between 1977 and 1995, the TFR declined from 5.80 to 4.95 in the country as a whole, from 5.82 to 5.17 in rural areas, and from 4.98 to 3.22 in urban areas. By education, the TFR declined from 5.84 to 5.34 among women with no education, from 4.76 to 4.57 among women with at least some primary education, and from 3.63 to 2.67 among women with more than a primary education.

The total fertility rate can be calculated not only from ASFRs (TFR) but also from parity progression ratios (TFR_p). The trend in total fertility is about the same, regardless of whether TFR or TFR_p is used as the measure of total fertility. By residence, however, the TFR measure indicates that total fertility has been falling considerably faster in urban areas than in rural areas, whereas the TFR_p measure indicates that fertility has been falling at about the same rate in urban areas and rural areas. The TFR measure also indicates that total fertility has been falling faster among illiterate women than among women with a primary education, and fastest among women with more than a primary education, whereas the TFR_p measure indicates that total fertility has been falling at about the same rate in the first two education groups and fastest in the third. These differences between the results based on the TFR and the results based on TFR_p require further investigation.

The results indicate that, between 1982 and 1986 in the country as a whole, period parity progression ratios changed little in the case of transitions from birth to marriage, marriage to first birth, and first to second birth; fell sharply in the case of transitions from second to third birth and third to fourth birth; changed little in the case of transitions from fourth to fifth birth and fifth to sixth birth; and fell sharply in the case of transitions from sixth to seventh birth and from seventh or higher order birth to next birth.

Appendix

Table A1 Equations for calculating linear trend estimates of TFRs

Characteristic	Equation for TFR
Total	9.4580 - 0.0472 T
Residence	
Urban	12.5971 - 0.0982 T
Rural	8.6162 - 0.0361 T
Education	
No education	8.0222 - 0.0281 T
Primary	5.5899 - 0.0107 T
Beyond primary	7.7698 - 0.0534 T

Note: Linear trend estimates of TFRs for particular calendar years are calculated by substituting a calendar year for T in the equations. When doing so, only the last two digits of the calendar year are used (e.g., 77.5 is used in place of 1977.5).

Table A2 Equations for calculating linear trend estimates of PPPRs, TFR_p, and $TMFR_p$

Fertility measure	Equation for PPPRs, TFR_p, and $TMFR_p$
PPPRs	
B→M	1029.6809 - 0.7092 T
M→1	1023.1206 - 0.4728 T
1→2	920.8794 + 0.4728 T
2→3	1415.4468 - 5.6738 T
3→4	1785.2128 - 10.6383 T
4→5	943.4823 - 1.8913 T
5→6	812.6809 - 0.7092 T
6→7	1377.9291 - 7.5650 T
7+→8+	1159.0071 - 5.9102 T
TFR_p	11.8093 - 0.0757 T
$TMFR_p$	11.9893 - 0.0757 T

Note: Linear trend estimates of PPPRs, TFR_p, and $TMFR_p$ for particular calendar years are calculated by substituting a calendar year for T in the equations. When doing so, only the last two digits of the calendar year are used (e.g., 82.5 is used in place of 1982.5). The PPPRs generated by these formulae are in decimal form (i.e., they are not multiplied by 1,000).

Table A3 Equations for calculating linear trend estimates of TFR_p and $TMFR_p$ by residence and education

Characteristic	Equation for TFR_p	Equation for $TMFR_p$
Residence		
Urban	9.6681 - 0.0709 T	15.5338 - 0.1324 T
Rural	11.1269 - 0.0662 T	10.8757 - 0.0615 T
Education		
No education	10.3845 - 0.0567 T	10.9157 - 0.0615 T
Primary	9.2445 - 0.0567 T	11.7161 - 0.0827 T
Beyond primary	10.5717 - 0.0851 T	10.8517 - 0.0851 T

Note: Linear trend estimates of TFR_p and $TMFR_p$ for particular calendar years are calculated by substituting a calendar year for T in the equations. When doing so, only the last two digits of the calendar year are used (e.g., 82.5 is used in place of 1982.5).

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