

Chapter 5

**FERTILITY, POPULATION GROWTH, AND ACCURACY
OF CENSUS ENUMERATION IN PAKISTAN: 1961-1998**

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1. INTRODUCTION

Population censuses in Pakistan have included standard questions on fertility, but relatively little use has been made of the resulting data. The principal reason for this neglect has been a concern over data quality. Some of the estimates derived from previous censuses have been so clearly defective that there has been a general reluctance to invest effort in detailed analysis of the data.

This paper, like the others in this volume, begins with the premise that the census data should be neither accepted nor rejected prior to rigorous evaluation and analysis. To reject the census data as inadequate without thorough evaluation is as much a mistake as to accept it uncritically. There may be much of value in the census data, despite the inevitable imperfections, while at the same time recognizing that it may be more or less severely defective (see Annex 1).

Evaluation of data involves comparisons of statistics derived from one data source with comparable statistics derived from other data sources. Given the situation in Pakistan, where demographic estimation has been authoritatively described as “a treacherous business” [Sathar and Casterline (1998)], a thorough assessment of the 1998 census data on fertility demands comparison of fertility estimates from all available sources.

On making these comparisons, we find that survey based estimates of fertility in Pakistan are quite as problematic as census based estimates – even when the survey includes a full birth history. We have therefore extended the comparisons by testing the consistency of our best estimates of fertility with estimates of mortality and population growth. This comparison is effected by projecting the 1961 census age-sex distribution (adjusted) forward using estimates of age-specific fertility and mortality and comparing the projected population numbers with the numbers enumerated in subsequent censuses.

The 1961 census has been taken as the starting point, rather than the 1981 census, because initial projection comparisons revealed a substantial difference in completeness of enumeration between the 1981 and the 1998 censuses. Only by beginning in 1961 and comparing projected and census numbers for all subsequent censuses is it possible to subject the fertility estimates to a satisfactory test.

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2. Level and Trend of Fertility

Table 5.1 shows total fertility rates (TFRs) for Pakistan from nine data sources, beginning with the National Impact Survey (NIS) of the 1960s and ending with the Pakistan Reproductive Health and Family Planning Survey (PRHFPS) of 2000-2001.

Table 5.1. Total Fertility Rate Estimates for Pakistan, Various Sources

Data Source	Period	Midpoint	TFR	MAC*
National Impact Survey (NIS)	1960-61	1961.0	6.7	29.7
	1962-63	1962.0	6.5	29.4
	1964-65	1963.0	6.6	29.1
	1966-67	1964.0	5.1	27.9
Pakistan Fertility Survey (PFS)	1960-65	1962.5	7.1	29.1
	1965-70	1967.5	7.1	29.0
	1970-75	1972.5	6.3	29.0
Population, Labour Force & Migration Survey (PLM)	1965-70	1967.5	6.9	30.3
	1970-75	1972.5	7.1	30.1
	1975-80	1977.5	6.5	30.0
Population Growth Survey (PGS)	1976	1976.5	7.0	na
	1977	1977.5	6.6	na
	1978	1978.5	6.6	na
Pakistan Demographic and Health Survey (PDHS)	1976-81	1978.5	7.4	30.1
	1981-86	1983.5	7.7	29.8
	1986-91	1988.5	5.4	29.9
Pakistan Demographic Survey (PDS)	1984	1984.5	6.9	30.5
	1985	1985.5	7.0	30.8
	1986	1986.5	6.9	31.0
	1987	1987.5	6.9	30.6
	1988	1988.5	6.5	30.5
	1989	1989.5	6.4	30.3
	1990	1990.5	6.2	30.0
	1991	1991.5	6.0	na
	1992	1992.5	5.8	29.7
	1993	1993.5	5.7	na
	1994	1994.5	5.6	na
	1995	1995.5	5.6	30.0
	1996	1996.5	5.5	29.6
1997	1997.5	5.0	29.9	
1998	1998.5	4.8	na	
1999	1999.5	4.5	na	
2000	2000.5	4.3	30.0	
Pakistan Fertility and Family Planning Survey (PFFPS)	1982-87	1984.5	7.7	30.0
	1987-92	1989.5	7.1	29.9
	1992-97	1994.5	5.3	29.4
1998 Census Births Last Year	1997-98	1997.7	4.5	32.4
Pakistan RH and FP Survey (PRHFPS)	1997-2000	1999.0	4.8	29.6
PFS Average	1960-75	1967.5	6.8	29.0
PLM Average	1965-80	1972.5	6.8	30.1
PDHS Average	1976-91	1983.5	6.8	29.9
PFFPS Average	1982-97	1989.5	6.7	29.8

*Mean Age at Child-bearing

Sources and notes for Table 5.1:

<i>National Impact Survey</i>	Pakistan Population Planning Council (no date). Marital fertility rates from Table 4.4., page 116, and Figure 4.4, page 124, with interpolation between 1960-61 and 1964-65 to give rates for 1962-63 for age groups 35-39, 40-44 and 45-49. Age-specific rates for all women calculated using proportions married calculated from Volume 3, Table 13,k page III-114-115 or 1961 census report
<i>Pakistan Fertility Survey</i>	Alam, Irfan and Farooqui (no date). Table 1, page 52. The 1970-75 rate for the 45-49 age group is imputed to 1965-70 and 1960-65. The 1965-70 rate for the 40-44 age group is imputed to 1960-65.
<i>Population, Labour Force & Migration Survey</i>	Alam, Irfan and Farooqui (no date). Appendix table A.5, page 72. The 1975-80 rate for the 45-49 age group is imputed to 1970-75 and 1965-70. The 1970-75 rate for the 40-44 age group is imputed to 1965-70
<i>Population Growth Survey</i>	Federal Bureau of Statistics, <i>Population Growth Survey</i> reports for 1976 (Table 4.121, page 46), 1977 (Table 4.22, page 41) and 1978 (Table 4.23, page 44). The 1977 report gives a value for 1976 as well, 6.9 children per woman, with a note that this differs from the value given in the 1976 report because the latter included births to women under age 15 with the 15-19 group and births to women over age 50 with the 45-49 age group.
<i>Pakistan Demographic and Health Survey</i>	Pakistan National Institute for Population Studies (1992), Table 4.5, page 42. The 1986-91 rate for the 45-49 age group is imputed to 1981-86 and 1976-81. The 1981-86 rate for the 40-44 age group is imputed to 1976-81. The notes to the table indicate that the last two rates shown for each period are partially truncated. There is no indication of why the next to last rate is truncated, which would not ordinarily be the case.
<i>Pakistan Demographic Survey</i>	Pakistan Federal Bureau of Statistics (1987-2002). Table 4.16, page xviii, for 1984; Table 4.16, page XLVI, for 1985. Table 4.16, page XLVI, for 1986. Table 4.16, page XXXIV, for 1987. Table 4.16, page 51, for 1988. Table 4.15, page 48, for 1989. Table 4.14, page 51, for 1990; Table 4.14, page 41, for 1991; Table 4.41, page 41, for 1992; Table 4.14, page 43, for 1995 and 1996; Table 4.14, page 43, for 1997; Table 4.13, page 38, for 1999 and 2000 (2000 report). The reports containing values for 1993-1994 and 1998 were not available, so these values were linearly interpolated from surrounding years.
<i>Pakistan Fertility and Family Planning Survey</i>	Hakim, Cleland and Bhatti (1998). Table 6.5a, page 120. The 1992-96 rate for the 45-49 age group is imputed to 1987-91 and 1982-86. The 1987-91 rate is imputed to 1982-86.
<i>Pakistan Reproductive Health and Family Planning Survey</i>	Hakim, Sultan and Faateh ud din (2001). Table 4.6a, page 49. This survey collected data on the most recent three births to each woman, which was used to calculate age-specific birth rates for the four year period preceding the survey.

The National Impact Survey shows estimates for four two-year periods during the early 1960s. The first three estimates indicate a median TFR of 6.6 children per woman, whilst the fourth indicates an impossibly sharp decline to 5.1 children per woman in the space of two years.

The next survey, the 1975 Pakistan Fertility Survey (PFS), collected a complete birth history and so provides estimates for the three five-year periods preceding the survey. The estimates for 1960-65 and 1965-70 indicate a level of 7.1 children per woman, higher than the overall level indicated by the NIS, and 2 children per woman higher than the NIS estimate for 1966-67. The fertility decline shown by the NIS is not confirmed by the PFS. The PFS estimates show a substantial decline beginning after 1970, however, from 7.1 children per woman in 1965-70 to 6.3 children per woman in 1970-75.

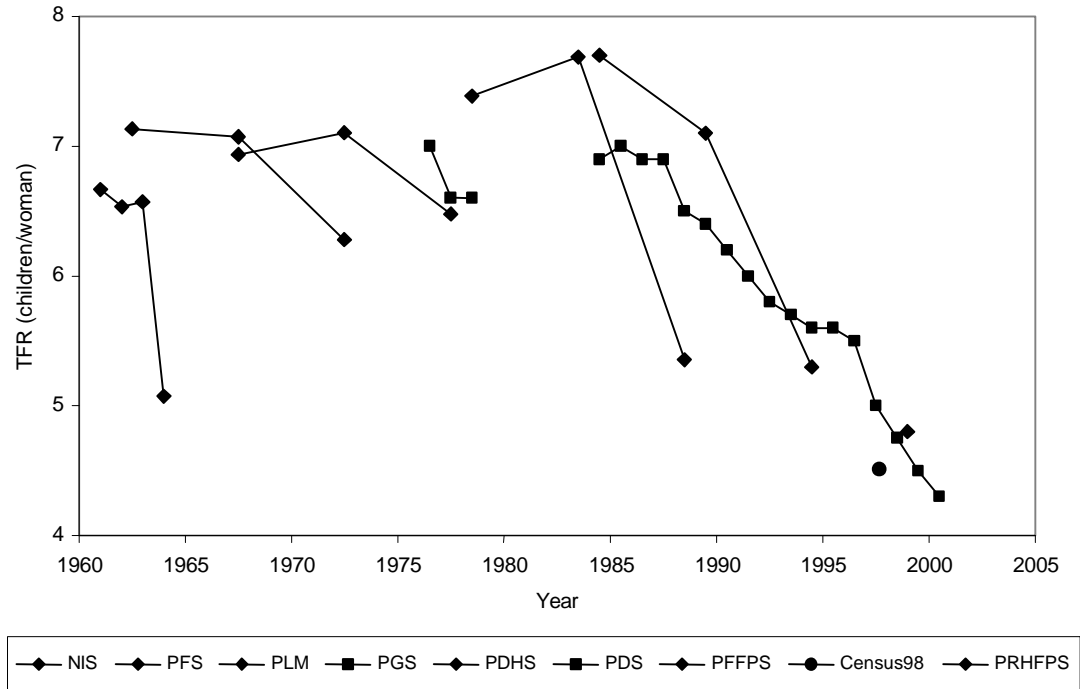
The fertility decline indicated by the PFS is not confirmed by the next survey, the 1980 Population, Labour Force and Migration Survey (PLM). Indeed, the PLM shows a slight increase

during the period for which the PFS shows a decline. The PLM estimates show a decline between 1970-75 and 1975-80, however, from 7.1 to 6.5 children per woman.

The decline indicated by the PLM receives some weak confirmation from the PGS estimates for 1976-78, but none whatsoever from the next birth history survey, the 1991-92 Pakistan Demographic and Health Survey (PDHS). The PDHS gives estimates for 1976-81 and 1981-86 of 7.4 and 7.7 children per woman, respectively, higher than any of the earlier estimates. The PDHS indicates another impossibly rapid decline in fertility between 1981-86 and 1986-91, 2.3 children per woman in a mere 5 years. It is hardly necessary to note that this decline is not confirmed by any subsequent survey.

The next birth history survey, the 1997 Pakistan Fertility and Family Planning Survey (PFFPS), shows the level of fertility declining from 7.7 children per woman for 1982-8 to 7.1 children per woman for 1987-92 to 5.3 children per woman for 1992-97. There is no subsequent comparable birth history fertility survey to confirm or refute this decline, but it also is impossibly rapid (see Figure 5.1).

Figure 5.1: Total Fertility Rate Estimates for Pakistan, Various Sources



The pattern of the estimates from the birth histories is clear: the estimates for the 5 year period preceding the survey are always too low. Why should this be? An obvious hypothesis is that the birth dates of many children born during the 5 years preceding the survey are misreported to dates for earlier periods, resulting in too few births during the first 5 year period and too many in earlier periods.

Suppose that this hypothesis is correct, but that the total number of births reported in the birth histories is approximately correct, and that there is minimal misreporting of birth dates of children born during the 15 years prior to the survey to earlier years. In this case the level of fertility indicated by the surveys for the 15 year period prior to the survey interviews will be approximately correct.

Calculating averages of the three estimates provided by each of the four surveys provides striking support for these suppositions. The averages for the PFS, the PLM, the PDHS and the PFFPS are, respectively, 6.8, 6.8, 6.8 and 6.7 children per woman. This nearly perfect consistency lies in stark contrast to the massive inconsistencies in the estimates for 5 year periods and provides powerful evidence that the level of fertility in Pakistan was essentially constant at 6.8 children per woman from 1960 through at least the mid-1980s.

Further evidence in support of this conclusion is provided by children ever born data. Table 5.2 shows average numbers of children ever born to women aged 15-19 through 45-49 from six different data sources, from the 1984-85 Pakistan Contraceptive Prevalence Survey to the 2000-01 PRHFPS. Average children ever born to women 45-49 at any given point in time approximates the total fertility rate at the time these women were at their mean age at childbearing. Given a value for the mean age at childbearing, the data in Table 5.2 provide a check of the fertility level indicated by the estimates in Table 5.1.

Mean ages at childbearing (MACs) are shown in the right most column of Table 5.1. In some cases the age-specific rates from which the TFRs are derived are not available. In these cases the MAC is not available. The median MAC overall values shown is 30.0 years. The values for the first two surveys, the NIS and the PFS, (median 29.1 years) are somewhat lower than the values for the following surveys (median 30.1 years), but there is a clear suggestion in the later surveys of a decline over the last 30 years. For present purposes these variations are negligible and the dating calculation may be made on the assumption of a mean age at childbearing of 30 years.

The average numbers of children ever born to women 45-49 in each of the surveys shown in Table 5.2 therefore refers to the time of the survey minus the difference between the (1) mid-point of the age group, 47.5 years, and (2) the mean age at childbearing, 30 years. Since the surveys were taken between 1984 and 2000, they provide estimates of total fertility for the years 1966 through 1982. The median number of children ever born to women aged 45-49 years is 6.8 children per woman, consistent with the level indicated by the TFRs in Table 5.1.

The mean ages at childbearing shown in Table 5.1 provide further indirect evidence on the level and trend of fertility prior to the late 1980s. There is substantial evidence that mean age at marriage for females rose during this period (see the nuptiality paper by Soomro in this volume). Rising age at marriage may result in fertility decline as a result of the “tempo” effect discovered nearly half a century ago by Ryder [see Bongaarts and Feeney (1998) for details and references]. It is not rising age at marriage *per se* that depresses fertility, however, but rising mean age at childbearing. When fertility is high, rising age at marriage may raise the ages at which first births occur without having much effect on the overall mean age at childbearing. In the case of Pakistan, the MAC values in Table 5.1 show no evidence of an increase that would significantly effect the level of fertility. They therefore

provide indirect support for the conclusion that fertility was approximately constant prior to the late 1980s.

Table 5.2: Average Children Ever Born to Women by Age, Various Sources

Age Group	1984-85 PCPS	1990-91 PDHS	1994-95 PCPS	1996-97 PFFPS	1998 Census	2000-01 PRHFPS	Median
15-19	0.15	0.2	0.13	0.11	0.16	0.10	0.14
20-24	1.25	1.0	1.27	1.02	1.08	0.88	1.05
25-29	3.12	2.6	3.07	2.75	2.60	2.41	2.68
30-34	4.79	4.3	4.71	4.62	3.92	4.29	4.46
35-39	5.97	5.5	6.10	5.58	4.89	5.33	5.54
40-44	6.74	6.3	6.89	6.43	5.58	6.40	6.42
45-49	6.96	6.4	6.93	7.17	5.87	6.74	6.84

Sources:

1984-85 PCPS	Pakistan Contraceptive Prevalence Survey, Table 8, page 48 for children ever born to currently married women. Marital status information not being provided in this report, proportions of currently married women are taken from the 1994-95 PCPS.
1990-91 PDHS	<i>Pakistan Demographic and Health Survey 1990/1991</i> , Table 4.7, page 44. The report presents values rounded to the nearest 0.1.
1994-95 PCPS	Pakistan Contraceptive Prevalence Survey 1994-95, Table 7.2, page 117, for children ever born to currently married women, Table 4.1, page 56, for proportion of currently married women.
1996-97 PFFPS	<i>Pakistan Fertility and Family Planning Survey 1996-97</i> , Table 3.1, page 20.
1998 Census	The values shown here are from a special tabulation of the 1998 census data produced for this project. The children ever born data published in the census reports are incorrect due to a problem with data processing.
2000-01 PRHFPS	Pakistan Reproductive Health and Family Planning Survey 2000-01, Table 4.1, page 44.

Note: Where children ever born are given only for currently married women, values for all women are calculated by multiplying by the proportion of currently married women.

The three remaining data collection operations show beyond any reasonable doubt that fertility decline in Pakistan began in the late 1980s and proceeded rapidly through 2000, the most recent year for which data is available. The most important evidence comes from the Pakistan Demographic Survey (PDS), an annual survey initiated in 1984. In the early years, PDS sample households were visited at quarterly intervals and information on births and deaths during the six months prior to the interview were recorded. The reports on events for the earlier 3 of the 6 months were then matched against the reports for the same period from the preceding survey. Later this scheme was modified to 2 visits per year with a 6 month recording period.

The PDS estimates of total fertility rate for 1984 through 1987 show an average level of 6.9 children per woman, 0.1 children per woman higher than the constant level indicated for earlier years by the four preceding birth history surveys. This in combination with the preceding analysis provides strong evidence against under-reporting of births in the PDS during these years.

The PDS estimates for 1988-2000 indicate a rate of decline of nearly 2 children per woman. This is extraordinarily rapid and suggests that completeness of birth reporting in the PDS may have deteriorated in recent years. One looks with particular suspicion at the discontinuity between 1996 and 1997 and the subsequent rapid decline. On the other hand, the level of fertility indicated by the PDS during the late 1990s is broadly confirmed by the two remaining data sources, the 1998 census and the Pakistan Reproductive Health and Family Planning Survey (PRHFPS).

3. Fertility, Mortality and Intercensal Population Change: 1961-1998

The fertility estimates of the preceding section may be tested by using them to project the 1961 census population forward and comparing the projected numbers of females and males with subsequent census counts. The projection will begin with the 1961 census and will advance to 2001 in five year steps. It will therefore require as input levels of fertility and life expectancy at birth for males and females for the five year periods 1961-65, 1966-70, ..., 1996-2000. Projected age-sex distributions and corresponding population totals as of the 1972, 1981 and 1998 censuses will be interpolated using the projected female and male population growth rates.

Estimates of life expectancy at birth for 1984-2000 derived from the PDS data are given in the mortality paper by Arshad Mahmood. These indicate a slight overall *decline* in life expectancy at birth during this period. Though the general level indicated by the estimates appears to be approximately correct, the precise levels are erratic, perhaps because of the relatively small numbers of deaths on which they are based. In view of this the average level of the male and female estimates for the years 1986-2000 may be used to estimate the level for the periods 1986-90, 1991-95 and 1996-2000. Estimates of female and male life expectancy at birth for 1961-65 through 1981-85 have been derived by linear interpolation and extrapolation from Blacker's estimates for 1972-81 [Blacker (1984): Table 7, page 11] and 1984-86 [Blacker, no date: Table 12, page 12].

The projection must account for international migration as well, but in view of the limited data available this is better done in the interpretation of the results than in the calculation of projected numbers. Key projection results are shown in Table 5.3. The levels of fertility and female and male life expectancy at birth for each projection period are shown in the lower panel of the table. A sex ratio at birth of 105 males per 100 females has been used. Female and male survival ratios are derived from the life expectancies at birth using the United Nations' general model life table family.

The upper panels of Table 5.3 compare census and projected numbers for females, males, and both sexes. Females and males are shown separately on the grounds that the former were probably less affected by international migration. The 1998 census enumerated 63.5 million females. The corresponding projected number, 63.8 million, exceeds the census number by 0.3 million, or 0.5 percent. This is remarkably good agreement, given the possibility of differential completeness of enumeration in the two censuses, the possibility of errors in the estimated levels of fertility and life expectancy at birth, and the possibility that international migration has confounded the comparison.

For males, the projected number falls short of the census number by 0.6 million, or 0.9 percent. This again is remarkably good agreement.

4. Accuracy of Enumeration in the 1961, 1972, 1981 and 1998 Censuses

The close agreement shown in Table 5.3 between the census and the projected total population numbers for 1998, 132.4 and 132.1 million persons, respectively, suggests that the accuracy of enumeration in the 1998 census was similar to the accuracy of enumeration in the 1961 census. Similarly, the close agreement in the percent difference between the census and projected numbers for 1972 and 1981, 11.0 percent and 10.2 percent, respectively, suggests that the accuracy of enumeration in the 1972 and the 1981 censuses was similar. The latter conclusion is consistent with Blacker's (c. 1988) analysis of population change between these two, that the 1972 and 1981 counts were high relative to the 1961 and 1998 counts.

Could the apparent disparity in accuracy of enumeration between the 1961 and 1972 censuses be accounted for by errors in the estimated levels of fertility and mortality or by net international migration? The fertility and mortality explanations are easily ruled out. To bring the projected number of females for 1972 up to the level of the 1972 census number, for example, it would be necessary to raise the intercensal total fertility rate from 6.8 to 8.8 children per woman, or to raise intercensal life expectancies at birth by over 14 years to an average level of nearly 60 years.

International migration may be similarly ruled out as an explanation, for it would require that the 1972 population gained 2.6 million females and 3.8 million males as a result of international migration between 1961 and 1972. While there was doubtless some international migration between the 1961 and 1972 censuses, and this may have resulted in a net gain to the population of Pakistan, so large a gain is beyond plausibility.

By elimination, then, we conclude that differential accuracy of enumeration in the 1961 and the 1972 censuses must indeed be the principal reason for the discrepancy between the census and the projected numbers for 1972.

Similar remarks apply to the discrepancy between the 1981 and the 1998 censuses. Errors in the estimated levels of fertility and mortality and international migration are unlikely to account for more than a small portion of the discrepancy. To account for the discrepancy by changing the fertility estimates, for example, fertility decline would have to have begun in the early 1980s and would have to have reached 3.7 children per woman for the 1996-2000 period. This would imply that the 1998 census, the 2000-2001 Pakistan Reproductive Health and Family Planning Survey, and the PDS all *over*-estimated fertility by about one child per woman. To account for the discrepancy by changing the mortality estimates, it would be necessary to lower life expectancy at birth to below 50 years. For international migration to account for the discrepancy, nearly 8 million persons, net, would have to have left the population.

Table 5.3: Projection from 1961 to 1998 Based on Estimated Trends of Fertility and Mortality (numbers in thousands)

Year	Census	Projected	Difference	Percent Difference	Growth Rates	
					Census	Projected
Both Sexes						
1961	42,880	42,880	0	0.0	na	na
1972	65,309	58,840	6,469	11.0	3.62	2.72
1981	84,254	76,429	7,825	10.2	3.01	3.09
1998	132,352	132,074	278	0.2	2.65	3.22
Males						
1961	22,960	22,960	0	0.0	na	na
1972	34,833	31,013	3,820	12.3	3.59	2.59
1981	44,233	39,945	4,287	10.7	2.83	2.99
1998	68,874	68,269	604	0.9	2.60	3.15
Females						
1961	19,921	19,921	0	0.0	na	na
1972	30,476	27,828	2,649	9.5	3.66	2.88
1981	40,021	36,484	3,537	9.7	3.22	3.20
1998	63,479	63,805	-326	-0.5	2.71	3.29

Period	Total Fertility Rate	Life Expectancy at Birth		Projected Population (both sexes)		
		Female	Male	Ending Population	Growth Rate	Population Sex Ratio
1966-70	6.80	47.1	47.7	56,038	2.8	113.4
1971-75	6.80	50.8	51.1	65,135	3.0	111.9
1976-80	6.80	54.5	54.5	76,429	3.2	110.6
1981-85	6.80	58.2	57.9	90,617	3.4	109.5
1986-90	6.60	61.4	60.5	107,793	3.5	108.6
1991-95	5.70	61.4	60.5	125,197	3.0	107.8
1996-2001	4.80	61.4	60.5	142,310	2.6	107.2

Notes:

- 1 Numbers in "Census" column in upper two panels give the female population of Pakistan, including FATA, at each census. The census dates for the 1961-1998 censuses are, respectively, 1 February, 16 September, 1 March and 5 March.
- 2 The 1961 census female and male age distributions were smoothed and extended to 100+ by fitting a stable population. They were also inflated to include FATA.
- 3 Projected population is calculated at five year intervals from 1 February 1961. Projected numbers of persons at the times of subsequent censuses calculated by exponential interpolation using growth rates calculated from the projected population.
4. See text for further discussion and explanation.

In summary, then, the census-projection comparisons point to three conclusions.

- ?? The 1961 and the 1998 censuses enumerated the population with approximately equal accuracy.
- ?? The 1972 and the 1981 censuses also enumerated the population with approximately equal accuracy.

?? The accuracy of enumeration in 1961 and 1998 differed from the accuracy of enumeration in 1972 and 1981 by approximately 10 percent, with the 1961 and 1998 censuses indicating a smaller population and the 1972 and 1981 censuses a larger population.

These conclusions are peculiar indeed. It is not particularly remarkable that the 1972 and 1981 censuses should have similar accuracy of enumeration. It is more surprising that the 1961 and 1998 censuses, being so far separated in time and taken under what were evidently very different conditions, should have similar accuracy of enumeration. That both of these conclusions should be true while, at the same time, the level of total population indicated by the 1961 and 1998 censuses should be approximately 10 percent below the level in the 1972 and 1981 censuses is little short of bizarre. Nonetheless, these conclusions are in our judgment the most plausible explanation of the evidence available at the present time.

From a purely logical point of view, the observed differences between the census and projected population numbers in Table 5.3 could be accounted for by (1) accurate enumeration in the 1972 and 1981 censuses and approximately 10 percent under-enumeration in the 1961 and 1998 censuses, (2) accurate enumeration in the 1961 and 1998 censuses and approximately 10 percent over-enumeration in the 1972 and 1981 censuses, or (3) any combination of under-enumeration in the 1961 and 1998 censuses and over-enumeration in the 1972 and 1981 censuses that gives a 10 percent difference in level between (a) the 1961 and 1998 censuses and (b) the 1972 and 1981 censuses.

Under normal circumstances, population censuses do not over-enumerate their target populations. It is well known, however, that the 1998 population census in Pakistan was originally scheduled for 1991 and that the delay resulted from the discovery of gross overstatements of population in the pre-1991 census house listing operation [Khan (1998)]. Detailed statistical evidence of these overstatements is given in the paper by Aslam Chaudhry. This makes the second and third explanations more plausible than they would otherwise be, but it obviously does not establish that the 1972 and 1981 censuses over-enumerated the population.

Census evaluation surveys were carried out following the 1972 and 1981 censuses, but they were not designed to detect, and probably could not detect, exaggeration in the census returns. Indeed, they indicated an overall under-enumeration of between 5 and 10 percent. They do not therefore shed any light on the crucial question of the extent of over-enumeration, if any, in the 1972 and 1981 censuses.

As noted in the chapter on census methodology by Aslam Chaudhry, two assessments of the accuracy of enumeration in the 1961 census were undertaken. The post-enumeration quality check (PEQC) estimated a net over-enumeration of 0.4 percent. The evaluation conducted by the Pakistan Institute of Development Economics (PIDE) estimated a net under-enumeration from 6.2 to 12.4 percent. Neither evaluation was based on a nationally representative sample, and the range of results indicates the difficulty of estimating accuracy of enumeration for this census.

Whatever the accuracy of enumeration for the 1961 census, the analysis presented here implies a similar accuracy for the 1998 census. If the 1961 census omitted 5 percent of the population, for example, the 1998 census must have omitted approximately 5 percent of the population as well. The

relative over-enumeration of the 1972 and 1981 censuses relative to the 1961 and 1998 censuses would in this case fall from approximately 10 percent to approximately 5 percent. If net omission in the 1961 census were as high as 10 percent, the relative over-enumeration of the 1972-1981 censuses relative to the 1961 and 1998 censuses would fall to zero, but the implied net under-enumeration in the 1998 census would rise to 10 percent as well.

It should be emphasized that all of these possibilities are equally consistent with the estimates of fertility, mortality and population growth presented in Table 5.3. The main features of these estimates are regarded with considerable confidence including the pattern of the trends in fertility and mortality and the consequent trend of the population growth rate. It is only total population size at each census that is uncertain, this on account of the uncertainties about the accuracy of the four census enumerations.

It is possible that a more extensive analysis of available evidence could shed further light on this issue, but it is perhaps equally likely that the problematic nature of the evidence means that the question will never be satisfactorily resolved. The best chance for resolution will undoubtedly be a future population census enumeration, carried out with rigorous measures to detect and control any tendencies to over-enumeration and followed by a census evaluation survey to measure under-enumeration.

5. Implications for the Trend of Population Growth Rates

These conclusions on the relative accuracy of enumeration for the past four censuses imply three conclusions about population growth rates.

- ?? The intercensal growth rate calculated from the 1961 and 1972 census counts is too high.
- ?? The intercensal growth rate calculated from the 1981 and 1998 censuses is too low.
- ?? The intercensal growth rate calculated from the 1972 and 1981 censuses is approximately correct.

In fact, the observed decline in intercensal growth rates, from 3.6 to 3.1 to 2.6 percent for the periods 1961-1972, 1972-1981 and 1981-1998, is an artifact of these differences in accuracy of census enumeration. When the difference in accuracy of enumeration between the 1961 and 1998 censuses and the 1972 and 1981 censuses is accounted for, the intercensal growth rates *increase* from 2.7 to 3.1 to 3.2 percent, as shown in the rightmost column of the third panel of Table 5.3.

The trend of the population growth rate in Pakistan since 1961 may be seen more clearly in the last panel of Table 5.3, which shows growth rates for five year projection periods from 1961-65 through 1996-2001. The growth rate rose from 2.6 percent per annum to 3.5 percent per annum between 1961-65 and 1986-90 and then declined to 3.0 percent for 1991-95 and to 2.6 percent for 1996-2000. The rise between 1961 and the late 1980s was the consequence of rising life expectancy at birth and constant fertility. The subsequent decline was the consequence of declining fertility and stagnating life expectancy at birth.

6. The Rate of Fertility Decline

Comparisons with fertility declines in countries around the world show the extraordinary rapidity of the fertility decline indicated by the Pakistan Demographic Survey. The rate of decline in the total fertility rate is conveniently measured in children per woman per decade. If fertility declines at a rate of 1 child per woman per decade, for example, a transition from 6-7 to 2 children per woman takes 40-50 years. At 2 children per woman per decade, a fertility transition may occur in as little as 20 years.

Figure 5.2 shows fertility trends in 12 developing countries for the period 1950-2000. Each decline is fit by a straight line to obtain a rate of decline in children per woman per decade, which values are indicated in parentheses following the country name. The countries are ordered by rate of decline, from most rapid (China, at 2.6 children per woman per decade) to least rapid (India, 0.8 children per woman per decade). The countries shown are broadly representative of rates of fertility decline over an extended period.

Rather remarkably, most of the fertility declines are linear and so are well fit by a straight line and well described by a simple rate of decline. Once underway, fertility declines tend to continue without interruption down to or below replacement level. Malaysia is the principal exception, and systematic, if not large, departures from linearity are observed in Mexico, Egypt and Sri Lanka.

Pakistan's rate of decline, at 1.8 children per woman per decade, is second only to China's and nearly the same as Thailand's. The occurrence of rapid declines in two Muslim countries, Tunisia and Morocco, is notable.

Malaysia provides a cautionary warning. Fertility declined rapidly for 15 years, as it has in Pakistan, only to level off for 10 years and resume decline at a much slower rate. It is possible that the same could happen in Pakistan.

7. Conclusion

Fertility decline in Pakistan finally began in the late 1980s and has proceeded rapidly at least through 2000, the most recent year for which data is available. It is possible, perhaps even likely, that the speed of decline has been exaggerated by under-reporting of births in the Pakistan Demographic Survey during the second half of the 1990s. We have found no evidence of substantial underreporting, however, and even substantial under-reporting would leave a very rapid decline. From 1961 through the late 1980s there appears to have been little if any change in the level of fertility. All evidence points to a level of 6.8 children per woman during this period.

The most important evidence of fertility decline comes from the Pakistan Demographic Survey, which seems not to have received the recognition (or the dissemination) that it merits. Equally notable is the abysmal performance of the birth history fertility surveys as instruments for measuring the level and trend of fertility. It would be useful to know in more detail why the birth history surveys have performed so poorly, for they are important sources of many different kinds of information and their poor performance in one area casts a cloud of doubt on the validity of their results in other areas.

Figure 5.2. Fertility decline in selected countries, 1950-2000, with straight fit for rate of decline (children/woman/decade), ordered by rate of fertility decline, fastest to slowest.

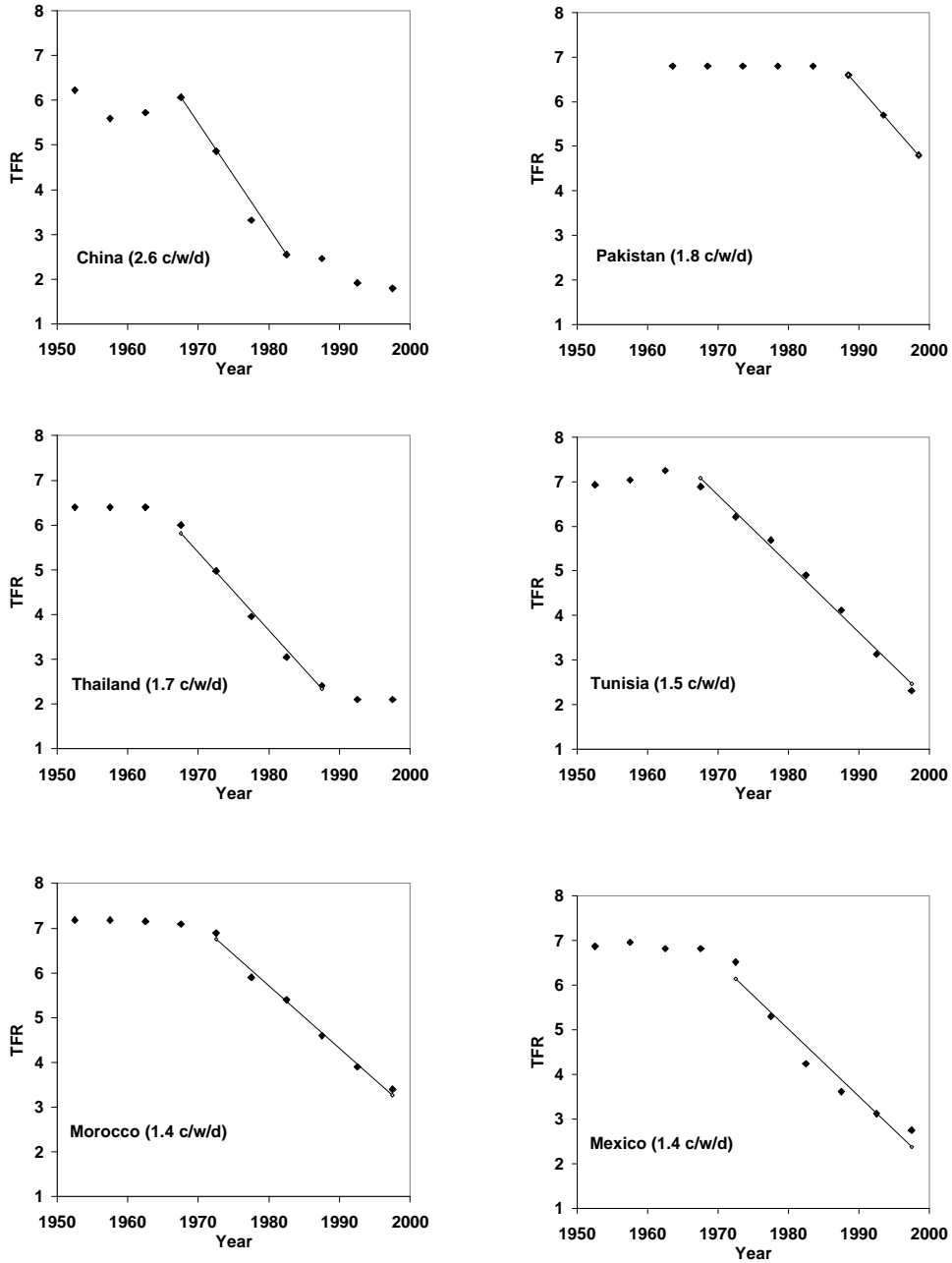
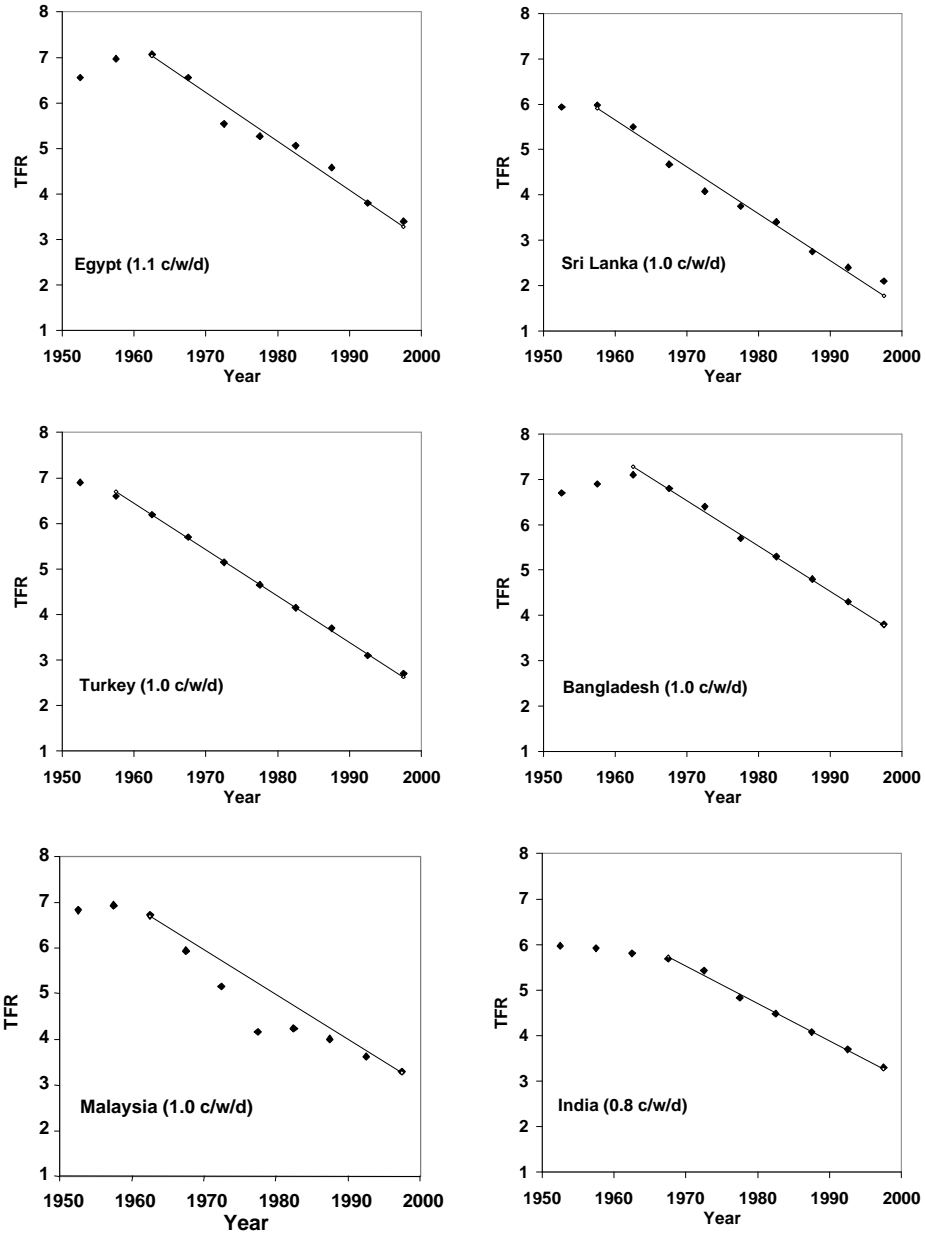


Figure 5.2. Fertility decline in selected countries, 1950-2000, *concluded*.



Source: Table 5.3 (for Pakistan) and United Nations (2000).

The rate of population growth in Pakistan was rising — *not* declining, as indicated by the intercensal growth rates — from the early 1960s through the late 1980s. This is consistent with the constant fertility and rising life expectancy at birth during this period. When fertility began to decline in the late 1980s, so did the population growth rate. The decline in the population growth rate was accelerated by the stagnation of life expectancy at birth, which remained approximately constant between the late 1980s and 2000.

It is encouraging that fertility and the population growth rate in Pakistan have finally begun to decline, but it should be pointed out that the fall in the growth rate since the late 1980s has only cancelled out the rise that occurred over the preceding decades. Reckoned purely in terms of the level of the population growth rate, Pakistan in the late 1990s stood exactly where it stood in the early 1960s.

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Annex 1**Evaluation of the 1998 Population Census Data on Fertility**

The 1998 population census of Pakistan included questions on number of male and female children ever born (items 23-26 on the long form) and on the number of male and female births during the 12 months prior to the census date as well as the number of these births surviving at the time of the census (items 27-30 on the long form). These questions were asked of a sample of ever married women 15-49 years of age in the North West Frontier Province (NWFP), Punjab, Sindh, Balochistan and Islamabad. The sample represented about 8.8 percent of the total enumerated population of 129,175,948 persons in these provinces. No information has been provided on the design or implementation of the sample. These questions were not asked in FATA (enumerated population 3,176,331 persons), the Northern Territories, or Azad Kashmir.

Births During the 12 Months Prior to the Census

Tabulations derived from the births in the last 12 months questions are given in Table 33 of the census publications, which show total number of ever married women in standard five year age groups together with the total number of male and female children born to these women during the last 12 months and the numbers of these male and female children living at the time of the census.

Accuracy of Birth Reporting: The total fertility rate (TFR) calculated from the 1998 census births last year data is 4.5 children per woman. To assess the accuracy of this value we compare it with values from other sources.

The Pakistan Demographic Survey (PDS) gives a value of 5.0 children per woman for 1997 (Table 5.1). Since this is for calendar year 1997, rather than for the 12 months preceding the census date (March 1), some downward adjustment is required for comparison with the births last year data. Based on the rate of change indicated by the PDS estimates for 1997 and 1998, $5.0 - 4.8 = 0.2$ children per woman per year, the $1997.7 - 1995.5 = 0.2$ year difference in the reference periods of the rates implies a downward adjustment of $0.2 \times 0.2 = 0.04$ children per woman. If the adjusted PDS TFR of $5.0 - 0.04 = 4.96$ children per woman is accepted as correct, the census TFR or 4.5 children per woman is low by 9 percent.

If the PDS level is too low, the implied level of omission would of course be higher. Comparing the estimate from the Pakistan Reproductive Health and Family Planning Survey (PRHFPS) with the PDS estimates (Table 5.1) indicates that the PDS estimates (average of 1999 and 2000) are about 8 percent below the level given by the PRHFPS, 4.4 as compared with 4.8 children per woman. Accepting the PRHFPS estimate as correct, this would imply an omission of about 16 percent in the births last year data.

If the PRHFPS estimate is too low, omission in the births last year data might be 20 percent or more. Given the general agreement between the 1998 census, the PDS and the PRHFPS, however, it

is reasonable to expect that the highest level of fertility indicated by these three sources is approximately correct.

It is of course possible that the true level of fertility is substantially higher even than the PRHFPS estimate. The biases of earlier birth history fertility surveys provide some basis for suspecting this. On the other hand, the agreement between various sources during the late 1990s is fairly good, as compared with the severe discrepancies between estimates in earlier years, and differences in the way the birth history was implemented in the PRHFPS may have minimized the errors experienced in earlier surveys.

In any case, we have at this point reached the limit of what can be concluded with currently available data. If omission in the 1998 census births last year estimate was more than 15-20 percent, we will have to await evidence from future data collection operations to establish this conclusion.

On present evidence, then, the births last year data from the 1998 census probably omitted 15-20 percent of all births. Since the TFR indicated by the census is lower than that of the TFRs indicated by the PDS or the PRHFPS estimates, the census births last year data contributes little to our knowledge of the level of fertility at the national level during the late 1990s. We would draw the same conclusion about the level of fertility at the national level if the census data did not exist, and with only slightly less confidence.

We hasten to add that the most of the value of census data lies not in its provision of estimates at the national level, which may be obtained far more inexpensively by population surveys. The value of census data lies mainly in its provision of estimates for subnational units, especially small subnational units, for which surveys either give unacceptably large sampling errors or no information at all.

The important issue, therefore, is the value of the census data at the subnational level, and this depends on the extent to which errors in census estimates are consistent across subnational units. For if the level of omission is reasonably uniform, comparison of national (and perhaps provincial) level estimates from the census with estimates from other sources may be used to develop one or more correction factors than may be applied to data for smaller units.

Unfortunately, assessing the variability of completeness of reporting for smaller units and population subgroups is problematic precisely because there are relatively few alternative sources on which to base assessments. Desirable as it would have been to do so, it was not possible pursue to work for this paper.

Age Pattern of Fertility: Examination of the data on births during the year prior to the census shows severe distortions in the age pattern of fertility, with numbers of births to older women heavily overstated with respect to births to younger women. The pattern is most pronounced in Sindh province. It is likely that the distortion in the age pattern of fertility reflects age misreporting errors, which are serious in the 1998 census as in earlier censuses, as much as it reflects poor reporting of births in the year prior to the census. Improving the quality of reporting to the births last year questions might therefore be insufficient to improve the quality of this data to the point of usability. In any case, the distortions in the age pattern of fertility in the births last year data rule out application of the P/F ratio method.

Children ever born data

Tabulations derived from the children ever born data are given in Table 29 of the census publications, which show numbers of ever married women in standard five year age groups with 0, 1, ..., 5 and 6 or more children ever born and total male and female children born to women in each age group. The truncation of the parity distributions at 6+ children makes it impossible to calculate total children ever born from them.

We had planned to use average numbers of children ever born to estimate completed fertility for five year age cohorts and then use the approximate equality of cohort fertility to period fertility at the time the cohort reaches its mean age at childbearing. Early on in the analysis, however, anomalies in the data were discovered which we suspected were due to high levels of non-response to the children ever born questions in combination, perhaps, with problematic imputations made during the computer processing of the census data. These were first brought to our attention by the author of the paper on mortality, who was working with the same data to generate estimates of infant and child mortality.

Special Tabulation 1: To scrutinize the effects of imputation of number of children ever born for women for whom it was not reported we requested and received two special tabulations of the census data. The first special tabulation, given in Table A1, is based on the census records used to produce the published tabulations. It shows ever married women by age in standard five year groups and number of children ever born with an open ended group of 20+ children ever born. The published children ever born tables truncate the parity distribution at 6+ children ever born, which is much, much too low for a population with Pakistan's level of fertility. Table A1 shows this tabulation for the national level. The lower panel of the table shows the calculation of average numbers of children ever born for ever married and all women.

Special Tabulation 2: The second special tabulation, given in Table A2, is based on unimputed census records. As is frequently done in processing population censuses, tabulations are not produced directly from the data collected in the enumeration ("unimputed records") but from edited data ("imputed records") from which (a) various inconsistencies have been removed and for which (b) individuals for whom particular information, such as number of children ever born, is not reported are assigned "imputed" values. Table A2 has the same form as Table A1, but is based on unimputed records rather than on imputed records. This tabulation does not provide for age not stated responses, whence women for whom age was not reported are omitted. For this reason, total numbers of women in Table A2 are lower than the total numbers in Table A1.

Comparisons: Table A3 compares average number of children ever born, for ever married and all women, as given in the published census reports, as calculated from Tables A1 and A2. Several conclusions may be drawn from this table. First, the level of nonresponse to the children ever born question was high, ranging from 31 percent for 15-19 year old women to 13 percent for 35-44 year old women. Second, the average numbers of children ever born calculated from the imputed data differ substantially from the average numbers of children ever born calculated from the unimputed data at younger ages, though they are quite close at older ages. Third, there is a discrepancy of about

0.5 children per woman between the average number of children ever born to 45-49 year old women calculated from the special tabulations (whether imputed or unimputed) and the published values. If the special tabulations are correct, as we assume they are, the published values are incorrect. The apparent explanation is a mistake in programming the calculation of the average number of children ever born.

Table A1. Children ever born data for Pakistan (less FATA): Special Tabulation 1

Children Ever Born	Age of Woman						
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
0	61,885	65,631	32,213	16,404	10,450	9,471	7,715
1	27,408	62,491	35,188	16,289	9,209	7,746	6,336
2	19,622	74,464	63,390	32,913	16,893	13,023	9,972
3	11,970	42,152	61,356	41,673	23,970	18,975	13,780
4	3,985	29,857	62,255	55,118	36,056	27,745	19,580
5	0	18,380	37,197	45,985	34,985	29,424	20,380
6	0	7,198	26,036	40,479	35,880	32,724	22,787
7	0	4,823	13,093	25,950	28,806	29,504	21,738
8	0	1,960	7,447	16,273	21,504	24,983	19,144
9	0	1,055	3,655	7,977	12,379	17,504	14,406
10	0	0	3,974	4,784	7,493	12,010	10,922
11	0	0	1,351	2,370	3,799	6,884	6,616
12	0	0	826	1,425	2,181	4,135	3,946
13	0	0	819	896	1,084	2,012	1,907
14	0	0	187	524	722	1,041	1,068
15	0	0	0	888	349	474	521
16	0	0	0	215	237	351	341
17	0	0	0	206	180	216	160
18	0	0	0	125	121	140	101
19	0	0	0	94	467	449	346
20+	0	0	0	0	0	0	0
Not Stated	0	0	0	0	0	0	0
Total	124,870	308,011	348,987	310,588	246,765	238,811	181,766
Calculation of Average Children Ever Born for Ever Married and All Women							
Proportion Not Stated	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Children Ever Born	118,502	651,327	1,199,157	1,418,324	1,324,648	1,422,712	1,113,008
MCEB, EM Women	0.949	2.115	3.436	4.567	5.368	5.957	6.123
Proportion EM	0.2110	0.6143	0.8523	0.9288	0.9574	0.9658	0.9754
MCEB, All Women	0.200	1.299	2.929	4.241	5.139	5.754	5.973

Source: Distribution of ever married women by children ever born and age group from special tabulation from individual census records. Proportion ever married calculated from Table 6, page 198, of national level census report.

Notes: The children ever born questions were asked on a sample basis only. Special tabulation values not inflated to population total. Not stated cases excluded from denominator in calculating average children ever born to ever married women. Average children ever born to all women calculated as product of average for ever married women and proportion of all women who were ever married.

Table A2. Children ever born data for Pakistan (less FATA): Special Tabulation 2

Children Ever Born	Age of Woman						
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
0	38,359	48,695	24,995	12,595	7,785	6,704	5,132
1	21,367	59,795	34,422	15,400	8,055	6,774	5,186
2	9,100	53,693	51,685	27,244	13,482	10,466	7,925
3	3,876	31,345	54,374	37,696	21,176	16,027	11,203
4	877	16,538	48,331	46,630	31,065	23,679	16,443
5	0	7,185	28,518	39,469	30,100	24,981	16,840
6	0	2,409	15,497	30,961	29,253	27,134	18,643
7	0	1,059	7,064	19,579	23,894	24,467	17,775
8	0	351	2,758	9,749	15,690	19,957	15,211
9	0	172	1,038	4,378	8,665	13,678	11,595
10	0	0	633	1,908	4,495	8,714	8,340
11	0	0	177	721	2,020	4,719	4,860
12	0	0	103	322	925	2,559	2,657
13	0	0	71	142	372	1,119	1,262
14	0	0	13	72	201	492	579
15	0	0	0	65	68	159	238
16	0	0	0	19	26	76	107
17	0	0	0	16	17	40	42
18	0	0	0	10	11	16	28
19	0	0	0	5	32	40	40
20+	0	0	0	0	0	0	0
Not Stated	33,018	57,445	50,129	39,295	30,149	29,265	23,339
Total	106,597	278,687	319,808	286,276	227,481	221,066	167,445
Table A1 Total	124,870	308,011	348,987	310,588	246,765	238,811	181,766
Difference	18,273	29,324	29,179	24,312	19,284	17,745	14,321
Proportion Not Stated	0.310	0.206	0.157	0.137	0.133	0.132	0.139
Children Ever Born	54,703	389,516	821,282	1,042,609	1,008,039	1,108,760	867,459
MCEB, EM Women	0.743	1.761	3.045	4.221	5.108	5.781	6.020
Proportion EM	0.2110	0.6143	0.8523	0.9288	0.9574	0.9658	0.9754
MCEB, All Women	0.157	1.082	2.596	3.921	4.891	5.583	5.872

Source: Distribution of ever married women by children ever born and age group from special tabulation based on unimputed census records. See text for explanation. Proportion ever married calculated from Table 6, page 198, of national level census report

Notes: See notes to Table A1 and text for further explanation.

Table A3. Average children ever born comparisons: Pakistan less FATA

Age Group	Ever-Married Women			Proportion Ever Married	Published	All Women		Proportion CEB Not Stated
	Special Tabulation					Imputed	Unimputed	
	Published	Imputed	Unimputed			Imputed	Unimputed	
15-19	1.57	0.95	0.74	0.21	0.33	0.20	0.16	0.31
20-24	2.50	2.11	1.76	0.61	1.53	1.30	1.08	0.21
25-29	3.80	3.44	3.05	0.85	3.24	2.93	2.60	0.16
30-34	4.98	4.57	4.22	0.93	4.63	4.24	3.92	0.14
35-39	5.82	5.37	5.11	0.96	5.57	5.14	4.89	0.13
40-44	6.40	5.96	5.78	0.97	6.18	5.75	5.58	0.13
45-49	6.59	6.12	6.02	0.98	6.43	5.97	5.87	0.14

Notes *Published* values calculated from Tables 29 of the national census report as described in text.
Special Tabulation values calculated from tabulations produced by the Pakistan Census Organization showing women with 0, 1, ..., 19, 20-99 by multiplying number of women with x children ever born by x and summing over $x=1,2,\dots,19$.

Proportion Ever Married calculated from Table 6 of national census report.

Proportion CEB Not Stated calculated as one minus the total women in age group from unimputed table by total women from age group from imputed table.