Journal of Health & Population in Developing Countries; 1999, 2(2):48-61

Fertility Decline in India: A Futuristic Perspective

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Fertility projections based on log linear analysis suggest that India will attain replacement level fertility by 2019, given the past trends during 1981-94 continue. About 56 percent reduction in the current fertility levels is required to take India to replacement level fertility. The proximate determinants play an important role in the continuing decline of fertility in both the low and high fertility states. The implications of such an observed fertility decline in terms of population momentum are further discussed.

Key words: India; Replacement level fertility; population; momentum

The beginning of the 1990s saw India entering the final stages of demographic transition with sharper decline in fertility than mortality levels[1,2]. According to the Sample Registration System (SRS), the total fertility rate (TFR) in India declined from 5.2 in 1971 to 3.5 in 1994. The recent decline in total fertility in India has been found to be more pronounced in the 15-19 and 30-49 years age groups. For example, during 1981-94, about 24 percent decline was observed in the 15-19 years age group and 38 percent in the 30-49 years age group as compared to only 12 percent in the 20-29 years age group. The relative contributions of fertility in the 15-19 and 30-49 years age groups are trivial when compared to that in the 20-29 years group. Fertility decline in the latter age group is expected to increase prevalence of small family size in India in the near future. If there is such a sharp decline in Indian fertility levels, when would India and its states attain replacement level fertility? Mari Bhat[3] anticipates that if the total fertility rate (TFR) drops at a rate of 0.7 births in the next decade, India would attain replacement fertility by around 2015. However, faster reductions are expected from Northern states where the decline in fertility levels has been much slower. The pace of decline in Indian fertility levels is owing to faster reductions of TFR in the south rather than the north and there exist wide variations in inter-state fertility levels. However, at the all India level, the reduction has been much faster than expected, especially in the urban areas[2].

Research studies based on the National Family Health Survey (NFHS)[a] have pointed out that the inter-state variations in fertility estimates can be attributed to the convincing role of proximate determinants of fertility and diverse other demographic, social, cultural and economic factors[4-6]. The proximate determinants are biological and behavioral factors through which social, economic and environmental variables influence fertility behavior. Bongaarts and Potter argued that biologically, potential fertility is about 15.3 children per woman, which differs in different population groups[7]. The fertility behavior of women in India depends to a great extent on the social, economic and cultural contexts, in which the women live. In other words, childbearing in Indian society is dependent upon several social and cultural norms, including the time of marriage.

While the states of Kerala and Tamil Nadu have already reached replacement level fertility, some states like Uttar

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Pradesh, Bihar, Madhya Pradesh and Rajasthan are still reproducing at prodigious rates.[8-10] Sustaining these differentials for a longer period is undesirable as these could bring about serious consequences in the future. The ongoing population policies and family welfare programs in India have been strenuously aimed at bringing down the fertility to replacement level. Besides, the long-term implications of high fertility in India are also felt because of the built-in growth momentum of the current age structure of the population, which has been shaped by past trends in fertility and mortality, along with the growth due to current fertility. Recent projections suggest that population momentum will cause tremendous increase in numbers in the coming decades[11]. This growth potential is due to higher levels of fertility in the past. In the coming years, demographic momentum alone would be expected to lead to the doubling of many populations[12]. Also, it is believed that a sizeable proportion of the population in India in the future appears inevitable as a result of larger momentum. Visaria and Visaria (1994) argued that the ultimate population size of India would be enormous unless efforts are made to reach the replacement level fertility before 2016[2].

Theoretically, TFR which is the average number of children that a woman can have, subject to age specific fertility rates, is used to interpret fertility levels. However, it is an aggregate estimate and is composed of fertility performance in various age groups. According to the latest SRS reports, a sharp decline was observed in the 15-19 years age group uniformly in most of the Indian states, especially in the north. For example, fertility in this age group dropped to more than four-fifths in Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. Similarly, a marked decline was noted in the 30-49 years age group also, which clearly indicates that childbearing tends to concentrate more in the 20-29 years age group. It is hypothesized here that such observed decline of fertility in the 15-19 and 30-49 years age groups will definitely influence the future fertility levels. Also, the relative contribution of TFR from the 20-29 years age group would be higher and the reproductive behavior of this group would ultimately determine the future of fertility in India. This hypothesis directed us to have a clearer understanding of the trends and factors of future fertility decline in India.

The main objective of this paper is threefold; first, we have tried to project TFR until replacement levels are reached based on log linear regression method, and the components of TFR have been analyzed over time. Secondly, an attempt has been made to identify the fertility behavior of individual women based on the proximate determinants framework of Bongaarts and Potter (1983), by focusing on women in the 20-29 year age group[7]. Also, we have made a comparison of children ever born, by acceptance of sterilization of either of the couples, for women currently aged 20-29 years. In other words, we are interested in exploring the underlying determinants influencing fertility change for women, especially those in the 20-29 years age group. Finally, the implications of the existing fertility and the changes that occur in the future growth potential in terms of population momentum are discussed.

Data and Methodology

The data for this study has been taken from various volumes of SRS[13] for the period 1981-1994 and the NFHS[15]. The TFR was broken up into three components; 15-19 years, the younger cohort; 20-29 years; the middle; and 30-49 years, the older cohort in order to assess the fertility performance of these cohorts individually in relation to total fertility rate. Also, TFR in India and its states has been projected based on an assumption that the declining trend in fertility during the 13 years period (1981-94) would continue in the future. Projections have been done for India and 16 of its major states until the attainment of replacement levels, i.e., when TFR becomes 2.1[b], based on log linear analysis.

A linear regression model of the form

$$\log Y = a + bX \text{ ---------------------------- } (1)$$

was considered for the projections. Here, log Y is a linear function[15] of X. This suggests that if we transform each of the log Y values into a new variable Z, we can represent Equation (1) as

$$Z = a + bX \text{ --------------------------------- } (2)$$

In other words, Z is a linear function of X. Equation (2) was considered for projecting TFR and its components uniformly in all the Indian states. Here, the X values denote time in years; Z values denote the logarithmic transformation of the TFR at various time periods; a is a constant; and, b is the coefficient of slope at various time periods. After fitting a linear equation of the form as in Equation 2, using the data on fertility during the period 1981 through 1994, the trends in fertility were extrapolated to future by inputting different values for X in the same equation. Based on the fertility trends in the past, separate linear equations were fitted for making projections in the selected states. Also, based on the predicted time of replacement level fertility in India, three states each, which fall above and below Indian replacement level fertility were selected for further discussion.

For understanding the effects of proximate determinants on fertility behavior, we have used individual level data from the NFHS conducted during 1992-93 in India and its states. The survey was carried out by the Population Research Centers located at various places in India. It was initiated by the Ministry of Health and Family Welfare, Government of India and coordinated by the International Institute for Population Sciences (IIPS), Mumbai, India. The survey collected extensive information on fertility, mortality and morbidity as well as health aspects of mothers and children.

As mentioned earlier, the largest share of total fertility would depend on the fertility experience of women in the 20-29 years age group. The contribution of fertility in this age group by selected factors is examined using children ever born. For the analysis, we have adopted a different approach; i.e., we selected children ever born to sterilized women in the age group 20-29 years in contrast to those who are exposed to the risks of sterilization or those who have not been sterilized at the time of survey. The fertility experience of sterilized and non-sterilized groups was compared in order to understand the differentials of completed and current family size in India. The sterilization cases were determined by the sterilization status of either of the couple. For this, we resorted to life table technique, which also handles the problem of censoring. The censored cases are those women who were not sterilized at the time of survey but were likely to get sterilized in the future. The dependent variable is the survival time or the children ever born to women by the acceptance of sterilization, which is in the range of actual numbers or continuous series. The conditional probability of children ever born among the sterilized at various time periods is described as;

$$q_x = d_x / l_x \quad \text{------------------------------} \quad (3)$$

where d_x is the number of children ever born to the sterilized couples in the interval x and l_x is the number of individual women exposed to the risk of having children in the interval. The censoring of cases is done by the assumption that births among the non-sterilized are likely to occur at the middle of the interval. For details of the methodology, the reader is referred to event history methods worked out extensively by researchers.[16-19] In the life table analysis, we assume that all individuals are likely to experience similar risks. This assumption is simplified by the allowance of multivariate life table analysis, in which different risks are experienced based on different individual characteristics or explanatory variables[20]. To understand the effects of explanatory variables on the hazard rate associated with fertility in the 20-29 years age group, we used Cox's proportional hazard model[21-22], which is expressed as follows;

$$\lambda (x,t_i) = \lambda_0 (x) e^{(t_i \beta_i)} \quad \text{----------------------} \quad (4)$$

where $\lambda (x,t_i)$ is the hazard rate at time x, $\lambda_0 (x)$ is the baseline hazard function, t_i is the vector of explanatory variables, and β_i is a vector of parameter. For a unit change in a given characteristic, the relative change in the baseline hazard function rate is expressed as the exponential of the vector of coefficients.

The selected explanatory variables[c] include: proximate determinants such as use of spacing methods (modern and traditional), ever experience of infant and child loss and fetal loss (still births and spontaneous abortions); duration of marriage (exposure factor) and place of residence, and religion and education of mother (social, cultural and economic factors). The variables are categorized in the form of dummy variables. In the NFHS, the data of Uttar Pradesh and Haryana states were weighted, whereas the rest of the states were self-weighted. The variables that showed significant association in the likelihood ratio tests alone were included in the proportional hazard models.

In order to discuss the implications of fertility decline in India, the momentum of population growth was estimated for India and selected states. Population momentum was first estimated by Nathan Keyfitz in 1971 for an initially stable population. Much research works has been carried out since then on the theories and methods of population momentum.[23-29] However, the recent work done by Kim and Schoen (1997) has generalized it for any observed population and we have used this measure for the present analysis. The population momentum is estimated as the ratio of the ultimate stationary population to the initial observed size.

To estimate the stationary population, the initial population is projected in five year steps for about 150 years, assuming constant mortality and replacement level fertility. It is assumed that after about 150 years, the population is virtually stationary. The age-specific fertility and mortality rates were projected until replacement levels by using log linear method (Equation 2) based on the respective trends during the 1981-94 time period. The survival rates required for those projections are estimated from the life tables constructed using the age-specific mortality rates. It needs to be mentioned that some states are expected to be above replacement levels at the time when fertility in India drops to replacement levels. Therefore, the population momentum in these states is estimated at the time when fertility in India drops to replacement levels. The replacement level fertility or net reproduction rate (NRR) of 1 is obtained by scaling the observed age-specific fertility rates. The scaling requirements are met, by dividing each age-specific fertility rate by the observed NRR

Time for Replacement Levels

The fertility at the time of replacement levels corresponds to a TFR of 2.1. However, it is usually found that the level of fertility required for replacement or a net reproduction rate of unity could be slightly above the assumed TFR of 2.1 depending on the mortality situation in the country[30]. Therefore, the level of TFR corresponding to NRR of unity may vary between states. The time for replacement level fertility, based on the assumption that the declining trend during 1981-94 would continue in the future in India and major states, is shown in Table 1. It is observed that most of the Indian states will be converging towards replacement fertility level during the first decade of the next century. The results based on projections reveal that India would attain replacement level fertility by 2019.

Table 1 *Accomplishment of Replacement Levels based on Projection Estimates, India and States.*

States	TFR		Year of
	1981	1994	RPF *
India	**4.5**	**3.5**	**2019**
North			
Haryana	5.0	3.7	2016
Punjab	4.0	2.9	2004
Rajasthan	5.3	4.5	2041
Central			
Madhya Pradesh	5.2	4.2	2036
Uttar Pradesh	5.8	5.1	2093
East			
Assam	4.1	3.8	2017
Bihar	5.7	4.6	2032
Orissa	4.3	3.3	2002
West Bengal	4.2	3.0	2005
West			
Gujarat	4.3	3.1	2006
Maharashtra	3.6	2.9	2013
South			
Andhra Pradesh	3.9	2.7	2002
Karnataka	3.6	2.8	2005
Kerala	2.8	1.7	1987
Tamil Nadu	3.4	2.1	1990

**RPF denotes Replacement Level Fertility*

For convenience, the states in India are classified into different zones viz. North, Central, East, West and South. In the South, Kerala and Tamil Nadu have already reached replacement levels of fertility, that is during 1987 and 1990 respectively. The levels and patterns associated with both fertility and mortality transition were quite different in these two states. In Kerala, changes in fertility and sharp decline in mortality, especially infant deaths, were observed in the wake of structural changes in the political economy, land reforms, large public investment on education and the health sector and improvements in public health and hygiene[31]. Further, an increase in the number of surviving children as a result of a rise in female age at marriage and successful practice of family planning methods contributed to the declining fertility in Kerala.[32-33] However, female literacy has been envisaged as the key factor behind this transition.[34-35] Also, the contribution of female literacy to total human development is the highest in Kerala[36]. In contrast, the factors that necessitated the demographic transition in Tamil Nadu were less favorable when compared to Kerala. At the time of replacement level fertility in Tamil Nadu, infant mortality hovered around 56, female literacy was only about 51 percent and about 33 percent were living below the poverty line with poor dietary intakes. However, political and bureaucratic factors played a crucial role in various family welfare measures thereby reducing fertility, through overcoming the cultural barriers imposed by low literacy and poorer living conditions[34]. In addition, the higher age at marriage, especially of females, and use of contraceptives made significant contributions to lowering fertility in Tamil Nadu.

The target of replacement level fertility is almost close in the state of Andhra Pradesh (by 2004) where there has already been a marked decline in TFR over time. For the past two decades, fertility has been declining in Andhra Pradesh, and the decline was faster in the middle of the 1980s[37]. The changes in the rural economy and employment structures, which also brought about a shift in the living conditions, were responsible for the fertility transition in Andhra Pradesh, particularly in the 1980s. The states of Punjab in the North, West Bengal in the East, Gujarat in the West and Karnataka in the South are expected to reach replacement levels by the middle of the next decade. In contrast, the past trends in fertility decline in the states of Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan are very slow when compared to the states nearing replacement levels. Therefore, these states are not expected to achieve the replacement level target of India (2019), given the assumption that the fertility decline observed since the 1980s will continue in the future. The differences in the projected time lag for replacement level fertility indicate that the state of Uttar Pradesh would take another 74 years after India reaching replacement level. The decline in fertility and mortality, especially infant and child mortality has not been apparent enough in Uttar Pradesh. The growth rate of population in this state has not been impressive at all; it was 2.29 percent during 1971-81, and it declined only to 2.27 percent during 1981-91[13]. The census and registration systems of India reported that child mortality remained higher for a long time, especially in Uttar Pradesh, Bihar, Madhya Pradesh and Rajasthan, and the decline in mortality levels in these states occurred at a slower pace when compared to the other states of India. It is argued here that a slower decline of child mortality would keep fertility rates higher and the corresponding declines would be tenuous[38].

In the following sections, we focus on six states which fall below and above India's replacement level fertility. The states are considered on the basis that these states represent low, medium and average distance to India's replacement level fertility. The selected states, which will replace their fertility before India does so include, Andhra Pradesh (low level), Punjab (medium level) and Gujarat (high level); those which will attain replacement fertility after India include Uttar Pradesh (high), Rajasthan (medium) and Haryana (low). For ease of explanation, we define the states, which will replace their fertility before India as low fertility and the others as high fertility states.

Components of TFR and Tempo of Decline

In this section we discuss the observed trends in the components of TFR over time since 1981. The decline in the components of TFR is very evident during the period 1981-94 (see Table 2). The reductions in fertility in both the

Table 2 *Trends in Components of TFR over Various Time Periods in India and Major States.*

States	15-19 Years			20-29 Years			30-49 Years			% Decline*
	1981	1994	PD	1981	1994	PD	1981	1994	PD	for RPF
India	**0.45**	**0.34**	**24.4**	**2.39**	**2.16**	**9.6**	**1.67**	**1.03**	**38.3**	**56.1**
Below Indian RPF										
Andhra Pradesh	0.61	0.55	9.8	2.15	1.68	21.9	1.18	0.42	64.4	28.1
Punjab	0.09	0.09	00.0	2.37	2.16	8.9	1.50	0.64	57.3	33.3
Gujarat	0.28	0.15	46.4	2.67	2.21	17.2	1.35	0.75	44.4	40.6
Above Indian RPF										
Uttar Pradesh	0.46	0.26	43.5	2.80	2.72	2.9	2.15	1.82	15.3	79.9
Rajasthan	0.44	0.30	31.8	2.63	2.59	1.5	2.18	1.64	24.8	73.4
Haryana	0.41	0.26	36.6	2.76	2.62	5.1	1.83	0.82	55.2	50.0

Source : computed from various volumes of Sample Registration System (SRS).
RPF :Replacement Level Fertility; PD: Percentage decline over 1981-94;
**denotes decline required in TFR from 1981 over 1994 towards replacement levels which is estimated as*

$$1 - \frac{\text{TFR (1981)-TFR(1994)}}{\text{TFR (1981) - 2.1}}$$

15-19 and the 30-49 years age groups during this period are very impressive and the decline was higher in the 30-49 years age group. This also clearly highlights the fact that childbearing tends to remain higher in the 20-29 years age group. The reduction in this component was found to be uniformly higher in the low fertility states of India. The fertility decline in the 20-29 years age group was found slower in all the states except Andhra Pradesh and Gujarat, which are closer to replacement levels.

Among the states, which are expected to attain replacement level fertility before India, the share of the 15-19 years component in total fertility was found higher in Andhra Pradesh. This might be attributed to low mean age at marriage of females in the state coupled with a larger share of illiterate population (NFHS, India). The state requires only about 28 percent decline in TFR from its present level over the period 1981-94 to attain replacement level fertility. Though the fertility of the15-19 years age group is higher in Andhra Pradesh, the share of TFR of the other age groups has reduced considerably, which is also attributed to the efficacy of the health seeking measures and family planning programs in the state[39,40]. Owing to faster reductions of fertility in almost all components, the state of Punjab requires only 33.3 percent reduction to attain replacement level.

The contribution of the 30-49 years component of fertility to TFR is found higher in Uttar Pradesh and Rajasthan. This is also an indication of the longer time required for reaching replacement level fertility, particularly in Uttar Pradesh (about 80 percent reduction in TFR). On an average, about 56 percent reduction is anticipated to reach replacement level fertility in India. The overall reduction was faster in the 30-49 years component of TFR and it was found to be uniform in all the states of India.

Towards the Future: The Motives behind Observed Fertility Decline

As has been observed, that bringing down India's fertility to below replacement level would largely depend on the reproductive experience and behavior of the 20-29 years age group. Therefore, it would be worthwhile examining the relative influence of the proximate factors influencing fertility in the low and high fertility states. The following results are based on the analysis of data from NFHS conducted during 1992-93. The analysis is restricted to children ever born to ever-married women currently aged 20-29 years by acceptance of sterilization.

First, we shall discuss the probability of children ever born by acceptance of sterilization among women currently aged 20-29 years in the selected states which are expected to reach replacement levels before and after Indian replacement levels of fertility. It has become evident that the inclination to limit family size to two children was gradually occurring in low fertility states, especially in the state of Andhra Pradesh (Table 3). The proportion resorting to sterilization with one child is hardly observed, irrespective of high and low fertility states, which is an indication that couples in India prefer to have at least two children per family.

Table 3: *Probability of children ever born by acceptance of sterilization among women currently aged 20-29 years in selected states of India, 1992-93*

Number of children ever born	Below Indian RPF			Above Indian RPF		
	Andhra Pradesh	Punjab	Gujarat	Uttar Pradesh	Rajasthan	Haryana
1	0.0033	0.0009	0.0004	0.0002	0.0007	0.0004
2	0.1282	0.0476	0.0857	0.0145	0.0328	0.0539
3	0.4307	0.2608	0.2727	0.0608	0.1606	0.2355
4 +	0.8499	0.3750	0.6878	0.2522	0.4953	0.3614

RPF :Replacement Level Fertility; Note: probability is calculated from life tables.

More than one-fourth of the women in the low fertility states opted for sterilization with three children in contrast to the high fertility states. In Uttar Pradesh, sterilized women with more than 4 children constituted only about 25 percent which is lower compared even to Rajasthan and Haryana. The transition to a small family size is more apparent in the low fertility states as compared to the high fertility ones. It is also anticipated that the changes that occurred in Kerala and Tamil Nadu and those occurring in Andhra Pradesh will be diffused to other states as well. However, the process conducive to changes in social conditions and reproductive behavior is time-found.

The mean number of children ever born to women currently aged 20-29 years by acceptance of sterilization in the low and high fertility states is shown in Tables 4 and 5. The results reveal that the mean number of children ever born was found higher for sterilized couples when compared to their counterparts. However, differentials in individual characteristics were found by the family size between these groups in all the selected states of India. The average family size among sterilized groups who had used spacing methods was found higher when compared to the non-sterilized ones. However, the difference was not too big, except in Uttar Pradesh. In other words, the observed differences in the state of Uttar Pradesh indicate that fertility would grow in the future unless couples adopt sterilization. The states which are expected to replace their fertility before India, have a comparatively smaller family size than those which are beyond the time of India's replacement fertility. Though, fertility transition has started taking place in India, it started late in some of the northern states of the country, and this is reflected in their family size also [41]. This phenomenon was due to inconsistencies observed in the mortality levels, particularly during the pre-independence period of India, when a majority was dependent upon agrarian economy[42]. Also, sterilization as an important permanent method was incorporated in the Indian family planning program in the wake of the 1960s[43]. The low use of spacing methods, especially in the high fertility states, is attributed to the fact that a major proportion of couples do not have proper knowledge about spacing methods coupled with a lack of access to obtaining the methods[44]. The popularity and diffusion of sterilization programs were successful in very few states like Kerala and Tamil Nadu, where the fertility has already reached below replacement levels. However, it needs to be mentioned that the family size was comparatively smaller for couples who used spacing methods.

Fertility behavior is also a function of exposure measured by the duration of marriage, an important proximate determinant, which differs among various cohorts. The states which are ahead of the Indian replacement level fertility have shown impressive results on fertility performance by marital duration, especially among sterilized groups. The sterilized women in the younger cohorts, or those who had spent less than 5 years of marital union, had decided on smaller family size when compared to those who had spent

Table 4 *Children Ever Born (average) to Ever-Married Women Currently Aged 20-29 Years by Acceptance of Sterilization and Background Variables in the Low Fertility States of India, 1992-93.*

	Andhra Pradesh				Punjab				Gujarat			
Variables	**S**	**NS**	**Total**	**(N)**	**S**	**NS**	**Total**	**(N)**	**S**	**NS**	**Total**	**(N)**
Contraceptive use*												
No	3.4	2.9	3.2	(3538)	3.6	2.8	3.0	(1175)	3.5	2.9	3.1	(2337)
Yes	3.4	2.6	3.0	(287)	3.3	2.7	2.8	(1079)	2.9	2.4	2.5	(592)
Duration of marriage (in years)												
< 5	2.1	1.3	1.4	(200)	2.3	1.6	1.4	(426)	2.0	1.5	1.5	(458)
5-9	2.8	2.5	2.6	(1249)	3.2	2.7	2.9	(1185)	2.9	2.7	2.7	(1242)
10-14	3.6	3.5	3.5	(1786)	3.8	3.8	3.8	(585)	3.8	3.8	3.8	(1059)
15 +	3.9	3.6	3.8	(588)	4.2	4.6	4.5	(58)	3.7	3.5	3.6	(170)
Infant & child loss												
Survivors	3.3	2.8	3.1	(3452)	3.5	2.7	2.9	(2114)	3.3	2.7	2.9	(2604)
Infant deaths	4.1	3.2	3.6	(292)	3.6	3.1	3.2	(114)	4.5	3.4	3.6	(245)
Child deaths	4.4	3.4	3.9	(59)	5.0	3.6	4.0	(22)	4.0	3.4	3.5	(63)
Fetal loss												
Yes	3.5	3.1	3.3	(560)	3.6	2.9	3.0	(399)	3.5	2.8	3.0	(414)
No	3.4	2.9	3.1	(3265)	3.5	2.7	2.9	(1855)	3.4	2.8	3.0	(2515)
Place of residence												
Rural	3.4	3.0	3.2	(2911)	3.5	2.8	3.0	(1670)	3.4	2.9	3.1	(2109)
Urban	3.3	2.6	3.0	(914)	3.4	2.5	2.7	(584)	3.5	2.5	2.7	(820)
Education of mother												
Illiterate	3.6	3.1	3.3	(2730)	3.7	3.1	3.3	(1153)	3.7	3.1	3.3	(1724)
1-6 years of schooling	3.0	2.8	2.9	(524)	3.4	2.7	2.8	(449)	3.1	2.9	2.9	(463)
≥ 7 years of schooling	2.9	2.0	2.5	(571)	2.9	2.3	2.4	(652)	2.8	2.1	2.2	(742)
Religion of mother												
Hindu	3.3	2.8	3.1	(3312)	3.6	2.7	2.9	(847)	3.4	2.8	3.0	(2635)
Others	3.9	3.5	3.7	(513)	3.4	2.8	2.9	(1407)	3.7	2.8	2.9	(294)
Total	**3.4**	**2.9**	**3.2**	**(3825)**	**3.5**	**2.7**	**2.9**	**(2254)**	**3.4**	**2.8**	**3.0**	**(2929)**

**denotes use of spacing methods (modern and traditional); Note: The standard deviation from calculated means varies between 0.5 and 1.7; Missing cases were excluded from the analysis; S denotes Sterilized and NS denotes Non-Sterilized Couples; N denotes the number of children ever born.*

Table 5: *Children ever born (average) to ever-married women currently aged 20-29 years by acceptance of sterilization and background variables in the high fertility states of India, 1992-93.*

	Uttar Pradesh				Rajasthan				Haryana			
Variables	**S**	**NS**	**Total**	**(N)**	**S**	**NS**	**Total**	**(N)**	**S**	**NS**	**Total**	**(N)**
Contraceptive use*												
No	3.7	3.4	3.4	(8852)	3.7	3.1	3.3	(3803)	3.7	3.2	3.4	(1793)
Yes	4.4	3.3	3.3	(1689)	3.1	3.0	3.0	(487)	3.3	2.9	3.0	(913)
Duration of marriage (in years)												
< 5	0.0	1.6	1.6	(654)	0.0	1.5	1.5	(225)	0.0	1.6	1.6	(288)
5-9	2.9	2.6	2.6	(3157)	3.2	2.4	2.4	(1122)	3.1	2.7	2.8	(1049)
10-14	3.6	3.7	3.7	(4434)	3.5	3.4	3.4	(1867)	3.8	3.8	3.8	(1009)
15 +	4.6	4.4	4.5	(2296)	4.0	4.1	4.0	(1075)	4.0	4.3	4.2	(360)
Infant & child loss												
Survivors	3.7	3.3	3.3	(8996)	3.6	3.0	3.2	(3852)	3.5	3.0	3.1	(2409)
Infant deaths	4.6	3.8	3.9	(1195)	4.6	3.7	3.8	(325)	4.8	3.7	3.9	(238)
Child deaths	4.4	4.1	4.1	(284)	4.8	3.8	3.9	(102)	4.4	4.3	4.3	(50)
Fetal loss												
Yes	3.9	3.4	3.5	(1913)	4.0	3.4	3.5	(641)	3.4	2.9	3.0	(665)
No	3.7	3.4	3.4	(8629)	3.6	3.1	3.1	(3649)	3.7	3.1	3.3	(2041)
Place of residence												
Rural	3.8	3.4	3.5	(8765)	3.7	3.2	3.3	(3568)	3.7	3.1	3.3	(2072)
Urban	3.5	3.0	3.1	(1776)	3.6	2.8	3.0	(722)	3.5	2.9	3.0	(634)
Education of mother												
Illiterate	3.9	3.6	3.6	(8229)	3.7	3.2	3.3	(3566)	3.8	3.3	3.5	(1770)
1-6 years of schooling	3.5	2.9	3.0	(896)	3.3	2.8	3.0	(372)	3.4	2.9	3.0	(402)
≥ 7 years of schooling	3.6	2.5	2.6	(1417)	3.2	2.2	2.4	(352)	3.2	2.3	2.5	(534)
Religion of mother												
Hindu	3.7	3.3	3.4	(8665)	3.7	3.1	3.2	(3998)	3.6	2.9	3.2	(2393)
Others	3.9	3.5	3.5	(1876)	3.7	3.2	3.2	(292)	3.6	3.7	3.7	(313)
Total	**3.8**	**3.4**	**3.4**	**(10541)**	**3.7**	**3.1**	**3.2**	**(4290)**	**3.6**	**3.1**	**3.2**	**(2706)**

**denotes use of spacing methods (modern and traditional); Note: The standard deviation from calculated means varies between 0.5 and 1.7; Missing cases were excluded from the analysis ;S denotes Sterilized and NS denotes Non-Sterilized Couples; N denotes the number of children ever born.*

more years in marriage. The inclination to go for a small family size and sterilization at earlier ages is apparent in these low fertility states. The health workers' pressure to attain sterilization targets among younger couples with two children has been widely acknowledged in demographic studies[45]. In the low fertility states, once the desired family size of 2 children was achieved, a major proportion, particularly in the younger ages, opted for sterilization [46]. The average number of children ever born was higher for the sterilized women who had spent longer years of marriage, especially in the high fertility states of Uttar Pradesh and Rajasthan.

There is a plethora of evidence in demographic literature that a decline in mortality conditions, particularly infant and child mortality, is concomitant with declining fertility behavior of a population[2]. The mean number of children ever born was favorable for the women who were both sterilized and had not experienced infant and child deaths in their lifetime. The differences in the mean number of children by survival status were found even sharper in the high fertility states of Uttar Pradesh, Rajasthan and Haryana. The average family size in these states was found higher for those who had experienced child mortality than infant mortality, except in Haryana. This could be due to the decline observed in child deaths in Haryana, unlike Uttar Pradesh and Rajasthan. In Andhra Pradesh, the mean number of children ever born was found higher among women who had not experienced infant and child deaths, particularly among the sterilized groups. Also, the timing of sterilization would be earlier because of the influence of surviving children, especially in the low fertility regions[47]. The assurance of children surviving has a greater impact on adoption of small family size in India. A good example in this regard is Kerala in the South. In Kerala, the decline in infant mortality was soon followed by a decline in fertility levels, especially during the last phases of demographic transition[33]. There is hardly any observed difference in the mean number of children by ever-experience of fetal loss, except in Rajasthan. However, it can be noted that women who have experienced fetal loss in their reproductive years are inclined to have a large family size. It is hypothesized here that a woman is more likely to go for more children when she confronts a reproductive or fetal loss in her reproductive health career.

With regard to the background characteristics, the family size was found higher among rural women, irrespective of any differences in the selected states. This is attributed to the poor accessibility and availability of contraceptive measures in rural India. Also, a major proportion relied on traditional methods, especially in the state of Uttar Pradesh[48]. Yet another reason is the preference for male children to contribute to the household economy, which is still prevalent in the rural parts of India[49]. Nag (1991) argued that fertility performance in these populations would continue until the desired composition is achieved[50]. Also, it is a fact that a major proportion of the population is dwelling in rural India with agricultural activities. The significant role of educational levels in bringing down fertility has been discussed extensively in research studies[51]. The average number of children ever born was found higher among illiterate women, uniformly across the selected states. The levels of literacy rates, and school enrolment rates, especially among females were dismally low in the high fertility states where female autonomy and empowerment is still in question[52]. Correspondingly, the fertility, mortality and contraception behavior would be poorer in these societies. Girls' schooling is one of the major contributing factors to the favorable demographic scenarios in Kerala and Tamil Nadu. This has been made possible by strong political will and the role of the government in promoting education and health among people[33]. Whether the success of the educational and health programs in these states can be replicated in the states with high fertility needs to be seriously considered. Cultural factors also play an important role in influencing children ever

Table 6 *Results from Proportional Hazard Models for Children Ever Born to Ever-Married Women Currently Aged 20-29 Years by Acceptance of Sterilization and Background Variables in States below India's replacement level fertility, 1992-93.*

Variables	Andhra Pradesh			Punjab			Gujarat		
	β	Exp (β)	P	β	Exp (β)	P	β	Exp (β)	P
Contraceptive use									
No	0.000	1.00		0.000	1.00		0.000	1.00	
Yes	-0.337	0.71	0.000	-0.559	0.57	0.000	-0.422	0.66	0.000
Duration of marriage (in years)									
< 5	0.000	1.00		NS			0.000	1.00	
5-9	-0.404	0.67	0.040				0.895	2.44	0.005
10-14	-0.682	0.50	0.000				0.747	2.10	0.022
15 +	-0.862	0.42	0.000				0.595	1.81	0.091
Infant & child loss									
Survivors	0.000	1.00		0.000	1.00		0.000	1.00	
Infant deaths	-0.703	0.46	0.000	-1.054	0.35	0.000	-0.810	0.45	0.000
Child deaths	-0.432	0.65	0.019	-0.830	0.45	0.065	-1.309	0.27	0.000
Fetal loss									
Yes	0.000	1.00		NS			NS		
No	0.159	1.17	0.017						
Place of residence									
Rural	NS			0.000	1.00		NS		
Urban				0.186	1.21	0.078			
Education of mother									
Illiterate	0.000	1.00		0.000	1.00		0.000	1.00	
1-6 years of schooling	0.553	1.74	0.000	0.158	1.17	0.172	0.279	1.32	0.005
≥ 7 years of schooling	0.728	2.10	0.000	0.102	1.10	0.454	0.698	2.01	0.00
Religion of mother									
Hindu	0.000	1.00		0.000	1.00		0.000	1.00	
Others	-0.692	0.50	0.000	-0.100	0.90	0.272	-0.931	0.39	0.000
-2 Log likelihood	30348.4			7352.5			11308.5		
Model chi square	391.55		0.000	56.57		0.000	146.90		0.000

Note: NS denotes Not Significant in the likelihood ratio tests and was not included in the regression models. Exp(β) is the hazard ratio obtained from the corresponding regression coefficients.

born in India. The results show that fertility was higher among women belonging to other religious groups when compared to Hindu women, except in Punjab, where Sikhs dominate. Also, in Uttar Pradesh, Muslims constitute a major proportion after Hindus and the fertility behavior of Muslims has been predominantly higher in many states of India. This is because of male opposition to family planning and the persistence of traditional religious values, which influence Muslim women to neglect family planning measures[53].

The results of the proportional hazard models representing the effects of proximate and background factors on the hazard rate of completed family size by acceptance of sterilization are shown in Tables 6 and 7. The results indicate that the timing of completion of childbearing has been significantly influenced by all the selected variables, especially the proximate determinants. Those who had used spacing methods had completed their childbearing at later stages when compared to non-users. The relationship was found true in all the low and high fertility states. However, the results in the likelihood ratio tests were not significant in Haryana.

With regard to the marital duration, the results were significant only in Andhra Pradesh and Gujarat of the low fertility states. It is interesting to note that when compared to younger cohorts, who have had a comparatively shorter marital duration, older cohorts are more likely to get exposed to childbearing ($p<0.001$). The relative risks of prolonged childbearing were found directly proportional to the duration of marriage. This clearly amplifies the tendency among younger cohorts to go for smaller family size by resorting to early sterilization. On the other hand, no significant

Table 7. *Results from Proportional Hazard Models for Children Ever Born to Ever-married Women Currently Aged 20-29 Years by Acceptance of Sterilization and Background Variables in States above India's Replacement Level Fertility, 1992-93.*

Variables	Uttar Pradesh			Rajasthan			Haryana		
	β	Exp (β)	P	β	Exp (β)	P	β	Exp (β)	P
Contraceptive use									
No	0.000	1.00		0.000	1.00		0.000	1.00	
Yes	-0.502	0.60	0.000	-0.426	0.65	0.001	-0.143	0.86	0.093
Duration of marriage (in years)									
< 5	NS			NS			NS		
5-9									
10-14									
15 +									
Infant & child loss									
Survivors	0.000	1.00		0.000	1.00		0.000	1.00	
Infant deaths	-0.814	0.44	0.000	-1.043	0.35	0.000	-0.880	0.41	0.001
Child deaths	-1.305	0.27	0.000	-0.942	0.39	0.001	-1.081	0.33	0.019
Fetal loss									
Yes	NS			0.000	1.00		NS		
No				0.320	1.38	0.001			
Place of residence									
Rural	0.000	1.00		0.000	1.00		0.000	1.00	
Urban	0.456	1.57	0.000	0.277	1.31	0.020	-0.202	0.82	0.197
Education of mother									
Illiterate	0.000	1.00		0.000	1.00		0.000	1.00	
1-6 years of schooling	0.933	2.54	0.000	0.584	1.79	0.000	0.336	1.40	0.000
≥ 7 years of schooling	1.167	3.21	0.000	0.695	2.00	0.000	0.271	1.31	0.013
Religion of mother									
Hindu	0.000	1.00		0.000	1.00		0.000	1.00	
Others	-1.876	0.15	0.000	-0.795	0.45	-0.000	-1.382	0.25	0.000
-2 Log likelihood	13103.2			12935.9			10640.42		
Model chi square	510.68		0.000	158.76		0.000	137.22		0.000

Note: NS denotes Not Significant in the likelihood ratio tests and was not included in the regression models. Exp(β) is the hazard ratio obtained from the corresponding regression coefficients.

relationship was observed between marital duration and completion of childbearing in the high fertility states. This could be due to the lower levels of acceptance of sterilization or permanent methods of contraception in these states[14].

There exists a strong influence of the surviving status of children on the propensity to complete childbearing, in the high and low fertility states of India. The hazard of exposure to childbearing was found more likely among women who had experienced infant and child loss. This shows that women or couples are more likely to stop childbearing by resorting to sterilization, once their desired number of children are born and survive the infant and child stages of life. This result corroborates many other studies, which point out that fertility tends to be higher in regions where infant and child mortality is higher. Though the infant and child mortality in the low fertility regions has come to a lower level, the situation in the high fertility states is still deplorable. The results reveal that fetal loss has had significant effects on family size limitation, but only in the states of Andhra Pradesh and Rajasthan. The women who had fetal loss in terms of abortions or stillbirths are more likely to be exposed to higher fertility.

The background characteristics, especially education of women (respondents). also played an important role in determining the timing of completion of childbearing. The inclination to stop childbearing by adopting sterilization was found more pronounced in the urban areas of the selected states, except Haryana. The women who had some schooling were more likely to stop childbearing earlier, when compared to their illiterate counterparts. Further, those who had gone for higher levels of schooling were likely to stop reproduction at earlier stages. The significant association of women's education with childbearing was found highly relevant uniformly across the high and low fertility states. Regarding the cultural factors associated with fertility, early completion of reproduction was found to be more significant among Hindus when compared to members of other religions. The results were significant in all the selected states except in the state of Punjab, where Sikhs are dominant as compared to Hindus.

The Implications of Fertility Decline in the Future

One of the major implications of the current and future fertility decline in India is the phenomenon of population momentum. If the fertility in the low and high fertility states remains constant at exact replacement levels under the prevailing mortality conditions for a long time, the growth potential inherent in the population varying between states, is inevitable in any society. The estimated momentum figures show that India has an overall potential to add 34 percent to its original population size by the year 2019 until stationary stages are reached (see Table 8).

Table 8 *Momentum of Population Growth in India and Selected States.*

States	Year	Population Momentum
India	**2019**	**1.34**
Below Indian RPF		
Andhra Pradesh	2002	1.42
Punjab	2004	1.41
Gujarat	2017	1.32
Above Indian RPF		
Uttar Pradesh	2021	1.61
Rajasthan	2021	1.55
Haryana	2016	1.44

Note: The momentum in the states above Indian replacement fertility, except Haryana, is estimated around the time when India drops to replacement level fertility (2019).

In the case of the low fertility states, the states of Andhra Pradesh and Punjab will have a similar in-built growth potential due to momentum as the fertility drops to replacement levels. The state of Gujarat is expected to add about 32 percent to its population size by 2017 before reaching stationary levels. On the contrary, since the high fertility states are expected to take a longer time for replacement, the corresponding growth potential due to momentum is also much greater. Around the time when fertility in India reaches replacement levels, the states of Uttar Pradesh and Rajasthan will have tremendous growth potential, which is a warning to these states. The state of Haryana is expected to add another 44 percent of its population size by the time of replacement levels.

The growth due to population momentum also depicts the growth due to cohort flow or the process of aging of population, which is inevitable. An enormous increase in the population is anticipated, despite the declining trends associated with fertility. The fertility in the younger or the 20-29 years age group is still higher and further reductions are expected mostly from this age group. The sheer increase in the numbers of the high fertility states, coupled with under-development needs to be prudently considered. The further addition of population due to momentum would be a serious threat as it could hamper the developmental efforts in these states, especially with regard to poverty alleviation. Also, the problem of population momentum would aggravate the demographic situation of India, including the states which have already reached replacement level fertility. Even if India adopts the norm of one child per family as a strong policy measure, the implications of such a norm would be coercive and it would be effective only for minority groups. Therefore, the country should take stringent efforts to reserve basic resources such as food, shelter and clothing besides providing universal education and health facilities.

Conclusion and Discussion

An attempt has been made in this paper to assess the future scenario of Indian fertility decline and the causes and implications associated with it. It has become evident that most of the Indian states would be converging to replacement level fertility by the first decade of the next century. The projections based on log linear analysis show that India will be replacing its fertility by 2019 under the assumption that the observed decline during 1980-94 would continue in the future. The states of Kerala and Tamil Nadu have already reached replacement levels and Andhra Pradesh is going to do so by 2004. The high fertility state of Uttar Pradesh still requires another 74 years after India's attainment of replacement fertility level. The decline in the components of fertility decline was more pronounced in the 15-19 and 30-49 years age groups, and fertility is concentrated more in the 20-29 years age group. The tempo of fertility reduction in the latter component would determine the future levels of fertility in India. In general, India requires another 56 percent of fertility reduction to reach replacement level by 2019. The requirement of fertility decline is mostly sought from the state of Uttar Pradesh (80 per cent) whereas the state of Andhra Pradesh requires only 28 percent reduction to reach replacement level. The analysis of the proximate determinants and background factors associated with fertility behavior of the 20-29 years age group was done using data from the NFHS. The analysis based on proportional hazard models revealed that use of spacing methods, duration of marriage and ever experience of reproductive loss, including infant and child deaths, had significantly influenced fertility behavior of ever married women in the 20-29 years age group. The social and cultural factors, particularly education of women, also has had tremendous impact on the timing of completion of childbearing in India, especially in the high fertility states.

The changes that take place in the social and demographic forefront of the low fertility states are expected to occur in the high fertility states too. However, the change is time - dependent. One of the major implications of fertility decline in India is recognized as population momentum, and this will add another 34 percent to India's population by the time of replacement at stationary levels. The nature of current and future fertility developments can make a large difference in terms of the future size of the population. As the time and amount of reduction required to reach replacement levels are quite different in the states, the emerging demographic picture in the states could also be diverse, especially in terms of the age-structural changes. For example, aging of population is a phenomenon recently observed in the low fertility states, especially Kerala. And, even if all the women of child-bearing age were to have only 2 children each, the age structure of the population would still continue to grow for decades only due to momentum, because the next generation of mothers have already been born[55]. Unless there is a sharp and swift decline in the fertility levels as has happened in Tamil Nadu and Kerala, it may be difficult to control the population growth in India in the coming years[35].

The emerging demographic scenario of the high fertility states calls for precautions owing to the current trends of fertility as well as future in-built growth due to population momentum. In the state of Uttar Pradesh, population planning was more oriented towards social mobilization favorable to the political climate of the state and less attention was paid to health and education programs[55]. The effort of NGOs and other agencies on population issues and family planning programs is hardly implemented properly. The increasing number of potential job seekers in the state is also voluminous. All these social problems are going to add another disaster in terms of population and reproduction in this state. The experiences of the low fertility states have already shown that improvements in the levels of girls' schooling and popularization of family welfare measures have undoubtedly contributed to fertility transition. However, the effective implementation of family welfare programs is more important, especially at the individual level, than drafting a new population policy. Retherford and Ramesh, while analyzing determinants of fertility in Andhra Pradesh, argued that higher levels of education are not a necessary condition for low fertility in the state[40]. They suggested that a strong family welfare program could successfully reduce fertility to replacement levels despite less socio-economic development. However, this is a paradox if we consider the thesis of Das Gupta that social and economic development is necessary for reduction in fertility levels, and that is possible only through improvements in literacy levels[56]. It is argued here that it is the net effect or a chain of inter-dependent factors such as female education and accessibility and availability of health services along with individual reproductive behavior which bring down fertility levels in India. Also, a paradigm shift is required in the reproductive behavior of women, particularly in the 20-29 years age group. To conclude with Das Gupta[56], 'development and fertility decline are closely linked and the essential feature of this link is the generation of a sense of stability and control over individual life'.

Acknowledgments

An earlier version of this paper was presented at the International Workshop on 'Population Issues of India by the Dawn of the 21st Century' at Trivandrum, Kerala, India during 18-19, December, 1998. The authors would like to thank Dr PS Nair, Department of Demography, University of Kerala, for his valuable comments on this paper. Further this paper has been benefited by suggestions from Dr Frans Willekens, Dr Inge Hutter, Dr Ashish Bose and Dr Mari Bhat. We are grateful for their timely and valuable comments on this paper.

Notes

a National Family Health Survey (NFHS) was conducted all over India during 1992-93 that gathered retrospective information based on representative samples in various Indian states on fertility and health (maternal and child) aspects from women in the reproductive age groups (15-49 years).

b Craig (1994, p.20) [11] explicated that replacement level fertility is usually taken as 2.1, i.e., the level of fertility at which a population would exactly replace itself, the other things being the same.

c The importance of other proximate determinants such as lactation, and postpartum infecundity could not be explored as these variables were available only for a few years preceding the survey.

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