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Research Article

Does early childbearing and a sterilization-focused family planning programme in India fuel population growth?

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Does early childbearing and a sterilization-focused family planning programme in India fuel population growth?

Zoë Matthews[1]

Sabu S. Padmadas[2]

Inge Hutter[3]

Juliet McEachran[4]

James J. Brown[5]

Abstract

Recent stagnation in the reduction of infant mortality in India can arguably be attributed to early child bearing practices and the lack of progress in lengthening birth intervals. Meanwhile, family planning efforts have been particularly successful in the southern states such as Andhra Pradesh, although family limitation is almost exclusively by means of sterilisation at increasingly younger ages. This paper examines the population impact of the unprecedented convergence of early childbearing trajectories in India and quantifies the potential implications stemming from the neglect of strategies that encourage delaying and spacing of births. The effects of adopting a 'later, longer and fewer' family planning strategy are compared with the continuation of fertility concentrated in the younger age groups. Results from the cohort component population projections suggest that a policy encouraging later marriage and birth spacing would achieve a future total population which is about 52 million less in 2050 than if the current early fertility trajectory is continued.

[1] Centre for Global Health, Population, Policy and Poverty & Southampton Statistical Sciences. Research Institute, University of Southampton, United Kingdom. Email: z.matthews@soton.ac.uk
[2] Centre for Global Health, Population, Policy and Poverty & Southampton Statistical Sciences. Research Institute, University of Southampton, United Kingdom. Email: s.padmadas@soton.ac.uk
[3] Population Research Centre, University of Groningen, The Netherlands. Email: i.hutter@rug.nl
[4] Independent Research Consultant (Demography), London. Email: julietmce@googlemail.com
[5] Department of Quantitative Social Science, Institute of Education, University of London. Email: j.brown@ioe.ac.uk

1. Introduction

Successful family planning efforts have been achieved in India in recent years, particularly in some states such as Andhra Pradesh, although family limitation is achieved almost exclusively by means of sterilisation at increasingly earlier ages. Such an emphasis on sterilisation supports a pattern of early childbearing with short birth intervals. As a result the age-specific childbearing trends in India are currently heading towards an extreme pattern, not seen elsewhere in the world. Despite the decline in fertility, which can be seen as at least partly attributable to the sterilisation-based policies of the Government of India, there may be unforeseen consequences of rapid increases in early sterilisation and the compression of reproductive spans (Padmadas, Hutter, and Willekens 2004; Dyson 2002). Other theorists of population dynamics have emphasised the role of early childbearing in fuelling population growth. Among them, Tomas Frejka, quoted below from his original text describing the principles of population dynamics, would support this underexplored supposition. He states that: "an upward shift in the mean age of childbearing will reinforce deceleration of population growth, and, to the contrary, a downward shift will retard the deceleration of population growth." (Frejka 1973:149).

Indeed, when controlled for the number of children born per woman, mothers who give birth during their later years contribute more towards low population growth rates than those who give birth to their children early in life (Rajaretnam 1990). As the mean age of childbearing increases, the Total Fertility Rate (TFR) declines temporarily, even if women continue to eventually accomplish the same family size as before. In demographic parlance, this phenomenon is referred to as tempo effect, which has recently been demonstrated as operating across many less developed countries (Bongaarts 1999). Delayed childbearing and the promotion of longer birth intervals not only encourages lower fertility but also reinforces the deceleration of population growth (Bongaarts 1994). This characteristic of population dynamics, which was previously understood by the Chinese population planners and used to encourage a 'Later, Longer, Fewer' strategy (Bongaarts and Greenhalgh 1985) could also be adopted in India.

This paper examines the population impact of continued early childbearing trajectories in India and systematically contrasts this with the potential effect of strategies that encourage delaying and spacing of births. Using population projections, we examine the effect of adopting a family planning strategy that encourages later births and longer birth spacing. This effect is then compared with the outcome of any continuation of the current trend in Indian fertility patterns, with fertility concentrated in the 15-25 year age group. The latter option is commensurate with the continued rise in sterilisations. The main datasets used in this study include those from the Sample

Registration System (SRS), the National Family Health Surveys (NFHS), the Census of India and the United Nations World Population Prospects Database.

The paper is structured as follows: an overview of recent fertility and population growth is presented in the first section to set the scene, followed by a section briefly describing the history of family planning efforts in India and the recent rise in sterilisations. After this, two analytical sections present firstly the future fertility and secondly the possible population impact of pursuing the current early childbearing pattern in India. The discussion section reflects on possible future directions for family planning policy in India and includes some speculation on wider societal costs and benefits. Because of considerable demographic and cultural diversity among Indian states, policy generalizations must be tempered by a regional perspective. In this paper we have given a state oriented view of both the evolution of contraceptive use and the continued shortening of women's reproductive careers.

2. Recent population dynamics, growth and fertility in India

In comparison with the steep decline in fertility seen in some less developed countries over the last two decades, India has experienced a slow but steady fertility decline with some stagnation in recent years (Table 1). Although there is clear evidence of falling overall fertility, the national level aggregates mask regional variations. More dramatic drops have been seen in some of the southern states, notably Andhra Pradesh, where the TFR has declined from 4.6 in 1971 to 1.8 in 2005-06. The corresponding decline of the period TFRs in the northern and the central states were relatively less significant. Among states that have reached below replacement levels, Goa was the first in the mid 1980s, Kerala in 1988, Tamil Nadu in 1993 and Andhra Pradesh very recently. The northern states will have to wait for a few more decades to reach replacement level fertility (Dyson 2002). Concomitant to the declines in TFRs, a considerable proportion of births in India tend to occur in the lower reproductive age groups, mostly below 25 years.

In recent years, largely attributed to increase in the use of irreversible methods, the age pattern of childbearing in India has been changing to a very early pattern, which has become the most extreme of any society in the world. Within those states whose family planning campaign has been particularly successful, such as Andhra Pradesh, this early childbearing pattern becomes especially noticeable within the last decade of the 20th century. The age patterns of fertility over time in Andhra Pradesh as shown in Figure 1a confirm the extent of this trend. For a comparison, the age-specific fertility in world regions, India and Andhra Pradesh is graphically presented in Figure 1b. The

comparisons reveal that the level of very early (adolescent) childbearing in Andhra Pradesh is more than double that of any other world region.

Despite this overall decline in fertility levels, there has been little effect on the pace of Indian population growth[6]. The crude birth rate declined from 36.9 (per 1000) in 1971 to 25.8 in 2000 whereas the crude death rate declined from 14.9 (per 1000) to 8.5 during the same period (Registrar General of India 2002). The average annual exponential growth rate during 1991 was 2.14% which declined to 1.93% during 2001. The absolute size of the Indian population as on March 2001 was estimated approximately at 1027 million from 548 million in 1971 and 846 million in 1991 [7]. The reductions in growth rates largely as a result of unexpected fertility decline in the 1990s also influenced the age structure of India's population. In particular, the proportion of children aged 0-6 years decreased from 17.9% in 1991 to 15.4% in 2001. These changes were also partly accompanied by the declining sex ratios in the 0-6 age group (945 females per 1000 males in 1991 to 927 in 2001) that suggested two possibilities; a) sex selected distortions in the reported ages of children and b) the prevalence of sex selective abortions leading to excess female mortality. In their analysis, Das Gupta and Bhat (1998) suggested that excess female mortality in the younger ages were because of not only the overall reductions in high parity births but also the increase in the intensification of parity-specific discrimination. This intensification seems highly pronounced in northern India, where sex-selective abortion services have over time steadily increased (Dyson 2001; Mayer 1999; Basu 1999). On the other hand, the recent trends as revealed in national surveys indicate that regardless of these gender preferences many Indian couples desire fewer children and thus wish to stop childbearing early in their reproductive careers.

[6] Population growth in India during the twentieth century can be categorized into four distinct phases. Firstly the period 1901-1921 was characterized by a stagnant phase, secondly during 1921-1951 India experienced steady growth, then in 1951-1981 rapid high growth occurred and more recently during 1981-2001 high growth continued but with clear indications of deceleration in growth rates concomitant to decline in fertility levels (Census of India 2001).

[7] It is worth noting here that the official population projections based on the 1996 period projected India's population in 2001 to be 1012 million which was nearly 15 million less than actual population (Census of India 2001; Registrar General of India 1997). The underestimations of the 2001 total population were particularly marked in larger states such as Uttar Pradesh, Bihar, Haryana and Gujarat. For example, the decadal growth rate in Bihar rose unexpectedly from 2.10% in 1981-1991 to 2.50% in the following decade. However, the underestimations of total population in the larger states were somewhat counterbalanced by reduced population growth rates in states such as Andhra Pradesh, West Bengal, Kerala and Tamil Nadu

Table 1: Changes in period total fertility rates in India and selected states, 1971–2006

	Year					
Region / states	**1971**	**1981**	**1991**	**1992–93[a]**	**1998–99[b]**	**2005-06[c]**
India	5.2	4.5	3.6	3.4	2.9	2.7
North						
Delhi	na	na	1.8	3.0	2.4	2.1
Haryana	6.7	5.0	4.0	4.0	2.9	2.7
Himachal Pradesh	na	na	3.0	3.0	2.1	1.9
Jammu & Kashmir	na	na	na	na	2.7	2.4
Punjab	5.2	4.0	3.1	2.9	2.2	2.0
Rajasthan	6.3	5.2	4.6	3.6	3.8	3.2
Central						
Madhya Pradesh	5.6	5.2	4.6	3.9	3.3	3.1
Uttar Pradesh	6.6	5.8	5.1	4.8	4.0	3.8
East						
Bihar	na	5.7	4.4	4.0	3.5	4.0
Orissa	4.7	4.3	3.3	2.9	2.5	2.4
West Bengal	na	4.2	3.2	2.9	2.3	2.3
Northeast						
Arunachal Pradesh	na	na	4.1	4.3	2.5	3.0
Assam	5.7	4.1	3.5	3.5	2.3	2.4
Manipur	na	na	2.5	2.8	3.0	2.8
Meghalaya	na	na	4.1	3.7	4.6	3.8
Mizoram	na	na	na	2.3	2.9	2.9
Nagaland	na	na	2.3	3.3	3.8	3.7
West						
Goa	na	na	1.6	1.9	1.8	1.8
Gujarat	5.6	4.3	3.1	3.0	2.7	2.4
Maharashtra	4.6	3.6	3.0	2.9	2.5	2.1
South						
Andhra Pradesh	4.6	4.0	3.0	2.6	2.3	1.8
Karnataka	4.4	3.6	3.1	2.9	2.1	2.1
Kerala	4.1	2.8	1.8	2.0	2.0	1.9
Tamil Nadu	3.9	3.4	2.2	2.5	2.2	1.8

Note: SRS was not operational in Mizoram until 1995. na: not available.

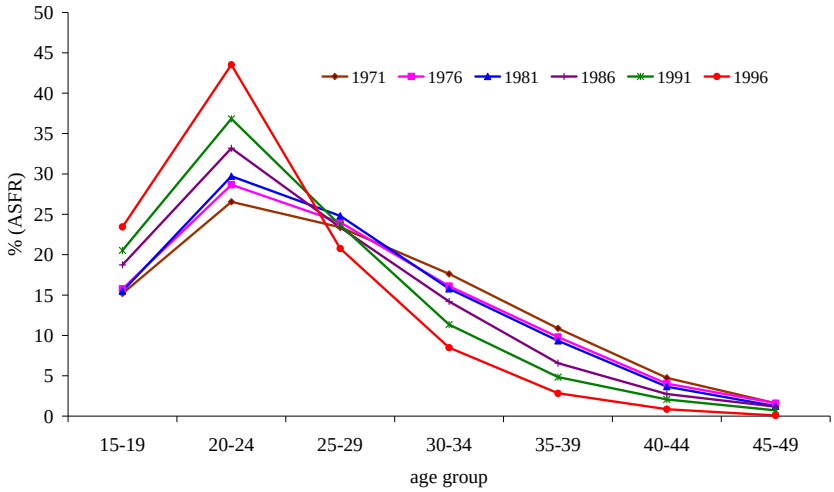
The estimates for the 2005-06 NFHS exclude those for three newly formed states in 2000 which were part of some of the largest states. Jharkhand state was formed out of the southern districts of Bihar, Chhattisgarh was formed out of eastern Madhya Pradesh, and Uttaranchal was formed out of the hilly areas of northwest Uttar Pradesh.

Data source: The estimates for the year 1971-91 were obtained from Sample Registration System (SRS, 1999).

[a] National Family Health Survey, 1992-93 (IIPS, 1995), [b] National Family Health Survey, 1998-99 (IIPS, 2000).

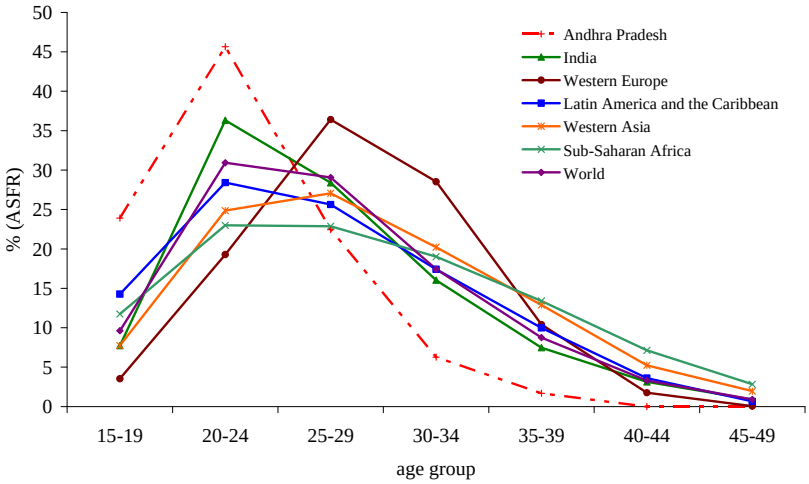
[c] National Family Health Survey, 2005-06n (IIPS, 2007).

Figure 1a: Age patterns of fertility in Andhra Pradesh (%), 1971–96



Data source: Sample Registration System 1999

Figure 1b: Age patterns of fertility, Andhra Pradesh, India and the World regions (%), 1995–2000



Data source: Sample Registration System 1999; United Nations 2000

3. Family planning programmes and the evolution of sterilisation

Family planning in India continues to be synonymous with sterilisation, although government policies strive to promote reversible methods (Bose 1993). Indeed much of the recent fertility decline in India (especially in the southern states) is attributed to increasing acceptance of sterilisation, particularly female sterilisation. Family planning evolution and the widespread high use of sterilisation has several roots.

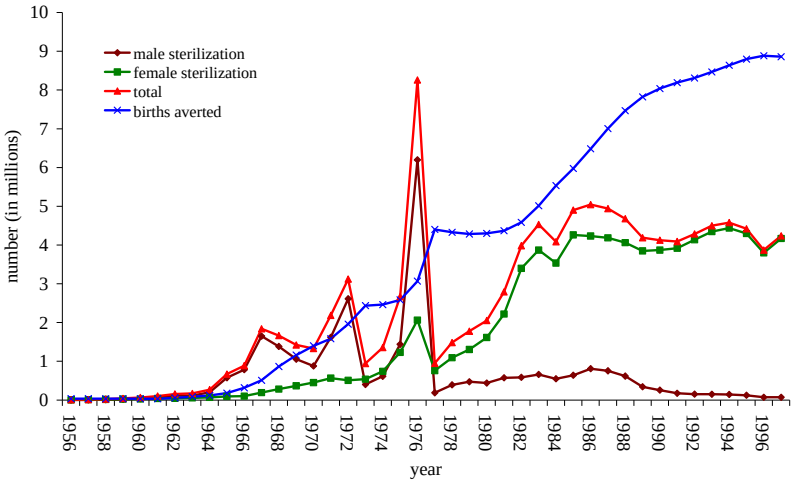
During the early phases of the health and family planning programmes in India, sterilisation services were introduced only in few Indian states for men especially in large cities such as Madras and Bombay; the programme initially focused on the distribution of diaphragm, jelly, vaginal foam tablets and condoms. A clinic-oriented approach to family planning prevailed in the first (1951–56) and the second (1956–61) five-year plans of the government of India. The third five-year plan (1961–66) introduced the cafeteria approach[8] as a strategy to promote different methods. The year 1962–63, when this new approach was first implemented, was considered as an important landmark in the Indian family planning programme (Srinivasan 1998; Raina 1994). As a part of this initiative, the IUDs introduced in 1965 turned out to be a failure as a result of side effects and high expulsion rates of the Lippes loop. Meanwhile, population planners recognized the problems associated with rapidly increasing population and felt the dire need for an effective population control programme. In response to this, sterilisation, especially vasectomy, was given due emphasis in the official family planning programme initiated during the inter-plan period (1966–69). As an effective promotion strategy, incentive systems were introduced for both clients and providers during this period (Srinivasan 1998).

The plans to popularize sterilisation were strengthened during the fourth plan (1969–74) through the launch of large-scale mobile camps. In consequence, the cafeteria approach gradually faded out and a more targeted approach to family planning emerged that focused on sterilisation, aimed at couples with three or more children. The successful implementation of the Ernakulam sterilisation camp in Kerala in 1971 where 62,913 vasectomies were performed along with the 1976 compulsory sterilisation law first introduced in Maharashtra for couples with three or more children provided a strong footing for further increase in sterilisation acceptance across various states in India (Nair 1974). The peak of this programme occurred when more than 8.26 million sterilisations were conducted during the mid-1970 emergency period. This peak had political consequences, bringing down the ruling party of Congress, the government under the leadership of Prime Minister Indira Gandhi (Basu 1985). The operation of mass sterilisation camps all over India from the mid 1960s had its effect as it can be

[8] Under the cafeteria approach women or couples could choose methods of their own choices.

seen from the substantial waves of total sterilisations over time shown in Figure 2. During the formation of a new government under the leadership of the Janatha party, the idea of coercive family planning was ruled out; but it did not exclude sterilisation from the later planning periods (Rao 2004). Subsequently male sterilisation declined and female sterilisation soon outpaced it.

Figure 2: Evolution of sterilisation and births averted, India, 1956–1996



Data source: Family welfare programme in India, Year book, various volumes

Government incentives, offered to potential clients and providers throughout the late 1960s and the 1970s, undoubtedly contributed to the rise of permanent methods over temporary methods in the country. The coercive aspect to family planning that predominated at that time, coupled with widespread poverty, influenced many families to accept these incentive-based sterilisations (Basu 1985; Cleland and Robinson 1992). The combination of incentives and the proven efficacy of the method motivated many couples to accept sterilisation, while simultaneously satisfying the providers' need for achieving their target numbers. From the 1980s onwards, male sterilisation faded in importance to the national family planning programme as depicted by the trends shown in Figure 2.

Later in the 1990s following the ICPD recommendations and in response to the documentation of corruption within the target-oriented programme, the Indian government adopted a target-free approach in April 1996 (Srinivasan 1998). Under the new target free philosophy, grassroots workers were made responsible for offering

family planning services to couples who were interested both in spacing births and in limiting their family size. Thus, in recent years, the pressure for women to accept sterilisations after their third child has been, at least theoretically, relaxed.

Despite the changes in policy, the use of spacing methods remained very low while sterilisation acceptance continued to rise. The first round of the National Family Health Survey conducted during 1992–93 reported that 27.4% of currently married women aged 15–49 years were sterilized which increased to 34.2% during 1998–99 and further to 37.3% during 2005-06 in the second and third rounds respectively (IIPS 2000). This has been accompanied by a marginal fall in the median age of female sterilisation, which decreased from 26.6 years during 1992–93 to 25.7 and 25.5 years during 1998–99 and 2005-06 respectively. A minimal increase in the women's marriage age together with a sharp decline in their age at sterilisation has resulted in the compression of women's reproductive spans (Padmadas, Hutter, and Willekens 2004); especially in Andhra Pradesh where recent sterilisation acceptance rates increased by about 65% between NFHS-1 and NFHS-3 (Table 2). The median age at sterilisation in this state also declined marginally from 24.5 to 23.3 years.

The rise of female sterilisation in Andhra Pradesh from 38.1% to 62.9% in just over ten years is dramatic – similar patterns are clearly emerging in larger states such as Madhya Pradesh and Uttar Pradesh. However, the compression of reproductive spans of women seen in Andhra Pradesh is mirrored by the overall Indian situation, as can be seen in Figure 3. NFHS showed that the timing of marriage, along with that for first and second births, has not changed much for the younger cohorts. In Andhra Pradesh the timing of these events tends to be around one year earlier than for the overall India case, but only the timing of sterilisation has changed over time. Median ages at sterilisation have dropped by almost two years between every five year cohort surveyed in 2005-06. This is true for India as a whole, as well as for Andhra Pradesh.

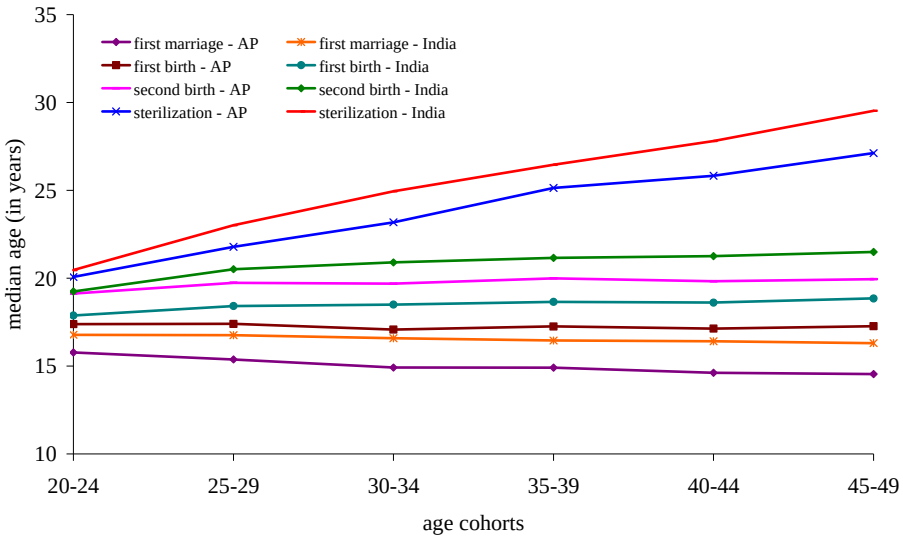
In summary, there is a tendency among women in India to enter into marriage at young ages, and for fertility to converge towards younger ages, births soon after marriage and increasingly early sterilisation. India as a whole is set to embark on a continuation of these trends, converging towards the patterns seen in Andhra Pradesh. This 'Andhra-isation' of India is likely to produce a pattern of childbearing which is not seen elsewhere, especially not where levels of development are as high as they are in India. The extent to which a diverse setting such as India will follow 'Andhra-isation' is arguable, especially given that the levels of education for women in that state are still low compared to others, and that the age at marriage in India may rise, whereas that in Andhra is currently very low. However, given that the rise in sterilisation can be seen throughout India, including in progressive states such as Kerala and Tamil Nadu, the establishment and continuation of an earlier pattern of childbearing is almost inevitable in India.

Table 2: Changes in female sterilization between 1992-93 and 2005-06, India and states

	%			
Region / states	**1992-93**	**1998-99**	**2005-06**	**% increase[a]**
India	27.3	34.2	37.3	36.6
North				
Delhi	20.0	26.3	23.0	15.0
Haryana	29.7	38.7	38.2	28.6
Himachal Pradesh	32.6	45.1	49.0	50.3
Jammu & Kashmir	25.3	28.0	26.3	4.0
Punjab	31.5	29.3	30.8	-2.2
Rajasthan	25.3	30.8	34.2	35.2
Central				
Madhya Pradesh	26.4	35.7	52.2	97.7
Uttar Pradesh	11.7	14.9	29.3	150.4
East				
Bihar	17.3	19.2	23.8	37.6
Orissa	28.2	33.9	33.1	17.4
West Bengal	26.3	32.0	32.2	22.4
Northeast				
Arunachal Pradesh	10.3	20.6	22.5	118.4
Assam	12.1	15.7	13.0	7.4
Manipur	10.9	14.4	8.2	-24.8
Meghalaya	9.4	6.5	9.5	1.1
Mizoram	44.5	45.2	42.9	-3.6
Nagaland	6.3	12.3	9.9	57.1
West				
Goa	29.5	27.8	25.8	-12.5
Gujarat	37.5	43.0	42.9	14.4
Maharashtra	40.0	48.5	51.1	27.8
South				
Andhra Pradesh	38.1	52.7	62.9	65.1
Karnataka	41.0	51.5	57.4	40.0
Kerala	41.8	48.5	48.7	16.5
Tamil Nadu	37.5	45.2	55.0	46.7

Data source: National Family Health Surveys, IIPS (1995; 2000; 2007)
[a]denotes the percentage change between 1992-93 and 2005-06.

Figure 3: Median age at reproductive events, Andhra Pradesh and India, 2005–06



Data source: IIPS (2007)

The effect of narrowing reproductive spans is likely to be the shortening of birth intervals. However, the evidence for this in India is mixed. Studies show that the proportion of births with a preceding birth interval of less than two years is increasing in some states, especially those with high fertility, but this is not universal in India, and mean birth intervals remain almost static around 24 months (Whitworth and Stephenson 2002; Pandey et al. 1998; Nath, Land, and Singh 1994; Bhargava, Singh, and Saxena 1991). On the other hand, there is little progress in the reduction of infant mortality in India, particularly in large states (IIPS & Macro International 2007). Indeed the recent stagnation in the decline of mortality in early ages could arguably be attributed to the lack of progress in lengthening birth intervals which is already confirmed in India (Whitworth and Stephenson 2002). Also, it is not unlikely that the harmful effect of short birth intervals on infant mortality in India will continue to be a side effect of early sterilizations.

4. The future patterns of Indian fertility

How accurately can we forecast future fertility levels? This question has been confronted and debated by demographers for many decades. In India, the Sample Registration System (SRS) is the only source for TFR data through the late 1980s. Later on, beginning in the early 1990s, the NFHS became available which allowed for comparison of period TFRs for three years preceding the surveys. NFHS records births based on individual birth histories. However, the reliability of both SRS and NFHS in recording fertility data has been questioned, particularly the impact of displacement effect, incompleteness and under-reporting of births (Bhat 2002a; Retherford and Mishra 2001; Narasimhan et al. 1997). The general consensus of demographers is that NFHS, using birth history estimates rather than corrected own children rates, probably overestimated the pace of fertility decline in India. The successive NFHS have produced TFRs that are well below SRS estimates in some states, for example NFHS-2 in Bihar, Haryana and Uttar Pradesh. For all India, the SRS data in 1997 show relatively older age pattern of fertility than does the NFHS conducted during 1998–99 (IIPS 2000; Registrar General of India 1999). Although a discussion on the discrepancy between SRS and NFHS is beyond the scope of this paper, we compare both sources at the state levels, however emphasising the advantage of NFHS owing to a nationally represented fertility data derived from detailed birth histories. Taking into consideration the regional heterogeneity vis-à-vis north-south differences in fertility rates, and moreover the variations at district levels, several researchers suggest the need to consider regional and provincial level estimations for forecasting fertility (Dyson 2002; Bhat 2002b; Bocquet-Appel et al. 2002; Guilmoto and Rajan 2001; Nair and Padmadas 1999).

Different fertility assumptions have been taken into account for forecasting fertility. While a cohort based TFR might yield better results there is no such data provision yet in the Indian case. The official national population projections made by the Registrar General of India used regression equations to estimate annual period TFRs at state level based on the period 1980-1993 (Registrar General of India 1997). In this case, the TFR was assumed to reach below the replacement level of 2.1 children per woman by the year 2026. Although regional variations were considered, it did not explicitly consider the pace of fertility transition especially in the northern larger states where fertility levels are also largely underestimated. Dyson (2002) produced non-linear fertility trajectories for India based on a plausible faster rate of decline assumptions using correction factors for SRS-based period TFRs, especially for the high fertility states including Uttar Pradesh. Dyson's estimates suggested that a TFR of 2.13 (high variant: 2.30, low variant: 1.98) is plausible in India by 2015-20.

We believe that a general assessment of the under enumeration issues based on both SRS and NFHS need to be considered for the estimation of future fertility in India. A revision made by Bhat (2002b:379) suggested the following modifications. First, the base 1984-90 SRS-TFR was adjusted for under-enumeration of births taking into account of the under-enumeration of births observed in the NFHS. Second, TFRs were projected assuming a Gompertz model (S-shaped curve) instead of linear or log-linear models. Third, all-India TFRs were derived as weighted averages of individual state-specific assumptions. The state-weighted average projected values of TFR at an all-India level suggested a replacement fertility level of 2.11 by 2016-20, which was close to that suggested by Dyson (2002). The latter approach accounted for possible social changes in India vis-à-vis a modest increase in the age at first marriage, reproductive behaviour of working populations, further uptake of family planning especially sterilisation and the enormous heterogeneity between states observed in fertility rates.

The challenge, however, is to forecast the changes in the age patterns of childbearing particularly in the context of increase in the uptake of female sterilisation as observed in Andhra Pradesh. We compared the age patterns of fertility in Andhra Pradesh and India between the sterilized and non-sterilized women[9]. The ASFRs were estimated based on the period for three years preceding the surveys (not shown separately). The completed fertility experiences of sterilized women indicate childbearing to be clustered around very young ages. The third round of NFHS (2005-06) also showed that the period TFRs tend to be much lower among the sterilized than for the non-sterilized groups. In Andhra Pradesh, the differences in period TFRs for the sterilized and non-sterilized appear to be less significant. Sterilized women usually have given births at relatively young ages. The expected rise in female sterilisation especially in the context of poor spacing behaviour is likely to retain or accelerate young fertility in India.

5. Population impact of early childbearing

Given the pattern of increasingly early childbearing in India, with a possible move to the trends seen in Andhra Pradesh, it is likely that the population will increase more rapidly under current conditions compared with a move to later childbearing due to a shorter generational duration. To what extent this may happen can be gauged by carrying out population projections which compare early childbearing patterns with late patterns. As a first approximation to this, early childbearing patterns can be taken from the Andhra Pradesh case itself, and later childbearing patterns can be suggested by a

[9] The ASFRs calculated for the sterilized group were conditional on completed fertility experiences. The non-sterilized groups in each age group include those exposed to the risk of childbearing.

western Asian pattern which currently tends towards childbearing at older ages (although not as late as is currently seen in western Europe; see Figure 1b). Keeping the underlying period fertility levels constant whether early or late patterns are used, cohort component projections were carried out to test the magnitude of this effect from 1990 up to the year 2050. Period fertility assumptions used by various analysts are shown in Table 3. We have carried out projections based on all of the alternatives, but the United Nations variants have been used as a focus for the range of possible trajectories.

Table 3: Assumptions regarding future fertility levels, 1995–2050

		Total fertility rates in the projection period					
Assumptions	**Variant**	**1990–95**	**1995-00**	**2000-05**	**2005-10**	**2010-15**	**2015-20**
Bhat (2002) State-weight corrected TFR	Medium	3.80*	3.42	3.01	2.65	2.36	2.14
Dyson (2002) State-weight corrected TFR	High	3.80*	3.42**	2.92	2.68	2.48	2.30
	Medium	3.80*	3.42**	2.84	2.55	2.33	2.13
	Low	3.80*	3.42**	2.81	2.46	2.20	1.98
United Nations (2002)	High	3.80	3.45	3.26	3.12	2.96	2.78
	Medium	3.80	3.45	3.01	2.70	2.46	2.28
	Low	3.80	3.45	2.76	2.27	1.96	1.78
		2020-25	**2025-30**	**2030-35**	**2035-40**	**2040-45**	**2045-50**
Bhat (2002) State-weight corrected TFR	Medium	1.97	1.86	1.78	1.73	1.71	1.70
Dyson (2002) State-weight corrected TFR	High	2.14	2.10	2.10	2.10	2.10	2.10
	Medium	1.94	1.81	1.80	1.80	1.80	1.80
	Low	1.78	1.59	1.50	1.50	1.50	1.50
United Nations (2002)	High	2.64	2.52	2.42	2.35	2.35	2.35
	Medium	2.14	2.02	1.92	1.85	1.85	1.85
	Low	1.64	1.52	1.42	1.35	1.35	1.35

* denotes SRS estimate; **denotes Bhat estimate (2002)

In building assumptions for these projections, it is necessary to speculate on the future evolution of age specific fertility under the early and late childbearing scenarios. The first of these must be seen as likely if current trends continue, and the second should be constructed such that it is achievable given a different emphasis on birth spacing. The patterns used in the projections shown in Figures 4a and 4b are based on the following considerations. Firstly both early and late childbearing patterns start in

Figure 4a: Assumptions for early childbearing pattern

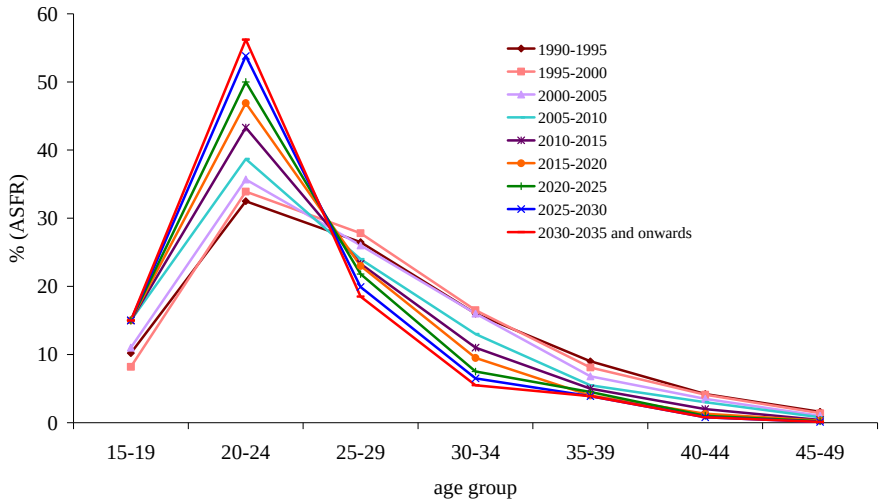
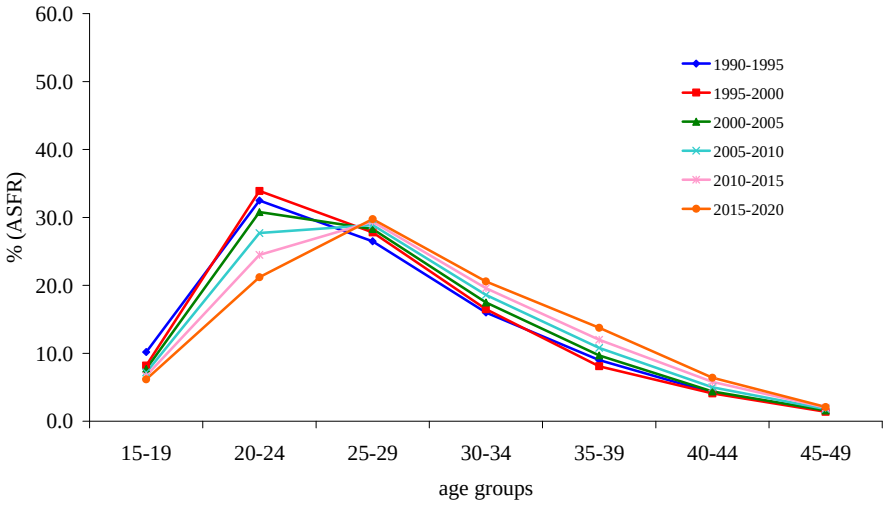


Figure 4b: Assumptions for late childbearing pattern



1990-2000 with the actual estimated pattern given by the Sample Registration Survey (Registrar General of India 1999). For the early pattern, the age-specific proportional pattern which is currently seen in Andhra Pradesh, as estimated by the SRS is applied in 2020, and the continuation of current trends in Andhra is applied up to 2030 until the childbearing proportion below 25 years is 70%. The proportion of fertility assumed in the first age group of 15-19, however, is not assumed to rise higher than 15% in India as a whole, given the likelihood of future modest increases in the age at marriage, especially in rural India which constitutes about three-fourth the total population. For the late childbearing pattern, the current pattern seen in western Asia (reported in United Nations 1999: 45) is applied in 2020, with a gradual proportional change to that position, and keeping the proportions of fertility constant by age after 2020. We followed the standard Coale and Demeny west model life tables to account for mortality assumptions. It is possible that the age-specific survivorship ratios could be slightly distorted in the future considering potential changes in infant mortality levels and the increases seen in HIV/AIDS mortality. However, we consider these influences to be trivial in the projection models. Net migration was not considered in the model based on the grounds that total net migration would be considerably negligible relative to India's absolute total population size. The sex ratios at birth were assumed to be 105 males for every 100 females.

The results of the projections show that the change from early to late patterns of childbearing can have significant effects on the population size of the country. As can be seen from Figure 5, the population trajectories for the two scenarios are within the high and low variants postulated by the United Nations, but by 2050, the difference between them has amounted to about 52 million extra persons. The two scenarios can also be applied to the UN upper and lower variants. If higher fertility is assumed, then the difference between late and early childbearing is magnified, such that the excess population under early childbearing exceeds 100 million. It should also be noted that the projections are sensitive to late pattern changes more than they are to early pattern changes. It is possible to assume a less extreme early childbearing regime with similar results, but a small change to late childbearing can affect the second scenario projection substantially. The projected medium variant total Indian population falls closely within the range as those estimated by other organizations and researchers (United Nations 2002; Bhat 2001; US Census Bureau 2004).

The timing of childbearing also exerts some effect on the population age structure. We constructed population pyramids to examine the potential changes in the age structure classified according to the early and late childbearing patterns (not shown separately). The upper base of the pyramid tends to expand over time as each age cohort moves upwards and this phenomenon seems much accentuated particularly for the early childbearing pattern; the expansion is reflected more in terms of absolute numbers than

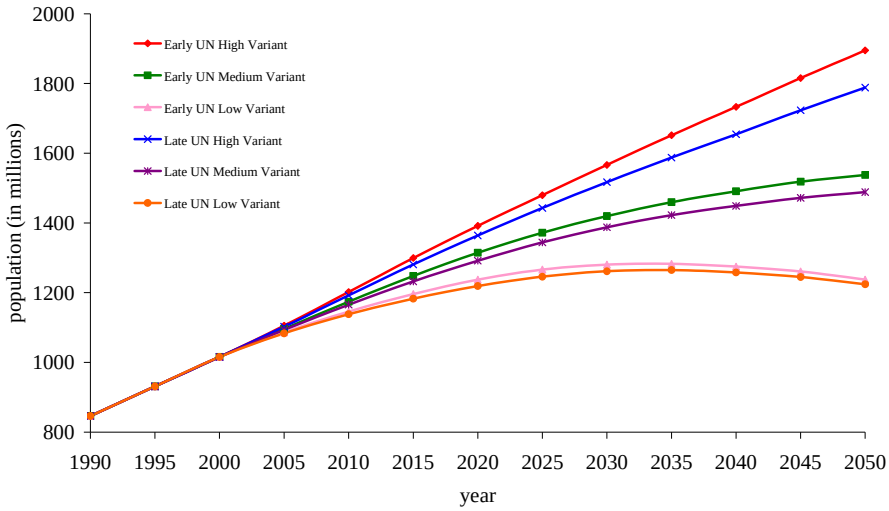
proportions. Nevertheless, it is apparent that the absolute population, especially in the older ages, is likely to grow much faster if childbearing occurs early among prospective young female cohorts in the reproductive ages. The effect of the already in-built population momentum in India would be noticeably higher under the early childbearing scenario, with a sizeable bulge in the older age cohorts.

Unsurprisingly the results were also sensitive to the fertility trajectory assumed. Given that a number of analysts have commented on the possible future of fertility in India, and that official forecasts have often been exceeded, it is worthwhile to look at alternatives to the United Nations published forecasts. Both Bhat (2002) and Dyson (2002) have published more sophisticated state-weighted forecasts of future fertility, both of which predict lower fertility in the long term than the United Nations. The differences between these two recent forecasts are small, but based mainly on the 'variant' to which fertility might eventually fall. Dyson (2002) in particular, has produced alternative forecasts based on low, medium and high variants. Using these alternatives, we have repeated the projections for early and late childbearing based on the revised fertility according to these authors, with the results shown in Table 4. Clearly there is less impact of childbearing patterns when using these fertility assumptions, but this is due to the fact that impact is greater where assumed fertility is higher. The excess population due to young childbearing pattern is estimated between 22.7 and 51.9 million persons at 2050 from the three scenarios suggested by Dyson, and the impact based on Bhat's forecast falls centrally within this range. Even by the year 2025, the impact is likely to be in excess of nearly 25 million additional persons, under all fertility assumptions.

Table 4: Total population (in millions) for the years 2050 and 2025 from projections based on early and late childbearing patterns

		Source of fertility assumptions						
		Bhat (2002)	Dyson (2002)			United Nations (2002)		
Year	Childbearing pattern		High variant	Middle variant	Low variant	High variant	Medium variant	Low variant
2050	Early	1457.0	1584.0	1439.7	1324.3	1895.0	1537.7	1237.6
	Late	1418.8	1532.1	1405.9	1301.6	1788.3	1488.4	1224.1
	Difference	38.2	51.9	33.8	22.7	106.7	49.3	13.5
2025	Early	1347.5	1366.5	1330.8	1303.7	1479.6	1371.8	1266.1
	Late	1321.3	1339.8	1306.7	1281.3	1442.8	1344.0	1246.0
	Difference	26.2	26.7	24.1	22.4	36.8	27.8	20.1

Figure 5: Projected population of India based on early and late childbearing patterns, 1990–2050



6. Discussion

The analyses presented in this paper have illustrated that, in India, a younger age pattern of fertility and the rise in sterilisation combined with shorter rather than longer birth intervals will encourage faster population growth. If the United Nations medium variant forecasts of Indian fertility are to be relied upon, by 2050, the additional number of persons in India's total population due to an early childbearing pattern will be as much as 52 million – nearly five times the current size of the Belgian or Hungarian population or more than 50% of the total population of all northern European countries put together. However, both the Bhat and Dyson medium variants using lower fertility assumptions produce relatively reasonable gains in population by 2050 (38.2 and 33.8 million respectively). This suggests that the results are highly sensitive to the assumptions made about current levels and future trends in fertility.

Future development prospects are perennially uncertain given the facts that most Indian couples still want an average of 2.3 children and that family planning needs, especially for spacing planning, remain drastically unmet for most regions of the

country (IIPS & Macro International 2007). If higher fertility is assumed, then the difference between late and early childbearing is magnified, such that the excess population under early childbearing exceeds 100 million. Applying the same analysis to more recent fertility projections produced by Indian demography experts put the excess population due to childbearing pattern at 51.9 million persons by the year 2050. This may be judged as a modest effect in terms of the total size of the Indian population but the 'magnitude' of this effect is certainly large enough to warrant attention by policymakers. To gauge the economic impact of this problem, if one imagines that the 52 million would have to live on $1 a day that would require an extra $18 billion on the country's GDP, apart from the strain on other natural resources.

Two broad areas for discussion, which follow on from the results of our analysis, concern the role of fertility decline in development, and the future role of sterilisation in the Indian family planning strategy. Retherford and Ramesh (1996), in their analysis of the determinants of fertility in Andhra Pradesh, argued that higher levels of education are not a necessary condition for low fertility in the state. This has certainly been borne out in more recent years. Particularly in Andhra Pradesh, nearly three-fifth of women who stopped childbearing by resorting to sterilisation did not have any schooling experiences (Padmadas, Hutter, and Willekens 2004). Another micro-level study conducted in Kerala pointed out a successful achievement of below replacement fertility even among poor and deprived social classes (Pallikadavath and Wilson 2005). However, Das Gupta argues that social and economic development is necessary for fertility reduction in India, and that is possible only through improvements in literacy levels, especially of females (Das Gupta 1995). Lutz and Scherbov (2004) assert that a rise in female school enrolment levels is needed to accelerate the pace of fertility decline in India.

Clearly, lower fertility will be achieved in India, as those states which have not reached replacement levels are all experiencing decreasing rates – the pace of decline depends on the scale of social development, especially in rural India. However, the extent to which education will make the difference, rather than effective sterilisation information and services, is debatable. The operation of successful family planning programmes has been shown to affect the behaviour of millions of couples in India, even promoting a 'culture of sterilisation' (Säävälä 1999), similar to what has been observed in Latin America, for example Brazil (Leone and Padmadas 2008) . If a shift to spacing methods is really envisaged, and the role of spacing to be taken seriously, then maybe this programmatic success could actually be translated to alternative method use. However, the changes that this shift would require are more than just the provision of a broader range of services, they are developmental as well, in that it will be necessary to empower young women in ways which are not solely about their reproductive capabilities. It is here that education and closing the educational gap

between the genders would surely be required. Evidence shows that women's education has a positive association with a wider range of contraceptive product usage in India (Basu 2005), whereby women possessing high levels of education use both modern and traditional non-terminal methods of birth control. Those with high levels of education also marry later, although they will have shorter first birth intervals than uneducated women. Nonetheless, it is unclear whether educated women use these non-terminal method options to prolong subsequent birth intervals or as effective substitutes for sterilization to compress reproductive spans into a narrower age range in the same manner that their uneducated counterparts accept sterilizations for the same purpose.

There are further complexities in the various viewpoints on the role of the fertility decline in development. Bhat (2002c) argues that fertility in India is declining because of contraceptive uptake by illiterate women, and that fertility decline is outpacing educational transition. He also reports that the odds of sending children to school are approximately 50% higher for illiterate women who are using contraception as compared to those who are not. This attests to the success of the sterilisation programme, but the likelihood of the more educated daughters of these women reaching education beyond primary level is countered by the trend for women to bear children in their early years. Dyson adds, rather optimistically, that lower fertility opens up opportunities for women to pursue their lives away from the domestic domain and that gender equality is associated with low fertility (Dyson 2002). However, the continuing prominence of poor gender indicators in India even in low fertility states raises the question of whether low status can accompany low fertility for women, especially where childbearing follows an early pattern. Although promoting birth spacing remains important, the most promising avenue for policy intervention to increasing the mean age at childbearing is later marriage for females; which could be accomplished by increasing school enrolment rates and years of schooling, and by providing employment opportunities.

Considering the future of family planning in India requires the balancing of successes and failures of the programme. Fertility decline and the increased acceptance of sterilisation without overt coercion has been achieved, but at the expense of the poor uptake of spacing methods. The dominance of sterilisation in India implies a lack of emphasis on reversible methods, and there is evidence that even reversible method use is adopted in India for the purposes of limiting, rather than spacing births (Pathak, Feeney, and Luther 1998). The problems of shorter generational lengths fuelling population growth, and the possibility of stagnating infant mortality might be balanced against past successes. From the projections presented in this paper, it is also clear that if lower fertility is achieved, then the difference in terms of population growth between early and late patterns is less significant. However, other problems associated with an early sterilisation programme (not documented in this paper) might also be balanced

against the success of programmes. These include the overall societal and familial concerns of early fertility decisions, the possible age-structural impact on dependent populations and the economic burden, the possible rise in divorce and the increased number of cases of regret after sterilisation (Green and Merrick 2005; Demeny 2003; Dyson 2002; Ramanathan and Mishra 2000; Bloom and Williamson 1998).

In practical terms, if the family planning programme were to focus less on sterilisation, now that it is well established, would this act as a brake on fertility decline? Questions should also be asked about the actual implementation of the target free approach, and whether coercion still plays a significant role in India's fertility decline (Rao 2004). Whatever the answers to these questions, the promotion of a range of spacing methods, including educational efforts to inform couples of their existence and efficacy, is long overdue in India. With the understanding that delaying births can increase fertility declines, programmes in transitional countries will face new challenges and the need to update their family planning promotional approaches (Bulatao 1998), and the Indian programme is no exception. The Bangladesh example, where sterilisation use fell dramatically with the enhanced provision of reversible contraception, might be considered as an alternative future course for India.

Additionally, the effects of very early sterilisation on women's lives should be actively considered by planners. If women who have been sterilized in their early twenties then go on to contribute to a skilled and educated workforce, and then maybe the extra population growth caused by an early childbearing strategy can be offset against the benefits gained. Dyson reports that new employment and educational prospects are now opening up for young women (Dyson 2002), that there is a rise in women's share of agricultural employment, an increase in average earnings for women and a fall in the male-female wage differential. Certainly the successive NFHS estimates of educational levels among women show a marked increase in recent years especially for young women[10]. Rishyasringa (2000) also states that economic changes in India are in support of women's empowerment. However, the assertion that young women in India can aspire to greater financial independence from men (Dyson 2002:393) might be possible among wealthy urban minorities, but the prospect of translating this to the lives of most (rural) women who start childbearing in their teens and stop in their early twenties is questionable. Despite small changes in women's working patterns seen from NFHS data, educational advances in recent years have not translated into significant changes in the employment of women. If empowerment and continued development are to be realised alongside a sterilisation-focused family planning programme, then policies need to consider the economic and developmental

[10] Despite improvements in the level of female education, age at entry into marriage remain stagnantly low in many states of India, particularly in Andhra Pradesh.

constraints for women who enter their first decade of adulthood with an education level which has been curtailed by childbirth as well as by domestic responsibilities.

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References

Basu, A.M. (1985). Family planning and the emergency: an unanticipated consequence. *Economic and Political Weekly* 20(10): 422-425.

Basu, A.M. (1999). Fertility decline and increasing gender imbalance in India. *Development and Change* 30(2): 237-263. doi:10.1111/1467-7660.00116.

Basu, A.M. (2005). Ultramodern contraception: social class and family planning in India. *Asian Population Studies* 1(3): 303-323.

Bhargava, S.K., Singh, K.K., and Saxena, B.N. (1991). ICMR Task Force National Collaborative Study: Identification of high risk families, mothers and outcome of their offsprings with particular reference to the problem of maternal nutrition, low birth weight, perinatal and infant morbidity and mortality in rural and urban slum communities. *Indian Pediatrics* 28(12): 1473-1480.

Bhat, P.N.M. (2001). Indian Demographic Scenarios, 2025. Working Paper No: 27. Population Research Centre, Delhi: Institute of Economic Growth.

Bhat, P.N.M. (2002a). Completeness of India's Sample Registration System: An assessment through general growth balance method. *Population Studies* 56(2): 119-134. doi:10.1080/00324720215930.

Bhat, P.N.M. (2002b). *India's changing dates with replacement fertility: A review of recent fertility trends and future prospects*. Paper presented at the 'Expert Group Meeting on Completing the Fertility Transition', New York: United Nations Population Division, pp. 376-391.

Bhat, P.N.M. (2002c). Returning a favor: Reciprocity between female education and fertility. *World Development* 30(10): 1791-1803. doi:10.1016/S0305-750X(02)00065-7.

Bloom, D.E. and Williamson, J.G. (1999). Demographic transitions and economic miracles in emerging Asia. *The World Bank Economic Review* 12(3): 419-455. doi:10.3386/w6268.

Bocquet-Appel, J.P., Irudaya Rajan, S., Bacro, J.N., and Lajaunie, C. (2002). The onset of India's fertility transition. *European Journal of Population* 18: 211-232. doi:10.1023/A:1019721310893.

Bongaarts, J. (1994). Population policy options in developing world. *Science* 263(5148): 771-776. doi:10.1126/science.8303293.

Bongaarts, J. (1999). The fertility impact of changes in the timing of childbearing in the developing world. *Population Studies* 53(3): 277-289. doi:10.1080/00324720308088.

Bongaarts, J. (2002). *The end of the fertility transition in the developing world*. Paper presented at the 'Expert Group Meeting on Completing the Fertility Transition', New York: United Nations Population Division, New York: 288-307.

Bongaarts, J. and Greenhalgh, S. (1985). An alternative to the one-child policy in China. *Population and Development Review* 11(4): 585-617. doi:10.2307/1973456.

Bose, A. (1993). *India and the Asian Population Perspective*. Delhi: BR Publishing.

Bulatao, R.A. (1998). *The value of family planning programs in developing countries*. Santa Monica: Population Matters, Rand.

Census of India (2001). *Provisional Populations Totals, Chapter 4 – Population Projections*. Series 1, Paper 1. New Delhi: Office of the Registrar General.

Cleland, J. and Robinson, W. (1992). The use of payments and benefits to influence reproductive behaviour. In: Philips, J.F. and Ross, J.A. (eds.) *Family Planning Programmes and Fertility*. Oxford: Clarendon Press: 159-177.

Das Gupta, M. (1995). Fertility decline in Punjab, India: Parallels with historical Europe. *Population Studies* 49 (3): 481-500. doi:10.1080/0032472031000148786.

Das Gupta, M. and Bhat, P.N.M. (1998). Fertility decline and increased manifestation of sex bias in India. *Population Studies* 51(3): 307-315. doi:10.1080/0032472031000150076.

Dyson, T. (2001). The preliminary demography of the 2001 census of India. *Population and Development Review*. 27(2): 341-356. doi:10.1111/j.1728-4457.2001.00341.x.

Dyson, T. (2002). *On the Future of Human Fertility in India*. Paper presented at the Expert Group Meeting on Completing the Fertility Transition, New York: United Nations Population Division, pp. 392-408.

Demeny, P. (2003). Population policy: a concise summary. In: Demeny, P. and McNicoll, G. (eds.) *International Encyclopaedia of Population*. New York: Macmillan Reference USA.

Dugger, C.W. (2001). Relying on Hard and Soft Sells, India Pushes Sterilization. *New York Times* June 22 2001 (http://www.nytimes.com/2001/06/22/world/22INDI.html, accessed on January 13, 2008).

Frejka, T. (1973). *The Future of Population Growth: Alternative Paths to Equilibrium*. New York: John Wiley and Sons.

Greene, M.E. and Merrick, T. (2005). *Poverty Reduction: Does Reproductive Health Matter?* Health, Nutrition and Population Discussion Paper. Washington DC: The International Bank for Reconstruction and Development and The World Bank.

Guilmoto, C.Z. and Irudya Rajan, S. (2001). Spatial patterns of fertility transition in Indian districts. *Population and Development Review* 27(1): 713-738. doi:10.1111/j.1728-4457.2001.00713.x.

International Institute for Population Sciences (1995). *National Family Health Survey: India 1992-93*. Calverton: IIPS: Mumbai and ORC Macro.

International Institute for Population Sciences (2000). *National Family Health Survey: India 1998-99*. Calverton: IIPS: Mumbai and ORC Macro.

International Institute for Population Sciences (IIPS) and Macro International (2007). National Family Health Survey (NFHS-3). 2005–06: India: Volume I. Mumbai: IIPS.

Leone, T. and Padmadas, S.S. (2008). The proliferation of a sterilization culture in women's lives: A comparison of Brazil and India. *Genus* 58(3-4): 77-97.

Lutz, W. and Scherbov, S. (2004). Probabilistic population projections for India with explicit consideration of the education – fertility link. *International Statistical Review* 72(1): 81-92.

Mayer, P. (1999). India's falling sex ratios. *Population and Development Review* 25(2): 323-343. doi:10.1111/j.1728-4457.1999.00323.x.

Nath, D.C., Land, K.C., and Singh, K.K. (1994). Birth spacing, breastfeeding and early child mortality in a traditional Indian society: a hazards model analysis. *Social Biology* 41(3-4): 168–180.

Nair, P.S. (1974). Mass vasectomy camp, Ernakulam (Kerala), July 1971. Report of the evaluation study. *Bulletin of the Gandhigram Institute of Rural Health and Family Planning* 8(2):88.

Nair, S.B. and Padmadas, S.S. (1999). Fertility decline in India: A futuristic perspective. *World Health and Population* 2(2): 48-61.

Narasimhan, R.L., Retherford, R.D., Mishra, V., Arnold, F., and Roy, T.K. (1997). *Comparison of Fertility Estimates from India's Sample Registration System and National Family Health Survey*. National Family Health Survey Subject Reports Number 4. Mumbai, India: International Institute for Population Sciences.

Padmadas, S.S., Hutter, I., and Willekens, F. (2004). Compression of women's reproductive spans in Andhra Pradesh, India. *International Family Planning Perspectives* 30(1): 12-19. doi:10.1363/3001204.

Pallikadavath, S. and Wilson, C. (2005). Paradox within a paradox: the fertility of the lower caste in Kerala. *Economic and Political Weekly* 40(28): 3085-3093.

Pandey, A., Choe, M.K., Luther, N.Y., Sahu, D., and Chand, J. (1998). *Infant and Child Mortality in India*. National Family Health Survey Subject Reports Number 11. Mumbai, India: International Institute for Population Sciences.

Pathak, K.B., Feeney, G., and Luther, N.Y. (1998). *Alternative Contraceptive Methods and Fertility Decline in India*. National Family Health Survey Subject Reports Number 7. Mumbai, India: International Institute for Population Sciences.

Raina, B.L. (1994). *The Population Challenge*. Delhi: B.R. Publishing Corporations.

Rajaretnam, T. (1990). How delaying marriage and spacing births contributes to population control? An explanation with illustrations. *Journal of Family Welfare* 36(4): 3-13.

Ramanathan, M. and Mishra, U.S. (2000). Correlates of female sterilization regret in the southern states of India. *Journal of Biosocial Science* 32:547-558. doi:10.1017/S0021932000005472.

Rao, M. (2004). *From Population Control to Reproductive Health: Malthusian Arithmetic*. New Delhi: Sage Publications.

Registrar General of India (1997). *Population Projections for India and States 1996-2016*. Office of the Registrar General of India, New Delhi: Government of India.

Registrar General of India (1999). *Compendium of India's Fertility and Mortality Indicators 1971-1997 Based on the Sample Registration System*. Office of the Registrar General of India, New Delhi: Government of India.

Registrar General of India (2002). Vital statistics. *SRS Newsletter*, No.13. Office of the Registrar General of India. New Delhi: Government of India.

Retherford, R.D. and Mishra, V. (2001). *An Evaluation of Recent Estimates of Fertility Trends in India*. National Family Health Survey Reports No. 19. Mumbai: International Institute for Population Sciences.

Retherford, R.D. and Ramesh, B.M. (1996). *Fertility and Contraceptive Use in Tamil Nadu*. *Andhra Pradesh and Uttar Pradesh*, National Family Health Survey Bulletin. IIPS, Mumbai, No 3, April 1996.

Rishyasringa, B. (2000). Social policy and reproductive health. In: Ramasubban, R. and Jejeebhoy, S. (eds.). *Women's Reproductive Health in India*. Jaipur and New Delhi: Rawat Publications.

Säävälä, M. (1999). Understanding the prevalence of female sterilization in rural south India. *Studies in Family Planning* 30(4): 288-301. doi:10.1111/j.1728-4465.1999.t01-1-.x.

Srinivasan, K. (1998). Population policies and programmes since independence: a saga of great expectations and poor performances. *Demography India* 27(1): 1-22.

United Nations (1999). *World Population Prospects: The 1998 Revision*. New York: Economic and Social Affairs.

United Nations (2002). *World Population Prospects, The 2002 Revision Population Database*. New York: United Nations Population Division.

US Census Bureau (2004). *Projected Population: India*. Population Division, International Data Base, US Bureau of the Census (http://www.census.gov/ipc/www/idbconf.html, accessed on May 11, 2006).

Whitworth, A. and Stephenson, R. (2002). Birth spacing, sibling rivalry and child mortality in India. *Social Science and Medicine* 55(12): 2107-2119. doi:10.1016/S0277-9536(02)00002-3.

Zavier, F.A.J. and Padmadas, S.S. (2000). Use of a spacing method before sterilization among couples in Kerala, India. *International Family Planning Perspectives* 26(1): 29-35. doi:10.2307/2648287.