An Investigation into Masculinization of Sex Ratio in India

Sayeed Unisa
Professor, Department of Mathematical Demography and Statistics,
International Institute for Population Sciences, Mumbai
Email: unisa@iips.net ; sunisa829@gmail.com
www.iipsindia.org

Paper presented at XXVI IUSSP International Population Conference
27 September to 2 October 2009
Marrakech

An Investigation into Masculinization of Sex Ratio in India

Sayeed Unisa
Professor, Department of Mathematical Demography and Statistics,
International Institute for Population Sciences, Mumbai

The decreasing child female to male ratio (FMR) has been one of the important concerns in India's demography in recent times. The general public concern of late is the apparent association of child FMR and fertility decline. The states of India are in different stages of fertility transition and some of them are experiencing sex selective abortions. It will be worthwhile to identify the states, which contribute to the decline in child sex ratio at the all India level. A decomposition exercise is attempted in this study and problem states are identified. States with initial low FMRs and faster population growth have contributed to all India FMR decline to some extent but it only explained a very small part of the observed decline. Based on sex ratio at birth, we conclude that the decline in all India child female to male ratio is due to significant changes in the regional pattern of sex ratios at birth.

Introduction

The decreasing child female to male ratio has been one of the important concerns in India's demography in recent times (Bhat 2002a; Croll 2000; Kundu and Sahu 1991; Nair 1996; Srinivasan 1994). The 2001 census shows an unusually low female to male ratio among children less than seven years of age for the country as a whole. Worse still, the child female-male ratios are the lowest ever in some of the affluent states of the country in 2001. Data from all available sources show that female to male ratio among children has declined.

The sharp decrease among under age seven female to male ratio in several states of India has been a subject of diatribe by some sections of feminist groups who are against family planning and two child norm. The issue of declining female-male ratio is multifaceted and there is no simple explanation for it. Several researchers have examined the historical trends and factors affecting the female to male ratios (Agnihotri 1995, 2000; Bhat 2002a and 2002b; Clarke 2000; Dandekar 1975; Guillot 2002; Mayer 1999; Visaria 1971). Some of the studies relate this decline in India to the existing son preference in several parts of the country (Arnold et al. 1998; Arnold et al. 2002; Das 1987). In other studies, it is found that differential stopping behaviour (with preferred sex composition for children by couples) is the main reason for decline of female to male ratio (Clark 2000; Cleland et al. 1983; Griffith et al. 2000; Kent and Larsen 1982; McClelland 1979; Yamaguchi 1989). In several other studies, demographers are concerned with high fertility level of India and attribute it to son preference (Bairgi and Bhattachary 1989; Das and Bhat 1997; Mutharayappa et al. 1997; Talwar 1975).

A general public concern of late is the apparent association of child female to male ratio and fertility decline. According to Mallik (2002), some of the programmes promote the transition to small families through strategies that voluntary support outright two-child norm by social and economic incentives. In another study by Croll (2002), it is argued that without change in gender reasoning, the rapid fertility decline and imposed smaller family size means that daughters are subjected to new trade-offs. Explanations and clarifications are not sufficient regarding the association of decline of female-male ratio, fertility decline and two-child norm (Kishore 1993; Mamdani 1972). Different states of India are in various stages of fertility transition and several of them are experiencing sex selective abortions. It will be worthwhile to identify the states, which contribute to the decline in child sex ratio at the all India level. A decomposition exercise is attempted in this study and problem states are identified.

It is well established that under normal conditions, more male than females are born among all human populations and it lies between 103 to 106 males per 100 females at birth (United Nations Secretariat, 1998). However, some population shows variation in sex ratio at birth that may be due to small sample of births. To examine changes in the sex ratio at birth, either good vital registration system or a very large sample of births has to be examined. Although from Sample Registration System (SRS) and from census it is found that sex ratio at birth is tilted more towards males. However to establish relationship between use of prenatal diagnostic techniques (sex selective abortion) and sex ratio at birth, we need to have estimates of sex selective abortions. Estimates of sex selective abortions are based on speculations because most of the abortions are illegal and not reported and there is hardly any documentation on the magnitude of sex selective abortion in India. Researchers have used 0-6 child sex ratio as indirect indicator of sex selective abortions (Bose, 2001; Retherford and Roy, 2003; Bhat and Zavier, 2007). Although it reflects pattern but hides the extent of deficit occurring before birth as this ratio reflects combined effect of sex ratio at birth and different mortality pattern for male and female children (Srinivasan and Bedi, 2008). From 2001 census sex ratio at birth is estimated for births which have taken place in the year preceding the census. Although, it gives estimates of sex ratio at birth, but it is not capturing the sex selective abortions because it is not possible from census to examine the sex ratio at birth by sex composition of previous children. From NFHS 1 & 2 surveys sex ratio at birth is estimated by birth order (Rutherford and Roy,2003; Arnold et al., 2002). However, sample of births in two rounds of NFHSs over a period of 15 years prior to each survey is only 184,808 and 171,194 respectively which is not large enough to distinguish the differences in sex ratio at birth by state level and socio-economic characteristics (Rutherford and Roy, 2003). In another study based on Special Fertility and Mortality Survey covering 133,738 births in 1997, sex ratio at birth is estimated (Jha et al, 2006). In this survey too, sample is not large enough to distinguish the differences in sex ratio by state and different socio-economic characteristics. Micro level data that have information both on use of prenatal diagnostic technique as well as sex ratio at birth will be better for examining this relationship. Hence, large-scale surveys conducted in India will be good to examine the changes in the sex ratio at birth. In this paper, an attempt is made to estimate sex ratio

at birth with larger data set namely District Level Household Survey (DLHS-2) where birth histories as well information on use of ultrasound is available.

Sources of Data

To examine the association between female to male ratio, fertility and two-child norm, data from censuses, and sample registration system (SRS) are used. Census data of 1971-2001 are used to examine the change and decomposition of female to male ratio (excluding the state of Assam, Jammu & Kashmir, and Mizoram as census was not conducted in these states at least once during the period of analysis). In this paper, we have taken the year 1971 as the starting point as fertility decline was noticeable in many states after this year. In addition, the technology introduced to detect genetic abnormalities in the 1970s has become commonly available after 1980s (Arnold et al. 2002). These techniques also came to be widely used to determine the sex of the foetus and subsequent abortions if the foetus was female (Henshaw et al. 1999). Cross-sectional and trend analysis is carried out to ascertain the relationship between fertility and female to male ratio at all India level.

Our analysis is mainly based on data from second District Level Household Survey (DLHS-2) conducted during 2002-2004 (1000 households per district), as it gives ample opportunity to estimate sex ratio at birth with large number of births (DLHS are designed to have estimate for district level indicator). DLHS provides information on use of ultrasound during pregnancy for a live birth born during the three-year period preceding the survey. DLHS covers only currently married women age 15-44 within those households.

The birth histories as well as individual characteristics used in the analysis were obtained from the DLHS-2 in 35 states and union territories in India. In this survey, 620,107 households and 507,622 currently married were covered. Information of children born to women was collected in this survey. For the current study, sample of births are restricted only to births which have taken place after 1985 till the survey date i.e., 2004 and have complete information of child. The sample of births we have in this study is 1,100,796 which are much larger than other surveys where sex ratio at birth is estimated.

To get an idea of change over time in the sex ratio at birth, year of birth is classified in five years interval starting from 1986 onwards. In this study 1986 is considered as the appropriate year for examining the impact of ultrasound technique as these services spread in urban and rural areas during 1980 in India and the reports of its misuse is reported from 1985 onwards (Arnold et al, 2002; Unisa et al 2007). States are divided into three group namely northwestern states (Himachal Pradesh, Punjab, Haryana, Delhi, Rajasthan, Gujarat and Maharashtra), southern states (Andhra Pradesh, Karnataka, Goa, Tamil Nadu and Kerala) and other states. The grouping of states consisting of northwestern states represents historically skewed sex ratio towards males, other group represents the states where fertility level have declined drastically and the remaining states are experiencing fertility transition. Other variables that are included in the analysis are residence (rural,

urban), age of women (current age as proxy of women's age at the time of birth), education of women, standard of living (proxy of economic status based on consumer durables), religion and caste/tribes. The selected variables cover socio-economic and biological factors that directly or indirectly influence sex ratio at birth.

Use of ultrasound and sex ratio at birth relationship is possible only for last birth which has taken place three years preceding the survey date i.e., 2001 onwards. Antenatal care during pregnancy where information regarding ultrasound is collected only for last birth a woman had during the reference period. Hence, separate logistic regression analysis is carried out to examine sex ratio at birth taking into account the sex composition of children already born and the use of ultrasound. These logistic analyses are restricted to only first three orders of births, which was last birth during the reference period. Number of cases of higher order births was very few; moreover, woman would get desired number of sons/daughters if she goes for more than three order births.

Methodology

Decadal change in the all India FMR is decomposed into:
(a) a population weighted sum of state specific change in FMR;
(b) a 'differential growth rate effect', which captures the fact that states with different initial female-male ratios grow at different rates (this term tells us how the all India FMR would have changed due to different state specific population growth rates, had state specific FMR remained unchanged); and
(c) a residual (or 'second-order term') which measures the difference between the actual FMR decline and the linear approximation to this decline. Contribution of each state to total is calculated by following method (See Dreze and Sen, 1995 for details):

$$C_i = s^0i*(f^1_i - f^0_i) + f^0_i*(s^1_i - s^0_i) + (f^1_i - f^0_i)*(s^1_i - s^0_i)$$

$$F^1 - F^0 = \Sigma\, s^0i*(f^1_i - f^0_i) + \Sigma\, f^0_i*(s^1_i - s^0_i) + \Sigma\, (f^1_i - f^0_i)*(s^1_i - s^0_i)$$

= weighted sum of state specific FMR + differential growth rate effect + residual

or

$$F^1 - F^0 = \Sigma\, C_i$$

Where
s^0 = Initial share of male population,
s^1 = Final share of male population,
f^0 = Initial Female-Male ratio,
f^1 = Final Female-Male ratio,
C_i= Contribution in all India FMR by state 'i',
F^0= Initial all India Female –Male ratio,
F^1= Final all India Female-Male ratio.

As already mentioned, one of the purpose of this paper is to examine trend of sex ratio at birth to gauge the sex selective abortions. Hence, births are therefore unit of analysis. Sex ratio at birth can be calculated directly for all socio-economic characteristics but it is influenced by many socio-economic characteristics. Therefore use of multivariate analysis will be better to examine the effect of each variables after controlling for other variables. As the response variable is binary, logistic analysis will be better for this purpose. Underlying response variable in the multivariate analysis of sex ratio at births takes values as '1'for male and '0' for female births. The basic logistic regression is given below:

$$\log[p/(1-p)] = a + b_1X_1+b_2X_2+ \ldots b_kX_4$$

$$\log[\text{sex ratio at birth}] = \log[p/ (1-p)]$$

From this equation, predicted value of sex ratio is specified by the odd of a male birth, p/ (1-p), where p denotes predicted proportion of male births. Variables X_i on the right-hand side of the equation denotes the predictor. Here predictor variables are residence, age, education, religion, caste/tribe of women, wealth index, and three groups of states (Northwestern, southern, and remaining states). In case second and higher order births, sex composition of previous order births are also considered. In addition, ultrasound is used in the analysis based on the last births. The predicted values of sex ratio at birth are calculated for categories of a particular predictor variable from the logistic regression equation by controlling for the other predictors by holding them constant at their mean values in the sample of births on which the regression is based. In the tables, only predicted sex ratio is presented for the different categories of variables and underling regression coefficient are not presented.

Results and Discussion

State specific trend of female to male ratio

The trend of female to male ratios (FMR) based on 0-4 and 0-6 age groups are criticized for their accuracy. Bhat (2002a) reported that a part of the observed fall of the FMR at ages 0-4 and its increase at ages 10-14 could be attributed to the rising accuracy of age reporting of children. As trends of child FMRs are affected by improvement in the quality of age reporting of young children, for the trend analysis a most reliable age group should be chosen that is least affected by age misreporting. According to Coale and Demeny (1967), 0-14 population is least affected by age misstatements. This age group is generally used for estimating fertility levels based on age distribution in India and other developing countries (Visaria 1969; Venkatacharya 1990). Hence, in this paper FMR of 0-4 along with 0-14 age groups are also examined.

State level FMRs are examined from 1971 to 2001 but difference in FMR between 1971 and 1981 was insignificant at all India level. Hence, for 1981-1991, 1991-2001 FMRs are plotted as the scatter diagram for 0-4, and 0-14 age groups (Figures 1 to 4). It is interesting to note from figures that there was significant decline in FMR of 0-4 age group during 1981-1991 for all the major

states, which is also reported in other studies (Agnihotri 1995). During this decade even in the southern states, the FMR decline is noticeable where gender discrimination is not so strong compared to northern states (Das and Bhat 1997). During 1991-2001, also decline in the child female-male ratio for major states was found but the magnitude of it was much lower than 1981-1991. In case of Kerala female to male ratio in 2001 was found higher than that of 1991.

From Figures 3 and 4 it may be noticed that in the age group 0-14 too there is decline in FMR during 1981-1991 but magnitude is not as high as in 0-4 age group in many states. During 1991-2001, also the overall FMR of 0-14 age group dropped but in major states, it was more or less the same. The pattern of 0-14 age group looks consistent and it will be useful to apply this age group to examine the sex bias (Bhat 200a).

Identification of states where sex selective abortions are high

After examining the trend of female-male ratios and decadal changes for different regions of India, it is hypothesised that above two percent changes simultaneously in FMR of 0-4 and 0-14 age groups could be due to female infanticides or sex selective abortions or biological change in sex ratio at birth. According to Bhat (2002b), rate of improvement in child survival to age five during 1971-1998 for girls were higher than boys (except Andhra Pradesh and West Bengal where it is same for boys and girls, and Tamil Nadu it is slightly higher for boys). Therefore, decline in FMR during 1991-2001 cannot be attributed to excess female mortality. Changes in sex ratio at birth are reported by some studies due to better antenatal care but concrete evidence is not available to accept drastic change in biological sex ratio at birth. Hence, it is postulated that in any state if more than two percent decline is observed in both the age groups then it could be the result of high magnitude of sex selective abortions.

To examine this hypothesis, state specific changes in FMRs for 0-4 and 0-14 age groups during 1991-2001 are plotted in Figure 6. The state of Punjab, Haryana, Gujarat, and Maharashtra showed distinct decline of more than two percent in FMR for 0-4 and 0-14 age groups. In case of Punjab and Haryana decline of FMR for both the age groups is quite high. Hence, it is concluded that in these four states massive sex selective abortions are taking place. In other states, the decline in FMR may not be due to sex selective abortions.

Decomposition of female-male ratio

There may be a possibility that states with initial low female-male ratios have experienced faster population growth than others, pulling down the all-India average (Dreaze and Sen 1995). Hence, it is important to examine the contribution of each state in the decline of 0-4 and 0-14 age group FMRs at all India level. For this analysis only those states were considered, for which four

consecutive census data are available. Hence, Assam, Jammu & Kashmir, Mizoram are not considered, where at least one census data was not available.

At the all India level, there is no change in 0-4 age group FMR during 1971-81, whereas 23 and 22 points decline are noticed for 1981-1991, and 1991-2001 respectively. In case of 0-14 FMR, there was two points increase during 1971-1981, eight points decline during 1981-1991 and again thirteen points decrease during 1991-2001. Therefore, contribution of different states to the decline of the female-male ratio at the all-India level for 1981-2001 for 0-4 age group; and 0-14 age group for 1991-2001 is analysed. Contribution of each state to total change in FMR is presented in the Tables 2 to 4.

The decomposition shows that change in the female-male ratio is mainly guided by the "total effect of changes in female-male ratio" for both the age groups. States with initial low female-male ratios and faster population growth have contributed to all India female to male decline to some extent but it only explained a very small part of the observed decline. Hence we can conclude that the decline in the all-India level female-male ratio is due to significant change in the regional pattern of this ratio. Thus, it can be said that there has been a certain decline in the sex-ratio at the all-India level, rather than a simulated change due to differential growth-rates across states (Table 3 to 5). In addition, to examine the effect of differential growth pattern of states on FMR, it is important to see the contribution of each state to the overall FMR.

The major states which had brought the decline in 0-4 age group FMR at all India level during 1981- 1991 are Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Gujarat, Orissa and Punjab (Figure 8). During 1991-2001, Andhra Pradesh, West Bengal, Maharashtra, Karnataka, Tamil Nadu, and Punjab contributed significantly to the decline of 0-4 all India FMR (Figure 9). The decline in FMR of India for 1991-2001 in 0-14 age group too these states namely, Andhra Pradesh, Tamil Nadu, West Bengal, Karnataka, Maharashtra, Kerala, Orissa, Gujarat and Punjab contributed largely (Figure 10). On the other hand for both the age groups and decades, Bihar, Uttar Pradesh and Rajasthan have contributed to an increase in the female-male ratio. Hence, these states balanced the magnitude of FMR at all India level otherwise the decline could have been of higher magnitude.

After examining child sex ratio trend and its decomposition, it is better to have understanding of sex ratio at birth from available data.

Sex Ratio at Birth

Single year data on proportion of male births is examined too gauge an idea of changes in the proportion of male births by order, single years data for all idea is examined and presented in Figure 6. Overall fluctuations are found for all order. However, over all proportion of male births as well as in first order births, it is more stable. Proportion of males in third order births over times has shown an increase at all India level. Therefore, it is decided to examine sex ratio at birth by socio-economic characteristics as well as for state level estimates with grouping year-wise data. Predicted

value of sex ratio at birth based on logistic analysis is presented as male – female ratio per hundred. An estimate of sex ratio at birth is given with 95% confidence interval and number of births.

Tables 5a to 5c show the sex ratio at birth by socio-economic conditions and order of birth. Two sets of estimates are given in these tables, one is corresponding to 1986-2000 and other is for 2001-2004. Sex ratio of first order births is almost same for 1986-2000 and 2001 to 2004 for most of the selected socio-economic characteristics. Sex ratio at birth below 106 is found only for scheduled tribes and for children of women who have education above ten years. In case of northwestern states as well as southern states, sex ratio at birth for first order birth is almost same.

Sex ratio for second order births is more than first order of births and it has shown slight increase. There is one point difference in the sex ratio at birth if the sex of first birth is female in comparison to first birth as male for most of the socio-economic characteristics(Table 5a and 5b). In case of Muslim and scheduled tribes population it is blow 106 and less than first order births. It is quite surprising to note that women who have 10 years and above education have highest sex ratio of birth for their second order births and it is just opposite of what is seen for first order births. Sex ratio of second order births in northwestern states is one point higher than southern states.

In case of third order births, there is seven point difference between those who had first two births as females compared to those who had at least one male child in first two orders. The wide difference of six to eight points is noticed across different socio-economic characteristics by sex composition of children of first two orders (Table 5c and Figure 7). It is quite striking to note that in the third order births sex ratio in these two groups of states is almost eight points apart (Table 5c and Table 6).

Map based on sex ratio at birth during 1986-2004 shows a red at Punjab, Haryana, Himachal Pradesh and Delhi with sex ratio at birth (Figure 8) . Trend of sex ratio at births based on all order of births at national level shows that it has increased almost by two points from 106.9 to 108.8 during the period 1986- 2004 (Table 6). Pattern of state level sex ratio at birth shows quite interesting results. Punjab has the highest sex ratio at birth of 116.7 from 1986 onwards. Other states where sex ratio at birth is around 110 from 1986 onwards are Haryana and Himachal Pradesh. The state of Gujarat, Rajasthan, and Maharashtra fall in the list of states that have around 110 sex ratio at birth if we consider births during 1986-2004. Southern states namely Andhra Pradesh, Karnataka, and Tamil Nadu have lowest sex ratio at birth (around 105) in 1986-1990 and it has increased over time by two points in Karnataka and Tamil Nadu and one point in Andhra Pradesh. The remaining states where sex ratio at birth was around 106 during 1986-90 have also experienced around two points increase. Increase of sex ratio at birth by two points in the major states of India that are contributing large number of births has made changes at the national scenario.

Use of ultrasound during pregnancy and other components are examined using DLHS and NFHS data. Use of ultrasound during pregnancy in the first order births and sex ratio at birth is not showing any significant association. Use of ultrasound in second and third order births and sex ratio at birth is showing positive relationship. Sex ratio at birth is too much distorted when this technique is used with female children in the previous birth orders.

Conclusions

Most of states which are contributing to the negative decline of all India female to male ratio have experienced rapid fertility decline and have major contribution to the change in total population. A small change in the state specific FMR child sex ratio in these states have made a big difference at all India level. Except Punjab, Haryana, Himachal Pradesh, Gujarat, and Maharashtra other states are known for less discrimination against girls. Punjab, Gujarat and Maharashtra are in the lime light for the use of technology for sex selective abortions. From sex ratio at birth for second and third order births we can draw conclusions that impact of sex selective abortions is found in the second and third order births.

Looking at changes in the state specific sex ratio at birth a question arises, 'why the states which have less discrimination against female children, and also have insignificant use of newer technology to identify sex at fetal stage have witnesses a decline in the FMR?' 'Is the decline of FMR a part of rapid fertility transition?' As fertility transition is taking place in many states, we are obviously finding the decline in female to male ratio. Once the fertility transition will be over female to male ratios will stabilize. In case of states that are identified as disturbing (Northwestern states), stringent measures to curb the sex selective abortions are required. Recent news paper report says that abortions of male feticide for money are also taking place in Punjab and Haryana (Bharadwaj, 2006). This shows the commercialization of abortions in the state of Punjab and Haryana. We very much believe that this study has thrown some light on the ongoing debate on the declining sex ratio among the child population.

REFERENCES:

Agnihotri, S. B. (1995) 'Missing females: A disaggregated analysis', Economic *and Political Review*, 19 August, pp. 2074-2082.

Agnihotri, S. B. (2000) *Sex Ratio Patterns in the Indian Population: A Fresh Exploration,* Sage, New Delhi.

Arnold, F., Choe, M. K. and Roy, T. K. (1998) 'Sex preference, the family building process and child mortality in India', *Population Studies,* vol. 52, no. 3, pp. 302-315.

Arnold, F., Kishor, S. and Roy, T. K. (2002) 'Sex-selective abortions in India', *Population and Development Review*, vol. 28, no. 4, pp. 759-785.

Arora, D. (1996) 'The victimizing discourses: Sex technologies and policy', Economic *and Political Weekly*, 7 February, pp. 21-35.

Bairagi, R. and Bhattacharya, A. K. (1989) 'Parental sex preference and its effects on fertility intention and contraceptive use in Calcutta', *Rural Demography*, vol. 16, no. 1 & 2, pp. 43-56.

Bharadwaj, A. (2006) 'Male foeticide for money', *DNA, National Daily*, October 15, 2006, pp. 8.

Bhat, P. N. M. (2002a) 'On the trail of "missing" Indian females: Search for clues', *Economic and Political Weekly*, December 21, pp. 5105-5118.

Bhat, P. N. M. (2002b) 'On the trail of "missing" Indian females: Illusion and reality', *Economic and Political Weekly*, December 28, pp. 5244-5263.

Bhat, P. N. M. and Zavier, J. F. (2003) 'Fertility decline and gender bias in northern India', *Demography*, vol. 40, no. 4, pp. 637-657.

Bose, A. (2001) 'Fighting female foeticide: Growing greed and shrinking child sex ratio', *Economic and Political Weekly*, vol. 36, no. 36, pp. 3427-3429.

Chahnazarian, A. (1988) 'Determinants of the sex ratio at birth: Review of recent literature', *Social Biology*, vol. 35, no. (3-4), pp. 214-235.

Clark, S. (2000) 'Sex preference and sex composition of children: Evidence from India', *Demography*, vol. 37, pp. 95-107.

Clarke, J. I. (2000) *The Human Dichotonomy: The Changing Number of Males and Females,* Pergamon, Oxford.

Cleland, J., Verrall, J. and Vaessen, M. (1983) 'Preference of the sex of children and their influence on reproductive behaviour', *World Fertility Survey Comparative Studies*, 27.

Coale, A. (1991) 'Excess female mortality and balance of sexes in the population: An estimated number of missing females', *Population and Development Review*, vol. 7, no. 3, pp. 517-523.

Coale, A. J. and Demeny, P. (1967) *Methods of Estimating Basic Demographic Measures from Incomplete Data*, Manual IV, Population Studies No 42, United Nations, New York.

Croll, E. (2000) *Endangered daughters: discrimination and development in Asia*, Rontledge, London.

Croll, E. J. (2002) 'Fertility decline, family size and female discrimination: A study of reproductive management in east and south Asia', *Asia-Pacific Population Journal*, vol. 17, no. 2, pp. 11-38.

Dandekar, K. (1975) 'Why has the proportion of women in India's population been declining?', Economic *and Political Weekly*, vol. 10, no. 42, pp. 1663-1667.

Das, N. (1987) 'Sex preference and fertility behaviour: A study of recent Indian data', *Demography,* vol. 24, pp. 517-530.

Das Gupta, M. and Bhat, P. N. M. (1997) 'Fertility decline and increased manifestation of sex bias in India', *Population Studies*, vol. 51, pp. 307-315.

Davis, K. (1951) *The Population of India and Pakistan*, Princeton University Press, Princeton, NJ.

Dreze, J. and Sen, A. (1995) *India: Economic Development and Social Opportunity*, Oxford University Press, Delhi.

Griffiths, P., Matthews, Z. and Hinde, A. (2000) 'Understanding the sex ratio in India: A simulation approach', *Demography,* vol. 37, pp. 477-487.

Guillot, M. (2002) 'The dynamics of the population sex ratio in India, 1971-96', *Population Studies*, vol. 56, pp. 51-63.

Henshaw, S., Singh, S. and Hass, T. (1999) 'The incidence of abortion worldwide', *International Family Planning Perspective,* 25 (Supplement): S30-S38.

Kent, M. M. and Larson, A. (1982) 'Family size preferences: Evidence from the World Fertility Survey', *Reports on the World Fertility Survey* 4, Washington D. C.: Population Reference Bureau.

Kishor, S. (1993) 'May God grant sons to all: Gender and child mortality in India', *American Sociological Review*, vol. 58, pp. 247-265.

Kishwar, M. (1993) 'Abortion of the female fetuses: Is legislation the answer?', *Reproductive Health Matters*, vol. 2, pp. 113-115.

Kundu, A. and Sahu, M. K. (1991) 'Variation in sex ratio: Development implications', *Economic and Political Weekly*, vol. 24, no. 41, pp. 2341-2342.

Mallik, R. 2002. 'A less valued life: Population policy and sex selection in India', *Center for Health and Gender Equity,* October.

Mamdani, M. (1972) *The Myth of Population Control,* Monthly Review Press, London.

Mayer, P. (1999) 'India's falling sex ratios', *Population and Development Review,* vol. 25, pp. 323-343.

McClelland, G. (1979) 'Determining the impact of sex preference on fertility: A consideration of parity progression ratio, dominance and stopping rule measures', *Demography*, vol. 16, pp. 377-388.

Miller, B.D. (1981) *The Endangered Sex: The Neglect of Female Children in rural North India,* Cornell University Press, Ithaca, USA.

Mukerjee, S. B. (1976) *The Age Distribution of Indian Population: A Reconstruction for States and Union Territories 1881-1961*, East-West Centre, Honolulu.

Mutharayappa, R. M. Choe, K., Arnold, F. and Roy, T. K. (1997) 'Son preference and its effect on fertility in India', *National Family Health Survey Subject Report* 3, pp. 1-35.

Nair, P. M. (1996) 'Imbalance of sex ratio of children in India', *Demography India*, vol. 25, pp. 177-187.

Natrajan, D. (1972) *Age and Marital Status, Census of India 1971, Census Centenary Monograph No. 8*, Office of Registrar General, Ministry of Home Affairs, New Delhi.

Office of the Registrar General (2002): *Sample Registration System Bulletin*, New Delhi, Registrar General of India, India.

Office of the Registrar General and Census Commissioner (2001): *Census of India 2001, Series 1, India, Paper 1 of 2001, Provisional Population Totals*, New Delhi: Registrar General and Census Commissioner, India.

Office of the Registrar General and Census Commissioner. CD, n.d. *Census of India 2001, Report and Series on Age*, *Series I*, Registrar General and Census Commissioner, India, New Delhi.

Office of the Registrar General and Census Commissioner. (1998) *Census of India 1991*, *Series 1, Part IV A. C Series*, *Social & Cultural Tables vol 2*, Registrar General and Census Commissioner, India, New Delhi.

Office of the Registrar General and Census Commissioner. (1986) Census of India 1981, *Series 1, Part IV A*. Social & Cultural Tables, Registrar General and Census Commissioner, India, New Delhi.

Srinivasan, S. and Bedi, A.S.(2008) 'Daughter elimination in Tamil Nadu, India: A tale of two ratios', *Journal of Development Studies*, vol.44,no.7, pp.961-990.

Talwar, P. P. (1975) 'Effect of desired sex composition in families in the birth rate', *Journal of Biosocial Sciences,* vol. 7, pp. 133-139.

Teitelbaum, M. H. (1972) 'Factors associated with the sex ratio in the human population', in G. A. Harrison and A. J. Boyee (eds.), *The Structure of Human Populations,* Clarendon Press, Oxford.

Venkatacharya, K. (1990) 'Simplified birth rate estimates under nonstable conditions', *Demography,* vol. 27, no. 1, pp. 131-147.

Visaria, P. (1969) 'Mortality and fertility in India, 1951-1961', *The Milbank Memorial Fund Quarterly*, vol. 47, no. 1, pp. 91-116.

Visaria, P. (1971) *The Sex Ratio of the Population of India,* Census of India 1962, vol. I, Monograph 10, Manager of Publication, Delhi.

Yamaguchi, K. (1989) 'A formal theory for male-preferring stopping rules on child bearing: Sex differences in birth order and in the number siblings', *Demography*, vol. 26, pp. 451-465.

Table 1: Female-Male Ratios by Age and Geographic Regions of India, 1901-2001

Age	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
India											
0-4	1032	1034	1040	1037	1005	992	992	979	978	954	934
0-14	940	944	945	946	939	957	946	937	938	930	918
North											
0-4	983	989	1005	1018	994	977	964	947	961	933	876
0-14	891	880	890	899	904	925	902	879	891	892	882
Central											
0-4	1059	1061	1070	1054	1026	1007	1014	995	998	971	934
0-14	960	967	960	957	946	963	952	940	944	930	876
South											
0-4	1053	1044	1048	1045	995	1004	996	969	965	963	955
0-14	981	991	997	969	975	997	984	962	978	963	946
West											
0-4	1053	1046	1053	1038	1011	982	979	970	961	943	904
0-14	950	954	955	962	954	955	947	942	943	935	898
East											
0-4	1049	1055	1045	1034	1012	1011	1027	1017	992	973	964
0-14	933	940	926	927	914	947	962	973	968	963	910

Source: Mukherjee 1976, Censuses of India, 1961 to 2001

Table 2: Decomposition of the Decline of India's Female-Male Ratio for the Age-group 0-4, 1981-1991

	Share of India's male population		Female-male ratio			Effect of change in state-specific FMR on Indian FMR	Contribution of different states to the total change in female-male ratio
	1981 (s^0)	1991 (s^1)	1981 (f^0)	1991 (f^1)	Change (f^1-f^0)		
India	1.000	1.000	978	955	-23	—	—
Andhra Pradesh	0.078	0.072	1000	978	-22	-1.70	-7.47
Bihar	0.112	0.116	1004	978	-25	-2.84	1.66
Gujarat	0.052	0.048	962	939	-23	-1.20	-4.19
Haryana	0.021	0.022	922	887	-35	-0.75	0.30
Himachal Pradesh	0.007	0.006	975	945	-29	-0.20	-0.80
Karnataka	0.056	0.051	981	962	-19	-1.03	-5.30
Kerala	0.033	0.027	975	951	-24	-0.78	-6.57
Madhya Pradesh	0.085	0.090	989	967	-22	-1.83	3.36
Maharashtra	0.091	0.096	961	946	-15	-1.35	2.97
Orissa	0.037	0.036	1003	974	-29	-1.08	-2.28
Punjab	0.025	0.024	925	874	-51	-1.25	-1.48
Rajasthan	0.058	0.061	978	936	-42	-2.47	-0.33
Tamil Nadu	0.065	0.053	974	951	-23	-1.50	-13.52
Uttar Pradesh	0.181	0.193	965	946	-18	-3.32	7.33
West Bengal	0.076	0.078	991	972	-19	-1.42	0.36
Other States & UTs	0.023	0.026	967	953	-14	-0.32	2.80
Decomposition of the all-India change in FMR	**Change in female-male ratio (a+b+c)**						**-23.14**
	(a) Total effect of change in state-specific FMRs = $\Sigma\, s^0*(f^1-f^0)$						-23.03
	(b) Differential growth rate effect = $\Sigma\, f^0*(s^1-s^0)$						-0.17
	(c) Second-order term = $\Sigma\, (f^1-f^0)*(s^1-s^0)$						0.06

Table 3: Decomposition of the Decline of India's Female-Male Ratio for the Age-group 0-4, 1991-2001

	Share of India's male population		Female-male ratio			Effect of change in state-specific FMR on Indian FMR	Contribution of different states to the total change in female-male ratio
	1991 (s^0)	2001 (s^1)	1991 (f^0)	2001 (f^1)	Change (f^1-f^0)		
India	1.000	1.000	955	932	-22	—	—
Andhra Pradesh	0.072	0.062	978	965	-14	-0.99	-10.73
Bihar	0.116	0.132	978	961	-17	-1.99	13.38
Gujarat	0.048	0.051	939	888	-50	-2.42	-0.40
Haryana	0.022	0.023	887	817	-69	-1.56	-1.35
Himachal Pradesh	0.006	0.005	945	889	-56	-0.34	-0.91
Karnataka	0.051	0.046	962	948	-14	-0.73	-5.67
Kerala	0.027	0.026	951	962	11	0.28	-0.93
Madhya Pradesh	0.090	0.092	967	947	-20	-1.78	-0.63
Maharashtra	0.096	0.091	946	913	-33	-3.18	-7.77
Orissa	0.036	0.033	974	959	-15	-0.54	-3.30
Punjab	0.024	0.022	874	794	-80	-1.97	-4.29
Rajasthan	0.061	0.069	936	913	-23	-1.40	6.04
Tamil Nadu	0.053	0.048	951	946	-5	-0.26	-5.11
Uttar Pradesh	0.193	0.204	946	928	-18	-3.49	6.95
West Bengal	0.078	0.070	972	966	-7	-0.52	-7.91
Other States & UTs	0.026	0.028	953	914	-39	-1.01	0.54
Decomposition of the all-India change in FMR	**Change in female-male ratio (a+b+c)**						**-22.09**
	(a) Total effect of change in state-specific FMRs = $\Sigma\, s^0*(f^1-f^0)$						-21.89
	(b) Differential growth rate effect = $\Sigma\, f^0*(s^1-s^0)$						-0.07
	(c) Second-order term = $\Sigma\, f^1-f^0)*(s^1-s^0)$						-0.13

Table 5: Decomposition of the Decline of India's Female-Male Ratio for the Age-group 0-14, 1991-2001

	Share of India's male population		Female-male ratio			Effect of change in state-specific FMR on Indian FMR	Contribution of different states to the total change in female-male ratio
	1991 (s^0)	2001 (s^1)	1991 (f^0)	2001 (f^1)	Change (f^1-f^0)		
India	1.000	1.000	930	918	-13	—	—
Andhra Pradesh	0.078	0.068	959	955	-4	-0.34	-9.12
Bihar	0.118	0.131	911	915	3	0.38	12.31
Gujarat	0.049	0.048	928	886	-42	-2.04	-2.30
Haryana	0.022	0.023	871	841	-30	-0.65	-0.17
Himachal Pradesh	0.006	0.005	956	921	-35	-0.21	-0.77
Karnataka	0.052	0.047	973	954	-19	-1.00	-5.78
Kerala	0.028	0.023	970	962	-8	-0.23	-4.81
Madhya Pradesh	0.085	0.088	940	931	-10	-0.82	2.24
Maharashtra	0.092	0.089	939	916	-23	-2.11	-5.12
Orissa	0.036	0.034	978	958	-21	-0.76	-2.90
Punjab	0.024	0.023	882	828	-54	-1.29	-2.07
Rajasthan	0.060	0.065	905	899	-6	-0.36	4.22
Tamil Nadu	0.056	0.047	957	947	-10	-0.56	-9.01
Uttar Pradesh	0.189	0.206	893	895	2	0.38	15.45
West Bengal	0.081	0.075	963	953	-9	-0.75	-6.54
Other States & UTs	0.025	0.028	936	913	-23	-0.58	1.66
Decomposition of the all-India change in FMR	**Change in female-male ratio (a+b+c)**						**-12.69**
	(a) Total effect of change in state-specific FMRs = $\Sigma\, s^0*(f^1-f^0)$						-10.94
	(b) Differential growth rate effect = $\Sigma\, f^0*(s^1-s^0)$						-2.21
	(c) Second-order term = $\Sigma\, (f^1-f^0)*(s^1-s^0)$						0.47

Table 5a: Predicted values of sex ratio at birth for first order of births (1986-2004), based on logistic regression, District Level Household Survey(DLHS-2)				
Characteristics	**Sex ratio at birth**	**95% Confidence interval**		**No. of births**
Residence*				
Rural	107.5	106.6	108.4	234370
Urban	106.3	105.1	107.6	110413
Religion**				
Hindu	107.0	106.2	107.8	282964
Muslim	106.4	104.4	108.4	42707
Christian	113.3	108.5	118.2	8447
Sikh	112.2	106.7	118.1	6079
Caste/Tribe				
Scheduled caste	106.7	105.0	108.4	63934
Scheduled tribe	105.8	103.5	108.2	30609
Other backward class	107.5	106.4	108.7	138960
Other	107.2	105.9	108.5	111280
Education				
Illiterate	107.0	105.9	108.0	160066
<=5 years	107.6	105.6	109.7	43067
6-10 years	107.8	106.5	109.2	99151
>10 years	105.6	103.6	107.6	42500
Standard of living*				
Low	106.3	105.3	107.4	150021
Medium	108.1	106.9	109.4	107766
High	107.2	105.8	108.7	86996
Group of states				
Northwestern	106.9	105.5	108.3	92945
Southern	106.9	105.4	108.4	80230
Other	107.3	106.3	108.4	171608
Total	107.1	106.4	107.8	344783

Note: Results in this table are predicted values from logistic regression for first birth order that incorporate predictors variables namely type of residence, current age of women, education of women, religion, caste and tribe, standard of living, and group of states(southern state, north west states, remaining states). Predicted value of SRB for any predictor is calculated keeping all other predictor variables (including those not shown) are held constant at their mean values in the underlying logistic regression. Northwestern states include Himachal Pradesh, Punjab, Haryana, Rajasthan, Gujarat, and Maharashtra. Goa is included in southern states.
*Significant at 5% level of significance; ** Significant at 10% level of significance

Table 5b: Predicted values of sex ratio at birth for second order of births(1986-2004), based on logistic regression, District Level Household Survey(DLHS-2)					
Characteristics	**Sex of first order of birth**	**Sex ratio at birth**	**95% Confidence interval**		**No. of births**
Place of residence*					
Rural	Female	108.7	107.4	110.0	102033
	Male	107.7	106.4	109.0	108853
	Total	108.2	107.3	109.1	210886
Urban	Female	108.0	106.0	110.0	45096
	Male	106.9	105.0	108.8	47953
	Total	107.4	106.0	108.8	93049
Religion*					
Hindu	Female	108.9	107.7	110.1	120691
	Male	107.9	106.7	109.1	128182
	Total	108.4	107.5	109.2	248873
Muslim	Female	104.2	101.2	107.2	18462
	Male	103.2	100.4	106.1	20061
	Total	103.7	101.6	105.8	38522
Christian	Female	108.4	101.4	115.9	3429
	Male	107.5	100.8	114.6	3762
	Total	107.9	103.1	113.0	7191
Sikh	Female	120.8	111.9	130.5	2626
	Male	119.4	110.8	128.7	2775
	Total	120.1	113.8	126.7	5401
Caste and Tribe*					
Scheduled caste	Female	106.7	104.2	109.2	27825
	Male	105.7	103.3	108.1	29794
	Total	106.1	104.4	107.9	57619
Scheduled tribe	Female	105.8	102.2	109.4	13515
	Male	104.8	101.5	108.3	14260
	Total	105.3	102.8	107.8	27775
Other backward class	Female	107.7	105.9	109.4	59355
	Male	106.7	105.1	108.4	63763
	Total	107.2	106.0	108.4	123118
Other	Female	111.4	109.4	113.5	46434
	Male	110.3	108.4	112.3	48989
	Total	110.9	109.5	112.3	95423
Education*					
Illiterate	Female	107.2	105.7	108.7	75806
	Male	106.3	104.8	107.7	81680
	Total	106.7	105.7	107.8	157487
<=5 years	Female	107.5	104.5	110.6	18835
	Male	106.5	103.6	109.5	20470

	Total	107.0	104.9	109.1	39305
6-10 years	Female	109.5	107.4	111.7	38667
	Male	108.5	106.4	110.6	41019
	Total	109.0	107.5	110.5	79686
>10 years	Female	114.1	110.4	118.0	13821
	Male	113.0	109.2	116.8	13637
	Total	113.5	110.9	116.3	27457
Standard of living index					
Low	Female	107.0	105.4	108.7	67228
	Male	106.1	104.6	107.7	71329
	Total	106.6	105.4	107.7	138556
Medium	Female	108.7	106.8	110.8	45466
	Male	107.7	105.8	109.6	49328
	Total	108.2	106.8	109.6	94794
High	Female	110.9	108.6	113.3	34435
	Male	109.7	107.5	112.0	36149
	Total	110.3	108.7	112.0	70585
Group of states*					
Northwestern	Female	111.3	109.1	113.5	40312
	Male	110.2	108.1	112.3	42641
	Total	110.7	109.2	112.2	82953
Southern	Female	106.5	104.2	108.8	33146
	Male	105.5	103.3	107.7	35223
	Total	106.0	104.4	107.6	68368
Other	Female	107.9	106.3	109.5	73671
	Male	106.9	105.4	108.4	78942
	Total	107.4	106.3	108.4	152614
Total	Female	108.5	107.4	109.6	147129
	Male	107.4	106.4	108.5	156806
	Total	107.9	107.2	108.7	303935

Note: Results in this table are predicted values from logistic regression for second birth order that incorporate predictors variables namely type of residence, current age of women, education of women, religion, caste and tribe, standard of living, and group of states(southern state, north west states, remaining states). Predicted value of SRB for any predictor is calculated keeping all other predictor variables (including those not shown) are held constant at their mean values in the underlying logistic regression. Northwestern states include Himachal Pradesh, Punjab, Haryana, Delhi, Rajasthan, Gujarat, and Maharashtra. Goa is included in southern states.

*Significant at 5% level of significance

Table 5c: Predicted values of sex ratio at birth for third order of births(1986-2004), based on logistic regression, District Level Household Survey(DLHS-2)					
Characteristics	**Sex of composition of first and second order of births**	**Sex ratio at birth**	**95% Confidence interval**		**No. of births**
Place of residence					
Rural	FF	113.6	111.4	115.9	40454
	MF+	106.8	105.3	108.4	75555
	MM	106.4	104.3	108.5	38216
	Total	108.5	107.4	109.5	154225
Urban	FF	119.6	115.9	123.5	15234
	MF	111.7	109.1	114.5	26551
	MM	111.3	107.5	115.1	13200
	Total	113.7	111.9	115.7	54985
Religion*					
Hindu	FF	114.9	112.8	117.0	45348
	MF	107.8	106.3	109.3	82843
	MM	107.2	105.2	109.3	40681
	Total	109.5	108.5	110.6	168872
Muslim	FF	114.6	109.5	119.9	7541
	MF	107.9	104.4	111.4	14646
	MM	107.8	103.2	112.5	8316
	Total	109.5	107.0	112.0	30504
Christian	FF	111.8	99.2	126.1	1075
	MF	104.0	94.8	114.0	1815
	MM	104.6	92.9	117.8	1094
	Total	106.2	99.8	113.0	3984
Sikh	FF	134.6	118.8	152.9	987
	MF	125.9	114.5	138.7	1689
	MM	125.3	108.4	145.2	734
	Total	128.2	119.9	137.3	3410
Caste and Tribe*					
Scheduled caste	FF	111.6	107.6	115.8	11265
	MF	105.1	102.3	107.9	21509
	MM	104.9	101.1	108.8	11288
	Total	106.7	104.7	108.7	44062
Scheduled tribe	FF	109.0	103.4	115.0	5486
	MF	102.7	98.8	106.7	10441
	MM	102.5	97.2	108.2	5385
	Total	104.2	101.5	107.1	21312
Other backward class	FF	115.1	112.2	118.2	22449
	MF	108.3	106.2	110.4	41567

	MM	107.9	105.0	110.9	20960
	Total	109.9	108.5	111.4	84976
Other	FF	120.1	116.5	123.8	16487
	MF	112.3	109.7	114.9	28589
	MM	111.5	107.8	115.3	13784
	Total	114.2	112.4	116.1	58861
Education*					
Illiterate	FF	112.2	109.8	114.7	33137
	MF	105.9	104.3	107.5	65108
	MM	105.7	103.5	108.0	33864
	Total	107.4	106.2	108.5	132109
<=5 years	FF	113.9	108.8	119.2	7442
	MF	107.4	103.9	111.1	13767
	MM	106.8	101.7	112.1	6582
	Total	109.0	106.4	111.6	27791
6-10 years	FF	120.1	115.9	124.5	12241
	MF	113.0	109.8	116.2	19505
	MM	112.4	107.9	117.1	9311
	Total	114.9	112.7	117.2	41057
>10 years	FF	135.4	125.8	145.8	2867
	MF	126.4	118.5	134.8	3725
	MM	125.8	114.3	138.7	1660
	Total	129.3	123.8	135.1	8252
Standard of living index*					
Low	FF	110.6	108.0	113.2	28078
	MF	104.2	102.4	106.0	53271
	MM	104.0	101.6	106.5	27871
	Total	105.8	104.5	107.0	109220
Medium	FF	116.6	113.1	120.2	16714
	MF	109.7	107.3	112.2	31289
	MM	109.4	106.0	113.0	15368
	Total	111.4	109.7	113.2	63370
High	FF	125.9	121.2	130.7	10897
	MF	117.6	114.2	121.2	17545
	MM	117.0	112.0	122.2	8177
	Total	119.9	117.4	122.4	36619
Group of states*					
Northwestern	FF	120.9	117.2	124.7	16008
	MF	112.9	110.3	115.6	28166
	MM	112.6	108.7	116.6	12521
	Total	115.0	113.2	116.9	56695
Southern	FF	112.1	107.7	116.6	9851
	MF	105.3	102.1	108.6	16297
	MM	105.4	101.2	109.9	9030

	Total	107.2	105.0	109.5	35178
Other	FF	113.4	110.8	116.0	29829
	MF	106.6	104.9	108.3	57643
	MM	106.3	103.9	108.7	29865
	Total	108.2	106.9	109.4	117337
Total	FF	115.2	113.3	117.2	55688
	MF	108.1	106.8	109.4	102106
	MM	107.6	105.8	109.5	51416
	Total	109.8	108.9	110.8	209210

Note: Results in this table are predicted values from logistic regression for third birth order that incorporate predictors variables namely type of residence, current age of women, education of women, religion, caste and tribe, standard of living, and group of states(southern state, north west states, remaining states). Predicted value of SRB for any predictor is calculated keeping all other predictor variables (including those not shown) are held constant at their mean values in the underlying logistic regression. Northwestern states include Himachal Pradesh, Punjab, Haryana, Rajasthan, Gujarat, and Maharashtra. Goa is included in southern states.

+MF represents here one male and one female child irrespective of their order.

*Significant at 5% level of significance

Table 6: Predicted values of sex ratio at birth for births occurring during the 1986-2004, District Level Household Survey(DLHS-2)					
States	**Year**	**SRB**	**95% CI**		**No. of births**
Jammu & Kashmir	1986-1990	107.1	98.4	116.6	2128
	1991-1995	108.5	100.8	116.9	2788
	1996-2000	108.1	100.7	116.1	3035
	2001-2004	109.5	96.0	125.1	880
	Total	108.1	103.7	112.7	8832
Himachal Pradesh	1986-1990	110.1	99.5	122.0	1490
	1991-1995	112.2	102.0	123.4	1704
	1996-2000	111.7	101.3	123.1	1624
	2001-2004	112.4	97.8	129.4	787
	Total	111.5	105.8	117.6	5605
Punjab	1986-1990	116.7	111.2	122.5	6579
	1991-1995	118.7	113.4	124.3	7420
	1996-2000	118.1	112.7	123.8	7087
	2001-2004	117.5	109.0	126.7	2737
	Total	117.8	114.9	120.9	23823
Uttarkhand	1986-1990	108.2	99.8	117.4	2354
	1991-1995	110.1	102.4	118.5	2883
	1996-2000	109.4	101.9	117.4	3090
	2001-2004	110.2	98.8	122.9	1297
	Total	109.5	105.1	114.0	9496
Haryana	1986-1990	110.3	104.9	116.1	6085
	1991-1995	112.2	107.1	117.6	7047
	1996-2000	111.7	106.6	117.1	6946
	2001-2004	111.8	104.5	119.7	3336
	Total	111.7	108.8	114.6	23113
Delhi	1986-1990	109.9	103.7	116.6	4516
	1991-1995	112.3	106.5	118.6	5320
	1996-2000	111.7	106.0	117.7	5625
	2001-2004	111.7	102.4	121.8	2039
	Total	111.6	108.4	115.0	17408
Rajasthan	1986-1990	108.5	105.2	111.9	15902
	1991-1995	110.7	107.7	113.7	20857
	1996-2000	109.9	107.1	112.9	22636
	2001-2004	110.1	106.0	114.3	10944
	Total	110.1	108.4	111.7	68890
Uttar Pradesh	1986-1990	106.3	104.4	108.3	46008
	1991-1995	108.3	106.6	109.9	66631
	1996-2000	107.6	106.0	109.1	72209
	2001-2004	108.7	106.4	111.0	34383
	Total	107.7	106.8	108.6	210957
Bihar	1986-1990	106.0	103.2	108.8	21350
	1991-1995	108.0	105.6	110.4	30260
	1996-2000	107.3	105.2	109.5	37299
	2001-2004	108.5	105.5	111.5	19916
	Total	107.4	106.1	108.7	105385
Assam	1986-1990	106.5	101.5	111.8	6565

	1991-1995	108.1	103.6	112.8	8544
	1996-2000	107.6	103.2	112.2	8842
	2001-2004	108.5	101.4	116.2	3334
	Total	107.6	105.1	110.2	27165
West Bengal	1986-1990	105.8	103.0	108.7	21048
	1991-1995	107.6	104.9	110.4	23785
	1996-2000	107.2	104.6	109.9	24860
	2001-2004	107.4	103.3	111.7	10065
	Total	107.0	105.5	108.5	78760
Jharkhand	1986-1990	105.6	100.7	110.7	6928
	1991-1995	107.2	102.9	111.7	9130
	1996-2000	106.6	102.7	110.6	11029
	2001-2004	107.6	102.2	113.2	5888
	Total	106.7	104.4	109.1	32351
Orissa	1986-1990	105.9	101.6	110.3	9085
	1991-1995	107.8	103.8	111.9	11016
	1996-2000	107.2	103.4	111.0	12338
	2001-2004	108.1	102.4	114.1	5248
	Total	107.1	105.0	109.3	37332
Chhatisgarh	1986-1990	105.6	100.2	111.3	5563
	1991-1995	107.7	102.6	113.0	6591
	1996-2000	106.8	102.2	111.7	7640
	2001-2004	107.9	101.3	114.9	3895
	Total	107.0	104.3	109.7	23633
Madhya Pradesh	1986-1990	106.2	103.2	109.4	17945
	1991-1995	108.2	105.4	111.0	22461
	1996-2000	107.6	104.9	110.2	25161
	2001-2004	108.3	104.3	112.5	10637
	Total	107.5	105.9	109.0	74792
Gujarat	1986-1990	109.1	105.5	112.8	13966
	1991-1995	111.2	107.8	114.7	15743
	1996-2000	110.1	106.8	113.5	16983
	2001-2004	111.0	106.3	115.9	8184
	Total	110.4	108.5	112.2	54450
Maharashtra	1986-1990	108.5	105.9	111.1	26180
	1991-1995	110.6	108.1	113.2	29006
	1996-2000	110.0	107.5	112.5	29911
	2001-2004	110.2	106.7	113.9	14458
	Total	109.9	108.5	111.2	98020
Andhra Pradesh	1986-1990	105.2	102.4	108.2	20051
	1991-1995	106.8	104.0	109.7	21910
	1996-2000	106.4	103.6	109.1	23016
	2001-2004	106.4	102.6	110.3	11627
	Total	106.3	104.8	107.8	75504
Karnataka	1986-1990	104.7	101.3	108.3	13741
	1991-1995	106.5	103.0	110.0	14529
	1996-2000	106.0	102.8	109.4	15808
	2001-2004	106.7	102.1	111.5	7851
	Total	105.9	104.0	107.7	50933
Kerala	1986-1990	106.5	101.4	111.8	6474

	1991-1995	108.3	103.3	113.4	7082
	1996-2000	107.6	103.2	112.2	8911
	2001-2004	108.8	103.9	113.9	7288
	Total	107.5	105.2	110.0	31391
Tamil Nadu	1986-1990	105.1	101.9	108.4	16281
	1991-1995	106.6	104.0	109.2	26335
	1996-2000	106.3	103.2	109.6	16735
	2001-2004	107.0	102.5	111.7	8315
	Total	106.2	104.4	108.0	54219
Total*	1986-1990	106.9	106.1	107.7	265676
	1991-1995	108.9	108.2	109.7	324175
	1996-2000	108.1	107.4	108.8	351568
	2001-2004	108.8	107.8	109.9	159376
	Total	108.2	107.8	108.6	1100796

Note: Results in this table are weighted sum of predicted values from logistic regressions for each birth order(up to eight orders) that incorporate predictors variables namely type of residence, current age of women, education of women, religion, caste and tribe, and standard of living and states. Predicted value of SRB for states is calculated keeping all other predictor variables are held constant at their mean values in the underlying logistic regression.

*Total includes north-eastern states and union territories.

Table 7: Predicted values of sex ratio at birth for last births with use of ultrasound, based on logistic regression, births during 2001-2004, District Level Household Survey(DLHS-2)						
Characteristics	Sex of composition of children of previous birth orders	Ultrasound during pregnancy	SRB	95% CI		No. of births
First order of births						
Rural	Not applicable	Yes	107.9	102.6	113.6	5911
		No	106.6	103.9	109.4	22636
		Total	106.9	104.4	109.4	28546
Urban	Not applicable	Yes	106.1	101.3	111.2	7038
		No	106.0	100.8	111.5	6041
		Total	106.1	102.5	109.8	13079
Total	Not applicable	Yes	106.9	103.3	110.7	12949
		No	106.5	104.1	109.0	28677
		Total	106.6	104.6	108.7	41625
Second order of births*						
Rural	Female	Yes	111.3	102.0	121.5	2014
	Male	Yes	110.2	101.3	120.0	2153
	Female or male	No	108.4	105.6	111.1	23739
	Total	Total	108.7	106.2	111.3	27907
Urban	Female	Yes	110.4	102.3	119.2	2650
	Male	Yes	108.8	100.9	117.4	2693
	Female or male	No	106.9	102.0	112.1	6875
	Total	Total	108.1	104.3	112.0	12219
Total	Female	Yes	110.8	104.6	117.3	4665
	Male	Yes	109.4	103.5	115.8	4846
	Female or male	No	108.0	105.6	110.5	30614
	Total	Total	108.5	106.4	110.7	40125
Third order of births*						
Rural	Female-Female	Yes	121.3	103.9	141.9	642
	Male – Female+	Yes	113.3	100.9	127.5	1126
	Any combination	No	110.2	106.9	113.5	17144
	Total	Total	110.7	107.6	113.9	18912
Urban	Female-Female	Yes	127.2	108.4	149.8	597
	Male - Female	Yes	118.2	105.3	132.8	1154
	Any combination	No	114.5	107.7	121.7	4177
	Total	Total	116.4	110.6	122.5	5928
Total	Female-Female	Yes	124.1	111.0	138.9	1239
	Male - Female	Yes	115.8	106.6	125.7	2280
	Any combination	No	111.0	108.0	114.0	21321
	Total	Total	112.0	109.3	114.9	24840

Note: ANC and delivery care is available only for the last birth. Hence, last births by order of births are considered here. Results in this table are predicted values from logistic regression for first, second and third order of births respectively that incorporate predictors variables namely type of residence, current age of women, education of women, religion, caste and tribe, standard of living, and group of states(southern state, north west states, remaining states). Predicted value of SRB for any predictor is calculated keeping all other predictor variables (including those not shown) are held constant at their mean values in the underlying logistic regression. +Male –Female represents one male and one female child irrespective of their order. *Significant at 5% level of significance

Figure 1:Change in Female-Male Ratio(0-4), 1981-91

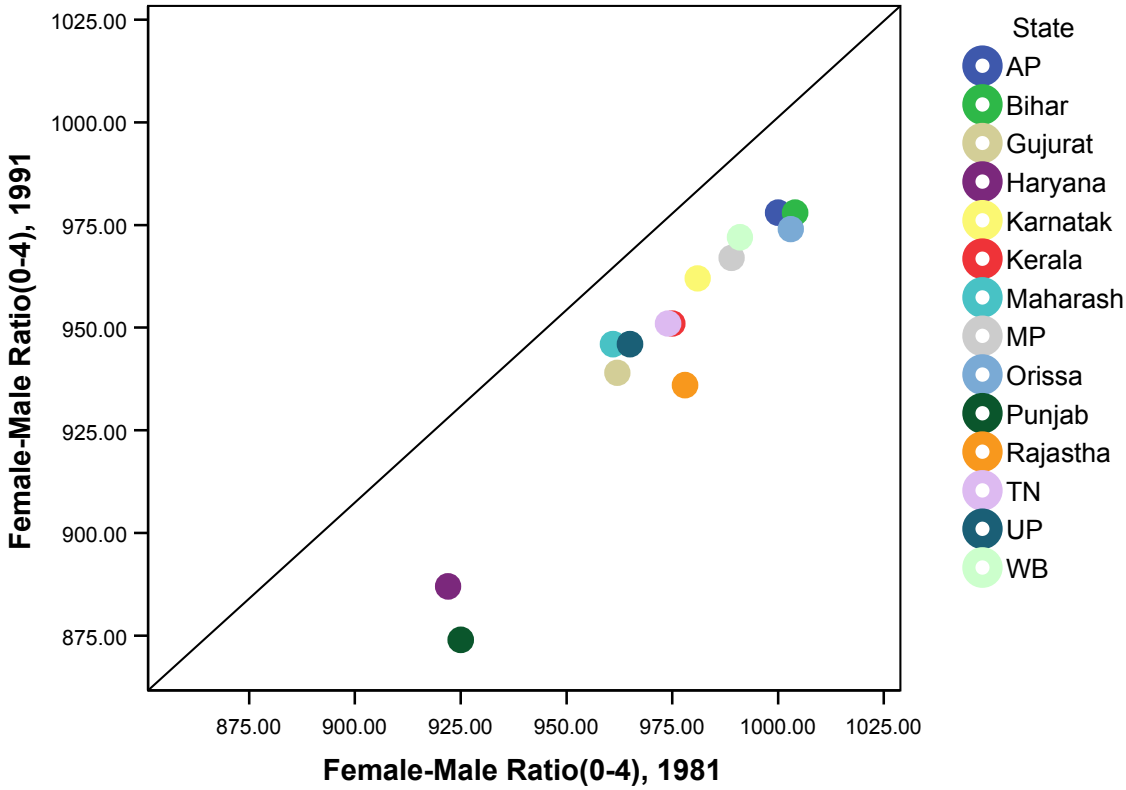

Figure 2: Change in Female-Male Ratio(0-4), 1991-2001

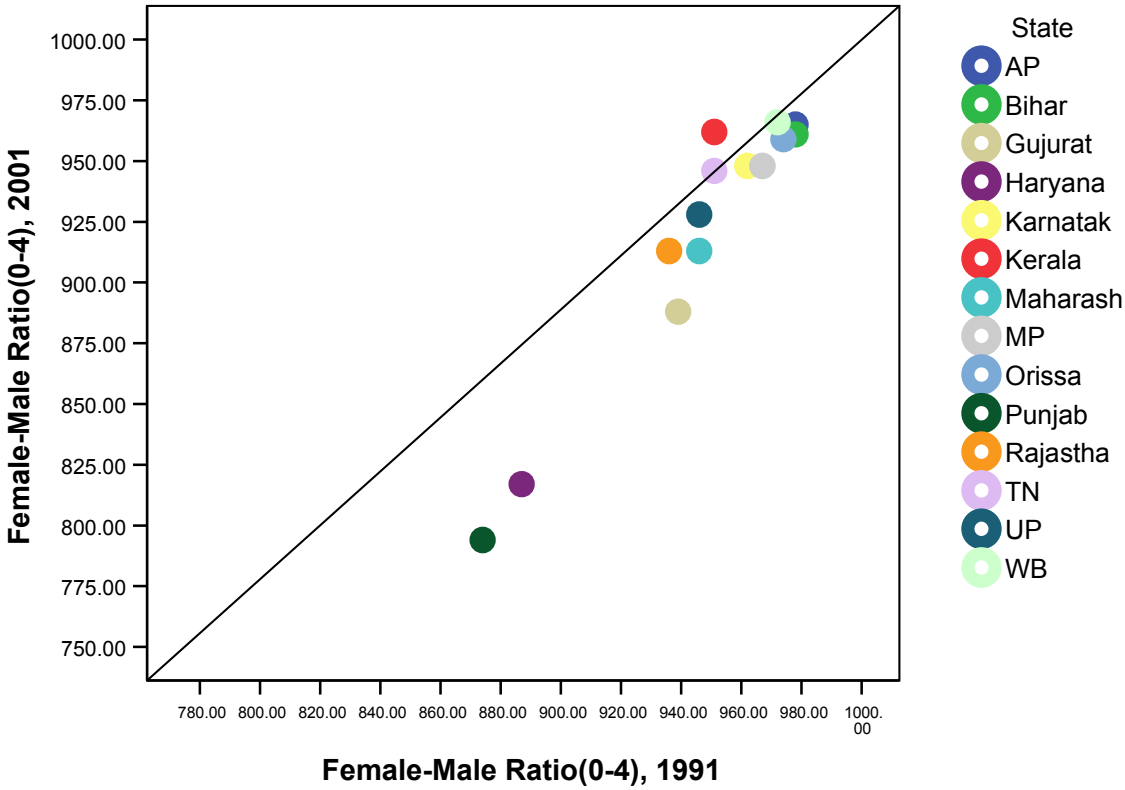

Figure 3: Change in Female - Male Ratio (0-14), 1981-1991

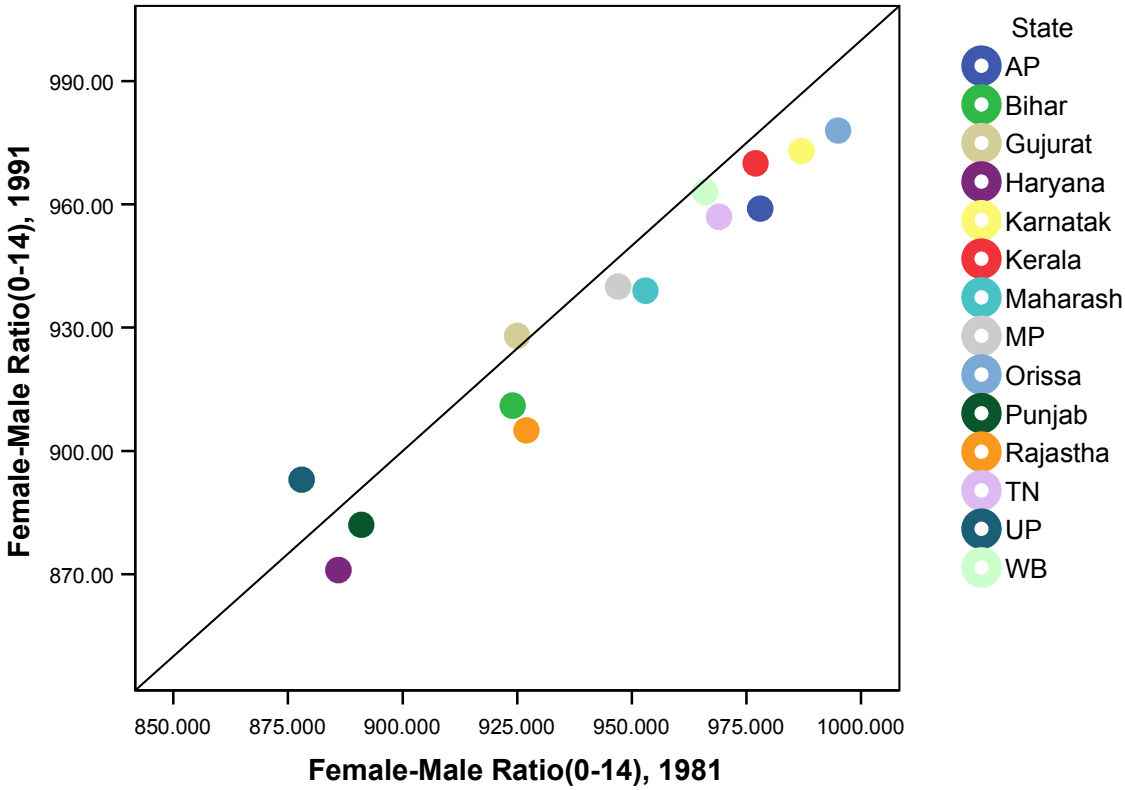

Figure 4: Change in Female - Male Ratio (0-14), 1991- 2001

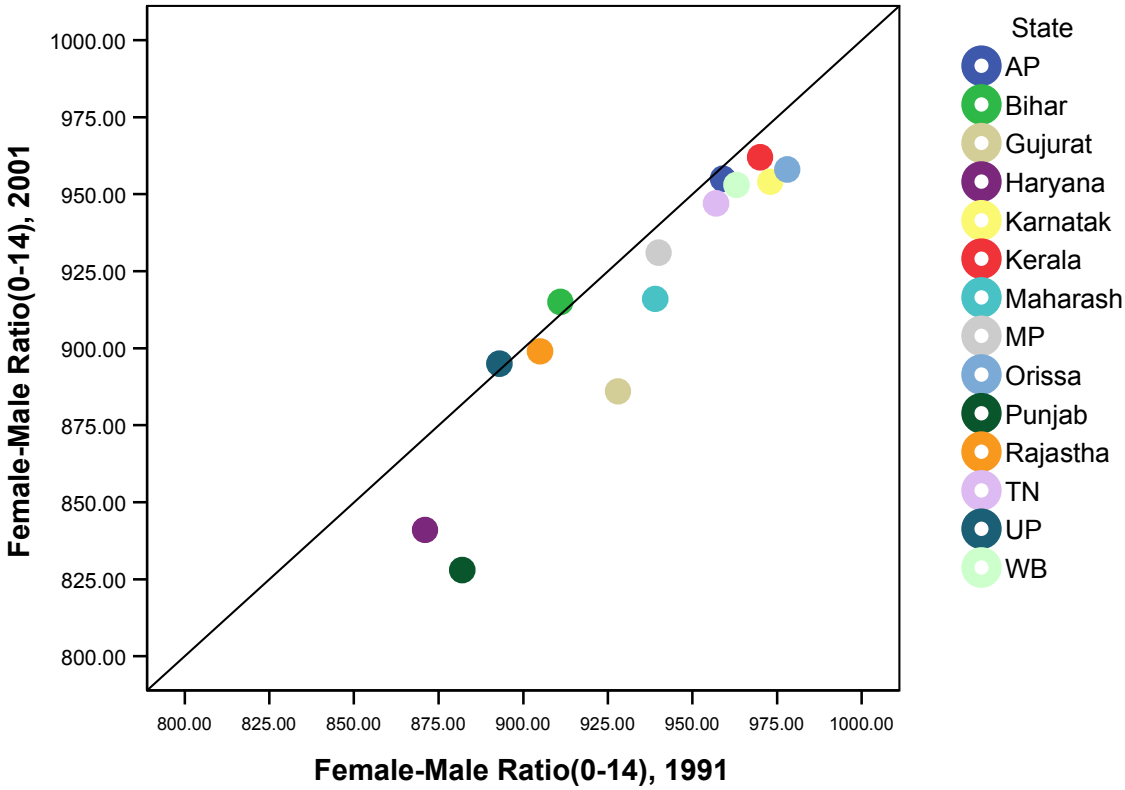

Figure 5: Decadal Change in 0-4 and 0-14 Age Groups FMRs by Regions

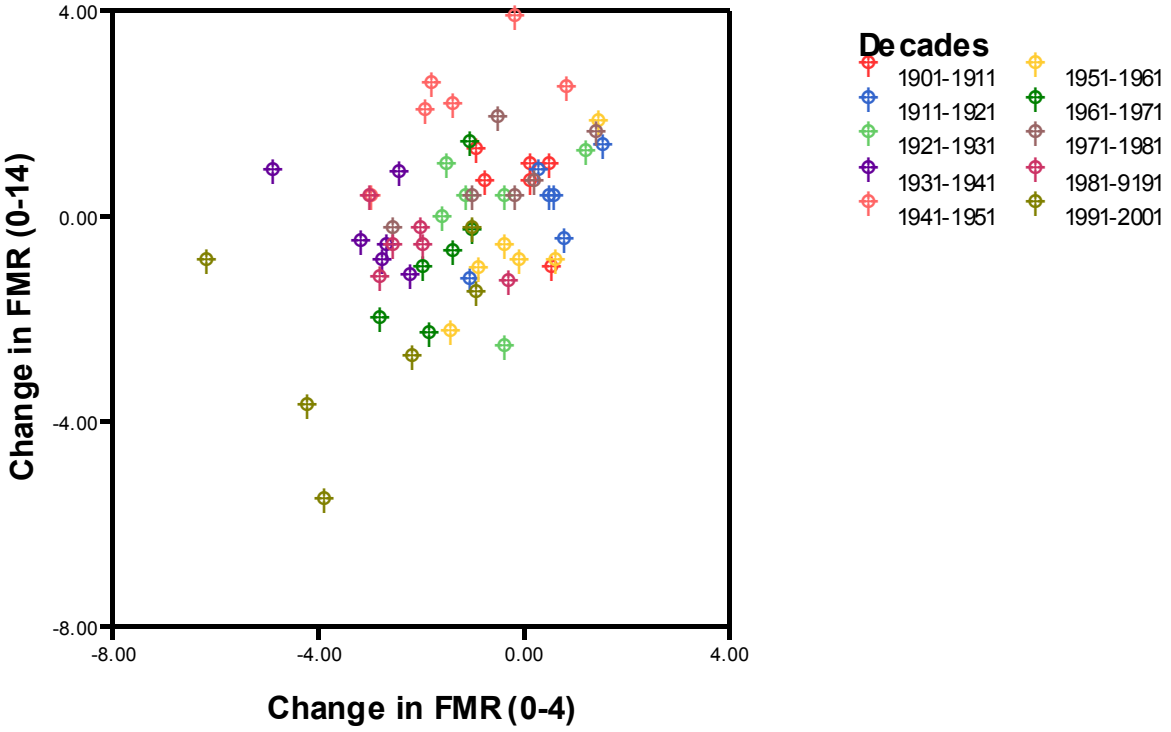

Figure 6:Percentage Decline in 0-4 and 0-14 Age Group FMR during 1991-2001

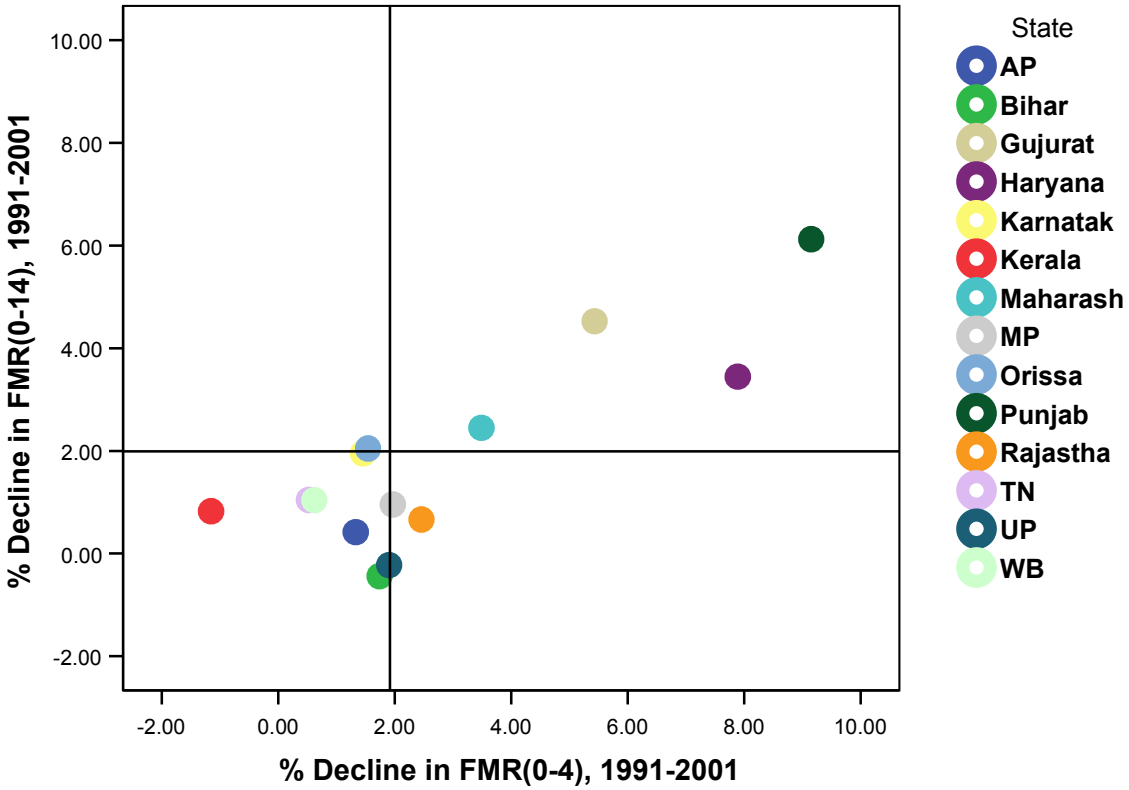

Figure 7: Share of males at birth by conditional order of births, 1986-2004, DLHS-2

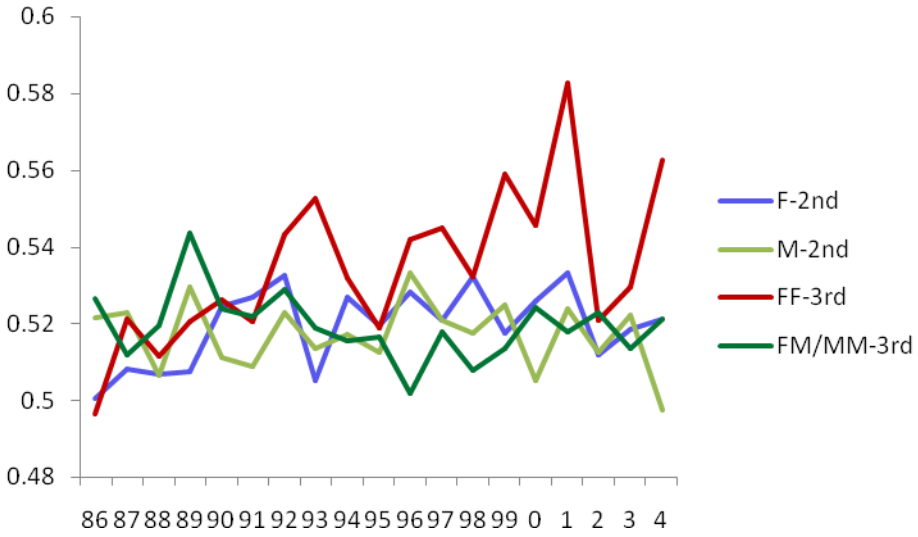

Figure 8: Predicted values of sex ratio at birth for births occurring during 1986-2004, District Level Household Survey (DLHS-2)