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How Do Female Literacy, Employment and Demographic Factors Increase Gender Gap among Children? A Panel Study of Last Four Decades in India and Districts of Major States

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Introduction

India is the second most populous country in the world. According to 2011 census, the population stood at 1210 million. India covers about 2.4% of the world 's surface area and sustains 17.5% of the world population, thus means every six persons in the world is an Indian. According to the census, 2011 there are 623 million males and 586 million females and the overall sex ratio of the Indian population is 943 females per 1000 males (Office of the Registrar General & Census Commissioner, India 2011). Conventionally, the sex ratio in India is measured as the number of females per 1000 males, and the sex ratio at birth is measured as the number of male births per 100 female births. The sex ratio has increased by 10 point from the previous decade, one of the highest since 1971. Although there has been an increase in the overall sex ratio in India, but the decline in child sex ratio (0-4-year age group) is alarming. The continuous decline in the child sex ratio from 979 females per 1000 males in 1981 to 924 females per 1000 males in 2011 is a matter of serious concern. This decline points towards strong son preference and sex selection bias for the male child and consequently there has been an increase in the number of missing girls in India. Sen (1990; 1992) coined the phrase "missing women" to describe this population imbalance and attributed it to sex discrimination. Gender inequality is one of the consequences of sex-selection, giving more preference to the birth of son than a daughter. The social and cultural organization of the society gives more preference for a son, as their heir and as an asset for their old age.

The declining child sex ratio (CSR) in India has been a matter of concern since the late 1980s. It has declined by 55 points since 1981 from 979 females per 1000 males to 924 females per 1000 males in 2011 (ORG 2011). Demographic research in India over the last three decades has focused extensively on fertility change and gender bias at the micro-level, but not much is explored to the change in the child sex ratio due to the prenatal and postnatal factors together. Driven by their strong son preference, couples can manipulate the size and sex composition of their families by using a range of contraceptive methods and, possibly, sex-selective abortion (Jayaraman, A. et al. 2009). The continuous decline in the child sex ratio across different

states of India could be attributed to the loopholes in implementing the Pre-Conception and Pre-Natal Diagnostic Techniques Act (PCPNDT Act). The widespread gender-based abortion of female fetuses and the low immunization rates among girls are indicative of the strong son preference in the country (Barot 2012). The Ministry of Health and Family Welfare, Government of India, has undertaken several measures to implement the Pre-Natal Diagnostic Techniques Act. (PNDT Act 1994), which was amended in 2003 and made into the Pre-Conception and Pre-Natal Diagnostic Techniques (Prohibition of Sex-Selection) Act to improve the regulation of the technology used in sex selection. The Act provides for the prohibition of sex selection and for the prevention of misuse of diagnostic techniques for sex determination leading to female feticide. The role of sex selection in the decline of child sex ratio needs to be investigated. Policymakers need to formulate appropriate policies for women with strict enforcement laws in order to contain this grave trend in son preference, infanticide, neglect, and devaluation of women in India. One of the most alarming trends in India is that son preference, which can be a normal attribute for women's who have only girls, is accompanied by the neglect and death of millions of females through lack of medical care, improper nutrition, infanticide, and sex-selective abortions. It is in these contexts that the present study becomes important. Significant fertility transition and the decline in child mortality in India over the last four decades is accompanied by the increased gender imbalance in the child age group in India. This demands for an investigation of the changing child sex ratio in India both at the micro- and macro-levels. There have been few attempts to understand the change in child sex ratio in the recent years. However, there is no study, which could link the demographic and socio-economic changes at the micro level with the child sex ratio in India over the last 30 years. The aim of the paper was to depict the pattern of decline in child sex ratio in the major states and districts of India from 1981 to 2011 and examine the determinants of the child sex ratio in districts using appropriate statistical methodology.

2 Materials and methods

The office of the Registrar General of India and census operations conducts a census every ten years since 1881, the latest conducted in 2011. The present study is based on the four subsequent rounds of Census of India, 1981, 1991, 2001 and 2011 (ORG 1981; 1991; 2001; 2011). Census of India collects information about population age-sex composition and type of residence at district as well as village level. Census of India is accessible on various dimensions, age-sex population by rural/urban, district and village level, socio-cultural aspects (religion, marital and literate population) and migration by many dimensions like a place of residence, a region for migration and migration stream etc. Nation-wide information is collected on fertility, mortality and migration. The analysis is based on a sample of 305 districts for which adequately detailed information is available. These districts are located in 14 out of 15 India's most populous states. These states contained 326 districts in 1981 and accounted for 94 percent of India's total population (Murthi et al. 1995). The missing state is Assam, where the 1981 census was not conducted. The Census of India atlas provides information about the boundaries changes of the districts and its timing over time. We used 1981 districts as the reference; all the districts splitted in the recent years from original district were merged to its original parent district.

Child Sex Ratio (CSR) in the age group of 0-4 years is the main dependent variable in this study. For independent variables, fertility and under five mortality rates were the major demographic factors considered in this study as previous micro-level studies also indicate strong linkage of declining fertility and child mortality on child sex ratio in India (Mohanty and Rajbhar 2014). Fertility is measured by the total fertility rate (TFR), which represents the number of children that would be born to a woman if she lived to the end of her childbearing years. For our purposes, the total fertility rate is a more useful measure of the fertility level than, say, the crude birth rate, since it is independent of the age structure of the population (Murthi et al.1995). The child mortality variable (U5MR) is the probability that a child will die before attaining the age of five years. It is based on census questions on the number of children ever born and the number of children surviving. Brass method is used for estimating U5MR in India and its districts. The United Nations South Asian Model was adopted as it appropriately represents the mortality patterns in the countries in South Asia, including India (RGI 2009). Based on the assumptions by the United Nations (1983), the child mortality patterns of women in the age groups 20-24 and 25-29 years were used as they appear to be most reliable. The average parity per woman was estimated by P (i) =CEB (i)/W (i), where CEB (i) denotes the number of children ever born to a woman belonging to the age group i, and W (i) denotes the total number of women belonging to the age group i irrespective of their marital status. The proportion of children dead for each age group of mothers was estimated by D (i) =CEB (i)-CS (i)/CEB (i) =CD (i)/CEB (i), where CS(i) denotes the number of surviving children reported by mothers belonging to the age group i, and CD(i) denotes the number of dead children reported by mothers belonging to the age group i. The multipliers K (i)'s was calculated according to the Trussell's variant of the original Brass method. The fertility factor (TFR) was calculated using ASFR estimated using Census of India data at the district level of major states of India. Description of the dependent and independent variables used in this study is provided in table 1.

Table. 1 Definition of variables used in this study

Variables	**Definitions**
Dependent variable	
Child Sex Ratio	No. of female per 1000 male among children (0-4 years) (census)
Independent Variables	
Urban	Proportion of population living in the urban areas, census (%)
Female literacy	Female 7+ literacy rate, census (%)
Scheduled caste (SC)	Proportion of scheduled-caste persons in the total population, census (%)
Scheduled tribe (ST)	Proportion of scheduled-tribe persons in the total population, census (%)
Female work participation rate (FWPR)	Proportion of female workers in the female population, census (%)
Total fertility rate (TFR)	Total number of children born to a woman in her life time if she was subject to the prevailing rate of age-specific fertility in the population, (census)
Under five mortality rate (U5MR)	Probability that a child will die before attaining the age of five years, census
North	Dummy variable, with value 1 for districts in Punjab, Haryana and Rajasthan (census)
Central	Dummy variable, with value 1 for districts in Uttar Pradesh, Madhya Pradesh (census)
East	Dummy variable, with value 1 for districts in Bihar, West Bengal and Odisha (census)
West	Dummy variable, with value 1 for districts in Gujarat and Maharashtra (census)
South	Dummy variable, with value 1 for districts in Tamil Nadu, Kerala, Andhra Pradesh, Karnataka (census)

Estimation of Random and Fixed Effect Models

Random and fixed effects model is used to examine the determinants of CSR using panel data from the last four decennial census data across the fourteen major states and its district in India. We have used the fixed effect model in the panel data sets (Torres and Reyna 2007). Panel data allow us to control for variables that we

cannot measure such as cultural factors or variables that change over time (i.e. national policies, international agreement, etc.) but not across entities. Fixed effect model removes the effect of time-invariant characteristics from the predictor variables so we can assess the predictors net effect. It explores the relationship between predictor and outcome variable within an entity (districts) (Torres and Reyna 2007). When using fixed effect, we assume that something within the individual may impact the predictor or outcome variable and we need to control for this. The equation for the fixed effect model is given as:

$$Y_{it} = \beta_1 x_{it} + \alpha_i + \varepsilon_{it}$$

Where Y_{it} is the dependent variable (child sex ratio) and i=entity (Districts) and t= time. x_{it} is the set of independent variables of ith district at time t

- β_1 is the coefficient for the independent variable
- ε_{it} is the error term.

As each entity is different therefore the entity 's error term and the constant should not be correlated with the others. If the error term is correlated, then fixed effect is suitable, otherwise, we use the random effect model. In our case, the error term was correlated hence we used the fixed effect model.

3 Results

Sex ratio is a powerful indicator of the social health of any society. Economically and socially advanced countries have shown a favourable sex ratio. Historically, the sex ratio in India has been negative. In other words, it has been unfavourable for females. During the pre-independence period, there was a marked decrease in the sex ratio from 1901 to 1941. The trend continued during the post-independence period too. From 1951 to 1971, there was a 16-point decrease in the sex ratio. Since 1971, the trend has changed, with the sex ratio witnessing an increment in the subsequent census in 1981 and reduction in 1991. Sex ratio had increased steadily thereafter until 2011.

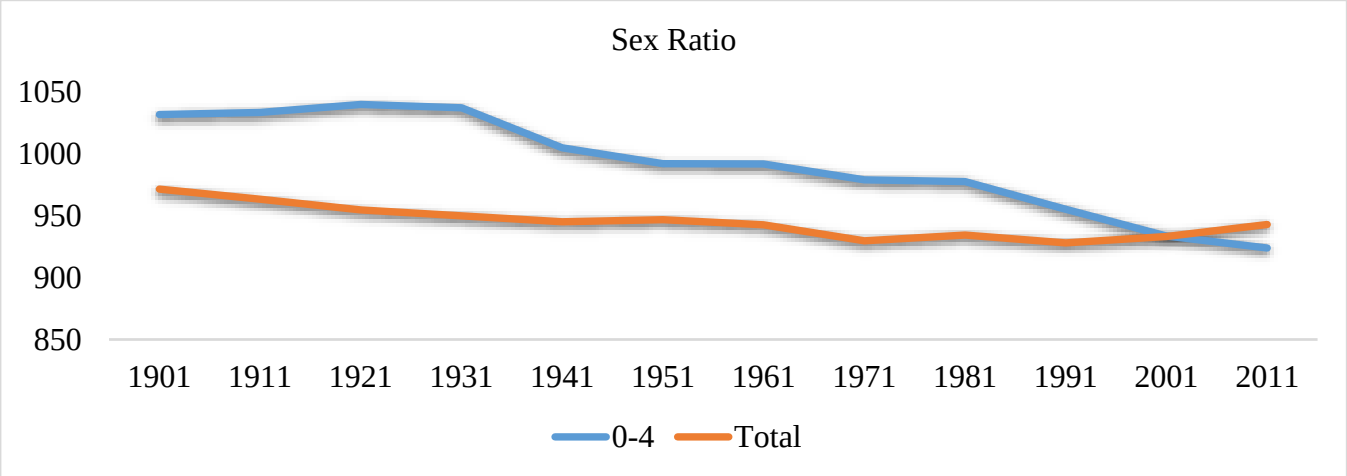


Figure 1: Trend in Overall and Child Sex ratio (0-4) in India, 1901-2011

3.1 Which socio-economic, demographic factors explain variation in child sex ratio at State Level?

Table 2 shows that the child sex ratio in India declined from 979 in 1981 to 955 in 1991. The decade between 1981 and 1991 showed a substantial 24-point decline in the child sex ratio, which was a matter of serious concern. The child sex ratio has decreased continuously from 1981 onwards for India and all the major states. Some states registered a huge decline in the child sex ratio between 1991 and 2001, including Gujarat, Haryana and Punjab, with a decline of 51, 70 and 80 points respectively. On the other hand, the state of Kerala showed an increase of 11 points in the child sex ratio between the years 1991 and 2001, indicating improved conditions for women and a step towards attaining a stronger future for the girl child. A decline of 10 points in the child sex ratio from 934 in 2001 to 924 in 2011. Almost all the states registered a significant decline in the child sex ratio except a few which showed a marked improvement. These include Gujarat (13 points), Haryana (23 points), Karnataka (7 points), Kerala (4 points), and Punjab (61 points). Some of the states, which showed a decline in child sex ratio were Andhra Pradesh (23 points), Rajasthan (21 points), Maharashtra (18 points), and Uttar Pradesh (18 points). However, from Table 2, we can clearly see that though the child sex ratio declined between 1981 and 2011, the decline was not very steep. In each decade, the size of the decline has reduced, and some of the states have shown an increasing trend in child sex ratio from 2001 and 2011.

In explaining the trends and variations in the gender differential in child sex ratio, much discussion has focused on the economic value of women measured by their female work participation rate. The data analysis reveals that while almost all the States showed an improvement in female work participation rate (FWPR) and urbanization in the last four decades, Rajasthan and Tamil Nadu showed the highest increase the last four decades (Table 2). FWPR in Haryana, Punjab and Gujarat surprisingly reduced by 5.1, 9.4 and 4.5 per cent respectively from 2001 to 2011. Punjab indicated an irregular pattern in FWPR. There was no significant change in the proportion of SC and ST population in the study states in this period. However, demographic (fertility and mortality) indicators show considerable transition in India and major states of India. Both fertility and mortality indicators reduced significantly in this period with fertility in some of the states reached below replacement level and Kerala successfully achieving MDG-4 U5MR target before 2015. However, states like Uttar Pradesh and Bihar exhibit high fertility, child mortality and strong son preference. On the contrary, Haryana and Punjab have worst child sex ratio even in the presence of low fertility and child mortality. In the central region of India, Gujarat and Maharashtra reached below replacement level fertility and skewed child sex ratio over time.

Table 2: Trends in child sex ratio, socioeconomic and demographic (fertility and mortality) indicators for India and major states from 1981-2011

States	Years	CSR	Urban	Female literacy	SC	ST	Female WPR	TFR	U5MR
Punjab	1981	925.0	27.7	40.9	26.9	0.0	6.2	4.9	111.0
	1991	874.0	29.5	50.4	28.3	0.0	2.8	3.8	92.0
	2001	794.0	33.9	63.4	28.9	0.0	19.1	2.4	78.0
	2011	855.0	37.5	70.7	31.9	0.0	13.9	1.9	63.0
Haryana	1981	922.0	21.9	27.8	19.1	0.0	10.6	5.4	138.0
	1991	887.0	24.6	40.5	19.7	0.0	6.0	4.3	73.0
	2001	817.0	28.9	55.7	19.3	0.0	27.2	3.2	95.0
	2011	840.0	34.9	65.9	20.2	0.0	17.8	2.3	73.0
Rajasthan	1981	978.0	21.0	14.5	17.0	12.2	21.1	6.1	176.0
	1991	936.0	22.9	20.4	17.5	10.4	12.8	5.0	110.0
	2001	913.0	23.4	43.9	17.2	12.6	33.5	4.2	109.0
	2011	892.0	24.9	52.1	17.8	13.5	35.1	2.8	87.0
Uttar Pradesh	1981	965.0	17.9	17.8	21.2	0.2	8.1	5.9	190.0
	1991	946.0	27.2	30.0	18.7	0.5	6.2	5.6	134.0
	2001	929.0	20.8	42.2	21.1	0.1	16.5	4.4	122.0
	2011	911.0	3.9	57.2	20.7	0.6	16.7	2.6	102.0
Bihar	1981	1004.0	12.5	17.2	14.5	8.3	13.5	5.2	141.0
	1991	978.0	10.2	22.3	16.2	0.4	8.5	5.3	89.0
	2001	957.0	3.5	35.8	15.9	0.1	12.7	4.5	99.0
	2011	941.0	11.3	51.5	15.9	1.3	19.1	2.9	96.0
Odisha	1981	1003.0	11.8	25.8	14.7	22.4	19.8	4.3	179.0
	1991	974.0	13.4	34.7	16.2	22.2	12.1	4.3	133.0
	2001	959.0	15.0	50.5	16.5	22.1	24.7	2.8	119.0
	2011	945.0	16.7	64.0	17.1	22.8	27.2	2.0	93.0
Madhya Pradesh	1981	989.0	20.3	19.5	14.1	23.0	30.6	5.3	197.0
	1991	967.0	25.1	26.6	17.1	16.6	17.9	4.9	147.0
	2001	938.0	26.5	50.3	15.2	20.3	33.2	3.9	137.0
	2011	928.0	27.6	59.2	15.6	21.1	32.6	2.6	97.0
Gujrat	1981	962.0	31.1	39.4	7.2	14.2	20.7	4.7	124.0
	1991	939.0	34.5	48.6	7.4	14.9	13.7	4.2	101.0
	2001	888.0	37.4	57.8	7.1	14.8	27.9	2.6	73.0
	2011	901.0	42.6	69.7	6.7	14.8	23.4	2.0	73.0
Maharashtra	1981	961.0	35.0	42.2	7.1	9.2	30.6	4.3	145.0
	1991	946.0	40.1	52.0	10.1	7.6	25.6	3.7	91.0
	2001	913.0	42.4	67.0	10.2	8.9	30.8	2.6	62.0
	2011	895.0	45.2	75.9	11.8	9.4	31.1	1.9	61.0
Andhra Pradesh	1981	1000.0	23.3	74.7	14.9	5.9	33.5	4.3	139.0
	1991	978.0	26.9	32.7	15.9	6.3	30.0	3.4	67.0
	2001	965.0	27.3	50.4	16.2	6.6	35.1	2.3	70.0
	2011	942.0	33.4	59.1	16.4	7.0	36.2	1.6	71.0
Karnataka	1981	979.0	28.9	34.0	15.1	4.9	25.3	4.7	142.0
	1991	962.0	30.9	44.3	16.4	4.3	22.7	3.9	90.0
	2001	948.0	34.0	56.9	16.2	6.6	32.0	2.4	73.0
	2011	955.0	38.7	68.1	17.1	7.0	31.9	1.8	78.0
Kerala	1981	975.0	18.7	77.3	10.0	1.0	16.6	3.3	80.0
	1991	951.0	26.4	86.2	9.9	1.1	12.8	2.6	60.0
	2001	962.0	26.0	87.7	9.8	1.1	15.4	1.7	47.0
	2011	966.0	47.7	92.1	9.1	1.5	18.2	1.8	34.0
Tamil Nadu	1981	974.0	0.0	36.7	18.3	1.1	26.5	3.9	132.0
	1991	951.0	34.2	51.3	19.2	1.0	25.1	3.1	67.0
	2001	946.0	44.0	64.4	19.0	1.0	31.5	1.8	78.0
	2011	945.0	48.4	73.4	20.0	1.1	31.8	1.6	61.0
West Bengal	1981	991.0	26.5	36.9	22.0	5.6	5.8	4.3	190.0
	1991	972.0	27.5	46.6	23.6	5.6	8.0	3.6	94.0
	2001	966.0	28.0	59.6	23.0	5.5	18.3	2.6	96.0
	2011	959.0	31.9	70.5	23.5	5.8	18.1	1.7	61.0

3.2 Issues and Hypothesis

In this section, we will discuss some credible correlation between the demographic and some basic social-economic and empowerment variables at the state level in India.

3.2.1 Empowerment and child sex ratio

Female work participation rate is not always positively correlated with the child sex ratio in all major states of India. Some of the states shows positively relationship and some states exhibits negative relationship. We can see in the scatter plot (Fig 2) that Kerala has highest child sex ratio but low levels of female work participation rate. On the other hand, Haryana and Punjab have low levels of both child sex ratio and female work participation. There is no clear-cut pattern found in female work participation rate and child sex ratio. Prima facie, the graphical plots of movement of FWPR and child sex ratio in India negated the positive correlation between the two (Fig 2). However, it is to be noted that women's contribution to the economy remains significantly invisible in national accounts. The low level of female educational attainment results in women's low earning potential, low nutritional status, high level of mortality and low financial and functional autonomy within households, which in turn has a positive impact on sex ratio.

3.2.2 The role of effective female literacy

Among the factor other than female empowerment. effective female literacy has a strong influence on child sex ratio (Murthi et al. 1995), especially female education is now widely considered one of the most powerful indicators (Murthi et al. 1995). A very close relationship between female education and child sex ratio has clearly emerged in the scatter plot (Fig 3.). Kerala has highest child sex ratio and a higher proportion of female education. While Bihar, Rajasthan, Haryana and Punjab shows worst female population among children with poor levels of female education.

An equivalent analysis on literacy, particularly female literacy indicates a good improvement over the decades in all the states. Kerala ranked top (87.7 per cent) among all states in female literacy followed by Maharashtra (67 per cent), Tamil Nadu (64.4 per cent) and Punjab (63.4 per cent) (fig. 3). Effective female literacy also affects the relationship between expected family and expected better family size. An educated mother is able to plan fewer births in order to achieve expected family size.

Fig. 2 Movement of Child sex ratio and female work participation rate in India by Census 2011

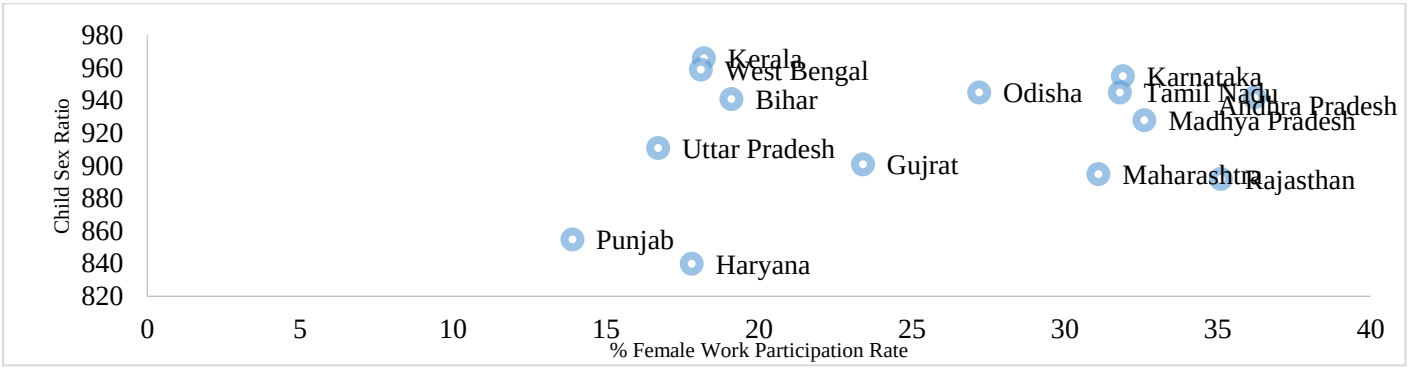


Fig. 3 Movement of Child sex ratio and % of effective female literacy in India by Census 2011

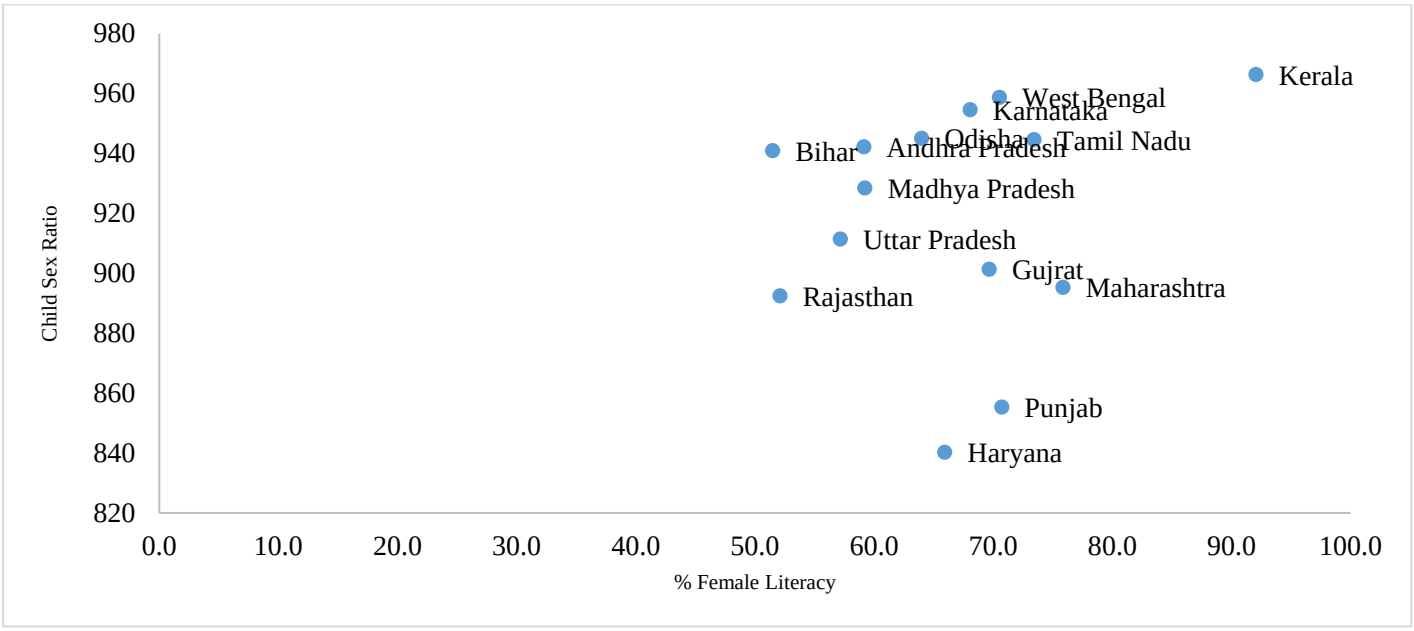


Fig. 4 Movement of Child sex ratio and % urban population in India by Census 2011

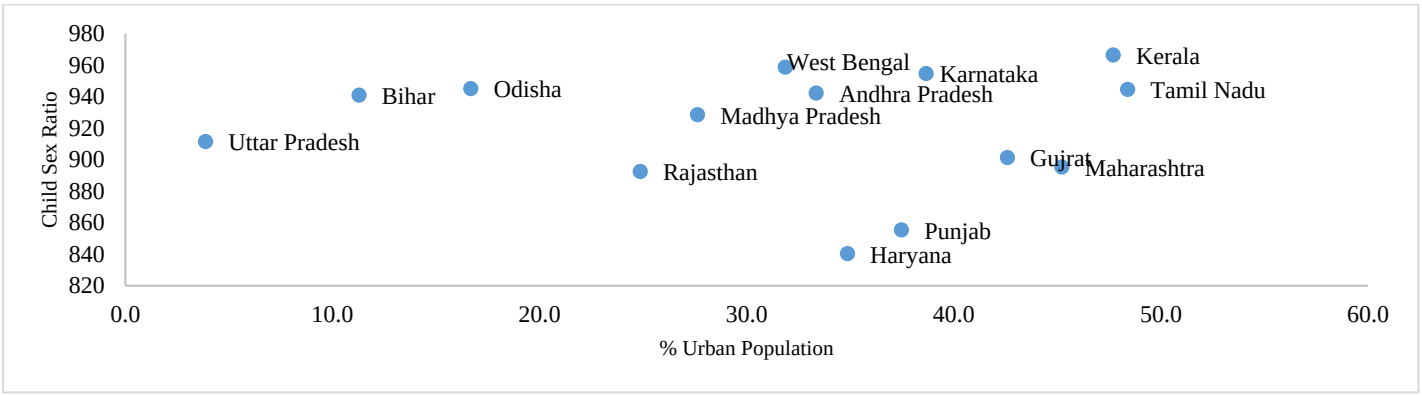


Fig. 5 Movement of Child sex ratio and % SC population in India by Census 2011

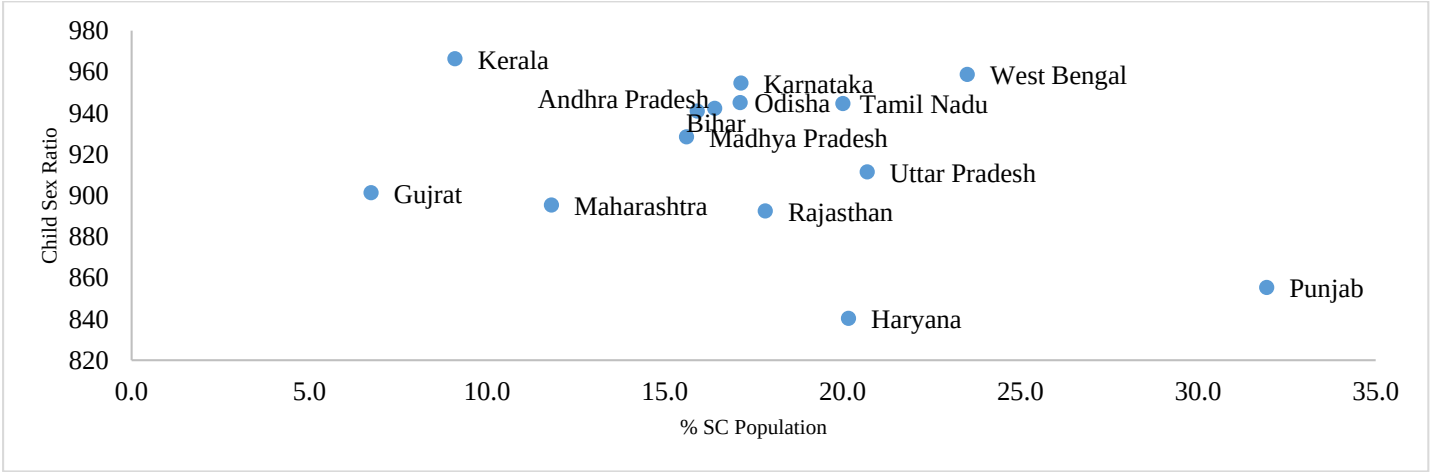


Fig. 6 Movement of Child sex ratio and % ST population in India by Census 2011

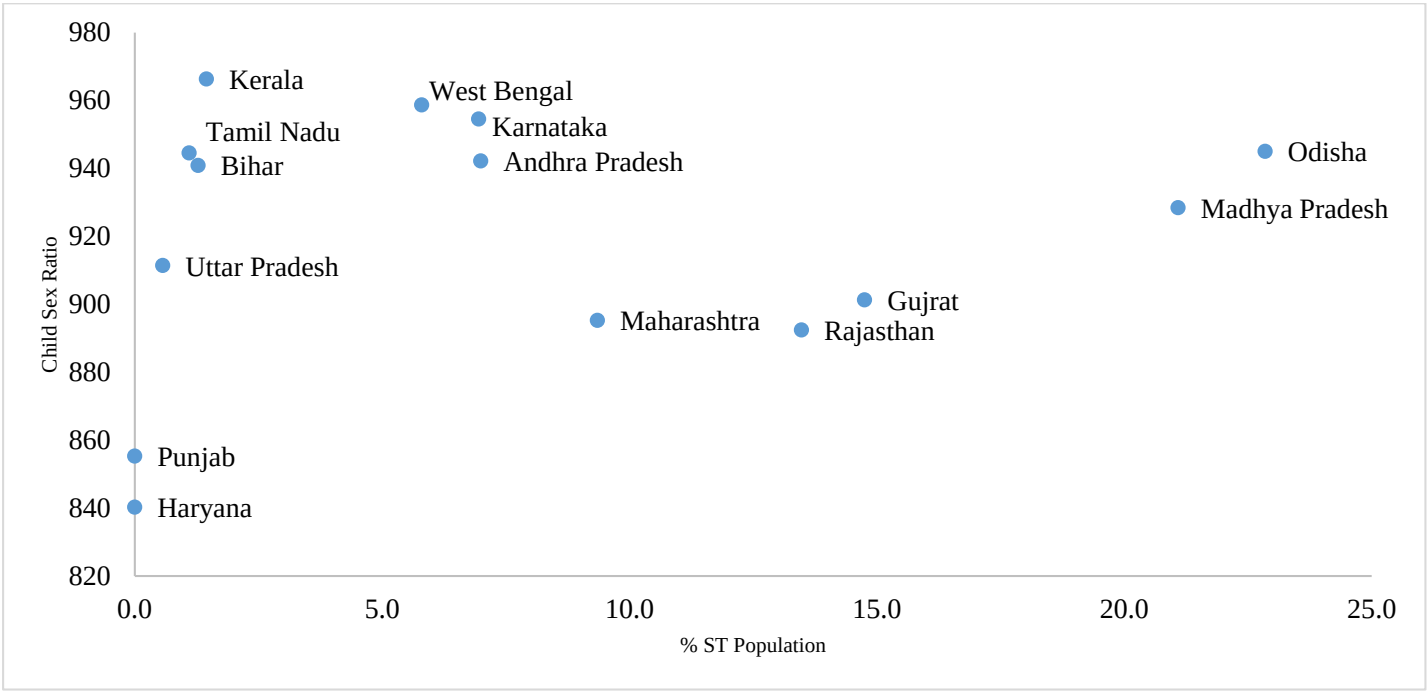


Fig. 7: Movement of Child sex ratio and total fertility rate in India by Census 2011

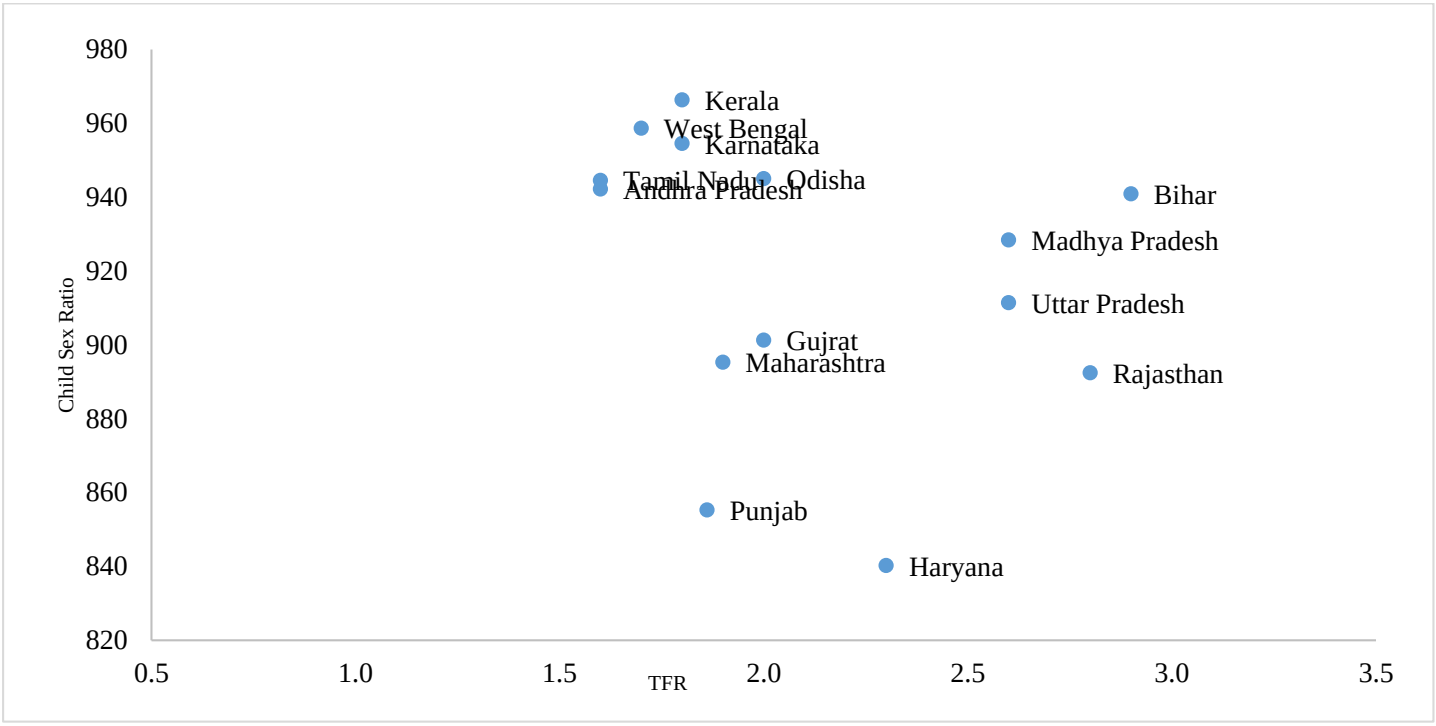
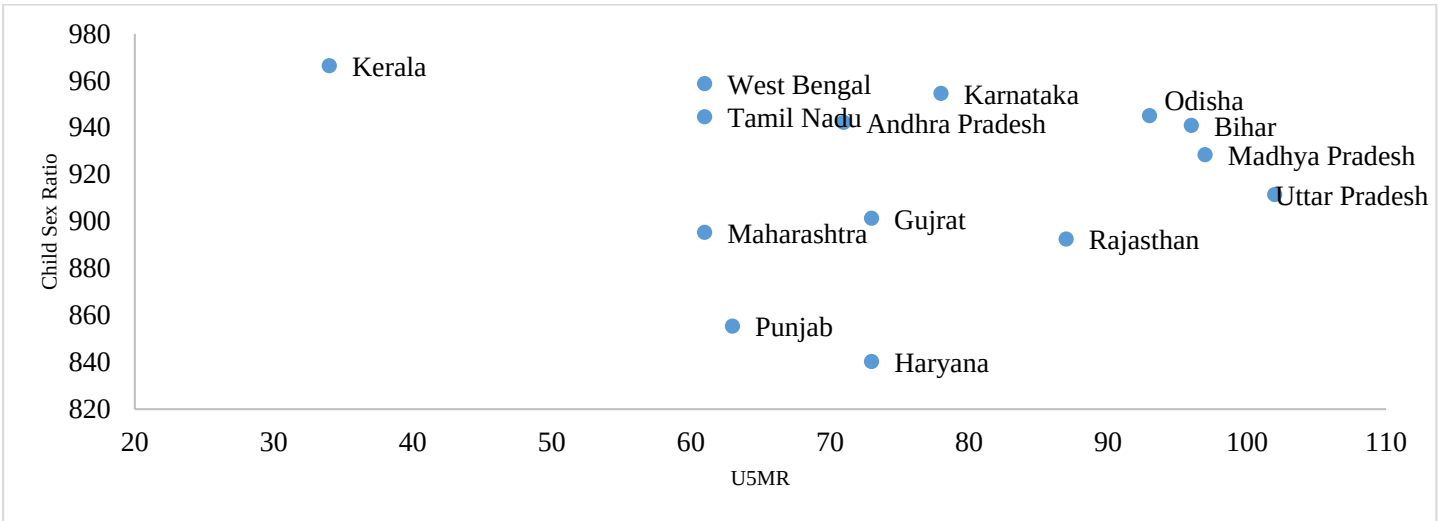


Fig.8: Movement of Child sex ratio and under five mortality rates in India by Census 2011



3.3 Child sex ratio at the district level

Table 3 suggests that the average child sex ratio for the districts in major states has reduced considerably from 976 to 920 in 2011. The average female literacy has increased by more than a double in the last four decades. There is a marginal increase in the proportion of scheduled caste and tribe population in the major states. The demographic transition is clearly outward from the change in TFR and U5MR values at the district level from 1981 to 2011.

Table. 3 Summary statistics of child sex ratio and selected demographic and socioeconomic characteristics at the district level, 1981-2011

	Overall		1981		1991		2001		2011	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Child sex ratio	943.0	50.0	976.0	53.0	950.0	34.0	927.0	51.0	920.0	40.0
Urban	23.9	17.8	20.8	16.1	23.0	16.0	25.9	17.9	25.8	20.6
Effective female literacy	45.1	21.8	28.5	21.5	36.0	17.7	53.2	15.2	63.2	12.2
SC	17.0	8.2	16.6	10.6	16.9	7.0	17.0	7.1	17.4	7.6
ST	8.1	14.2	7.8	13.5	8.3	14.6	8.0	14.1	8.4	14.5
Female WPR	22.2	12.3	20.0	13.7	15.7	10.3	26.9	10.7	26.4	10.5
TFR	3.8	1.4	5.1	0.9	4.4	1.0	3.3	1.1	2.2	0.6
U5MR	109.9	45.6	157.4	44.6	106.9	38.2	96.5	31.9	78.8	21.8
North	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4
Central	0.6	0.9	0.6	0.9	0.6	0.9	0.6	0.9	0.6	0.9
East	0.5	1.1	0.5	1.1	0.5	1.1	0.5	1.1	0.5	1.1
West	0.6	1.4	0.6	1.4	0.6	1.4	0.6	1.4	0.6	1.4
South	1.1	2.1	1.1	2.1	1.1	2.1	1.1	2.1	1.1	2.1

Table 4 shows the decline in CSR at the district level. Half of the districts (54.7%) shows more than 25 points decline in CSR from 1981 to 1991. Over time, this proportion reduces to 25% in the recent decades (2001-2011). This indicates a reduction in the pace of decline in child sex ratio in the recent period. However, the important point to note is that there is no change in the proportion of districts, which experienced no decline in CSR.

Table 4 Percentage distribution of districts by the decline in child sex ratio (CSR), 1981–2011

Decline in CSR	**1981-1991**	**1991-2001**	**2001-2011**
No decline	2.6	2.3	2.3
1-25 points	42.6	52.9	70.1
26–50 points	39.2	26.6	25.2
>50 points	15.5	18.1	2.3

3.3.1 Correlation of child sex ratio with socioeconomic and demographic factors at the district level for the major states of India 1981-2011

Table 5 shows pairwise correlation matrix between dependent and our socioeconomic predictors from 1981 to 2011. The significant negative correlation between CSR and urban population is observed during 1981 to 2001 except in 2011. Similarly, the significant negative correlation between effective female literacy and CSR was observed in the 1991 and 2001 census. The proportion of scheduled caste population has a negative correlation with CSR in the last three decades. Female work participation rate and proportion

of scheduled tribe population were positively and significantly correlated with CSR across the years. U5MR is also positively correlated with CSR and the relationship was significant in 1991 and 2001. Relationship of TFR with CSR is not very clear, as 1981 and 2011 data shows a negative relationship, while 1991 and 2001 data show a positive correlation. However, these relationships were not significant until recent year.

Table. 5 Correlation of child sex ratio (CSR) with socioeconomic and demographic factors at the district level in major states of India, 1981-2011

Independent variables	**CSR (1981)**	**CSR (1991)**	**CSR (2001)**	**CSR (2011)**
Urban	-0.13	-0.22	-0.21	-0.06
	(0.03)	(0.00)	(0.00)	(0.34)
Effective Female literacy	-0.09	-0.24	-0.14	-0.03
	(0.11)	(0.00)	(0.02)	(0.63)
SC	-0.02	-0.22	-0.18	-0.18
	(0.76)	(0.00)	(0.00)	(0.00)
ST	0.24	0.37	0.29	0.29
	(0.00)	(0.00)	(0.00)	(0.00)
Female WPR	0.13	0.38	0.14	0.27
	(0.02)	(0.00)	(0.02)	(0.00)
TFR	-0.02	0.04	0.06	-0.15
	(0.79)	(0.44)	(0.27)	(0.01)
U5MR	0.09	0.12	0.14	0.02
	(0.10)	(0.04)	(0.02)	(0.70)
REGION	0.11	0.37	0.43	0.51
	(0.07)	(0.00)	(0.00)	(0.00)

Note: Figures in the parenthesis are p values of correlation test.

Considerable improvement in socioeconomic and the demographic condition has been observed at the district level in India. In order to examine the effect of socioeconomic and demographic predictors on the CSR in the recent time, we run a simple OLS model to examine this relationship using the most recent Census 2011 data. Table 6 shows the OLS regression beta coefficient estimates for CSR as a dependent variable. The socioeconomic and demographic predictors were able to explain 62 percent of the variation in CSR at the district level. Urbanisation has a positive association with CSR, though the relationship is not significant. The female work force participation rate has a significant positive relationship with CSR in the districts of major states of India. With the increase in one percent of scheduled tribe population in a district, CSR improves significantly by 0.69 point. The region was another most significant predictor of CSR in 2011. As compared to the north region, other regions have significantly higher CSR.

Table 6 OLS regression estimates with Child Sex Ratio (CSR) of 442 districts of major states as the dependent variable, 2011

Independent variables	Beta coefficient	P value	95% CI
Intercept	849.01	0.00	[803.10-894.92]
Urban	0.04	0.63	[-0.13-0.21]
Female Literacy	-0.05	0.81	[-0.42-0.33]
SC	-0.09	0.66	[-0.52-0.33]
ST	0.69**	0.00	[0.48-0.90]

Female WPR	0.37*	0.04	[0.03-0.71]
TFR	4.49	0.23	[-2.87-11.85]
U5MR	-0.03	0.71	[-0.20-0.14]
Region (North=Ref.)			
Central	49.62**	0.00	[41.10-58.13]
East	77.41**	0.00	[68.85-85.98]
West	29.65**	0.00	[18.82-40.48]
South	84.96**	0.00	[75.11-94.82]
Adjusted R^2	0.62		

Further, we aim to examine the role of each predictor towards child sex ratio in 1981-2011. We run a panel fixed effect regression pooling all the census year observation together in one model and keep year as an independent variable. Table 7 shows the result of the panel fixed effect regression model. If all independent variable is constant over a period then child sex ratio will be 885 females per 1000 males in major states of India in 1981-2011. Table 7 shows that the increase in urban proportion is negatively associated with CSR. The female literacy and work force participation was negatively related with CSR. The proportion of ST population in a district remain positive predictor of CSR in panel model. TFR is also positively associated with CSR in the panel model. It was observed that all regions had a significantly higher CSR as compared with the northern region. Over the period, there has been a significant reduction in CSR even after controlling all the other predictors. As compared to the year 1981, CSR reduces by 18 points in the year 1991 and maximum in the year 2001 by 27 points and 22 points in 2011.

Table 7 Panel regression fixed effect model for 305 districts of major states, 1981-2011

Independent variables	Beta Coefficient	95% CI
Urban	-0.06	[-0.22,0.10]
Female Literacy	-0.20*	[-0.38, -0.02]
SC	-0.13	[-0.450,0.20]
ST	0.90**	[0.68,1.12]
Female WPR	-0.10	[-0.37,0.18]
TFR	8.97**	[4.95,12.99]
U5MR	0.01	[-0.08,0.11]
Region (North=Ref.)		
Central	38.08**	[28.88,47.27]
East	69.99**	[60.17,79.82]
West	34.65**	[23.57,45.73]
South	80.90**	[70.45,91.35]
Year (1981=ref.)		
1991	-18.29**	[-24.87, -11.70]
2001	-27.16**	[-36.15, -18.16]
2011	-21.82**	[-33.93, -9.72]
Constant (Intercept)	885.55	[858.20, 912.90]
Sigma U	19.09	
Sigma e	28.76	
Rho	0.31	(fraction of variance due to u_i)

Note : **p < 0.01; *p < 0.05

4 Discussion and conclusion

India, with a huge population of 1.2 billion comprises a majority of the population of the world. With sex-selection in favour of males – due to the social and cultural organization of the society that prefers sons for an heir and considers them an asset for the old age – the number of males has increased and created the social problem of 'missing girls'. Before the advent of technology, long before the 1980s, data clearly shows that there have been sex-selection preferences for the male child and that these vary across regions (Hesketh, T. and Xing, Z. W 2006). After the introduction of technology, prenatal deaths and abortion became more common than infanticide as forms of sex selection. At the same time, improvement in female life expectancy and reducing death rate becomes major factors in improving the overall sex ratio. However, if we look at the SRB, we can see a major decline from 1996-98 to 2012, and it is clearly favourable to males (RGI 2000; 2014). This shows that the social environment is still not favourable for females. In the recent decades, the decline in the fertility rate has created even greater pressure on the parents to go for sex selection, as they want at least one son for their future assistance. Child sex ratio includes both prenatal as well as postnatal sex selection and thus it is one of the important indicators for comparing the trend in sex selection. The large extent of the missing girls is evident from this study.

Child sex ratio shows a major decline from 1981 to 2011 in the country as a whole and in all the major states. However, the closer observation of the data for the Census 2001 and 2011 indicates that the situation has improved in the last decade compared to the decade preceding 2001. While the child sex ratio decreased by 10 points for the country as a whole, the ratio improved in some of the states. On the other hand, larger states like Bihar, Uttar Pradesh, Rajasthan, Orissa, Maharashtra, Madhya Pradesh, and West Bengal still show a negative child sex ratio (0-4). Further research is needed to inform the development of policy actions to prevent sex selective abortions and prevent the child sex ratio to become more skewed in India as a whole and in the states individually. Several studies have shown that a serious effort towards improving the sex ratio at birth or the child sex ratio has been effective.

This study found that there are several factors, which were positively or negatively associated with child sex ratio. For example, urbanisation is associated negatively with CSR. Urbanisation, as a sign of newness, stands for the transition from the old to new. However, it works as a paradox of modernity favouring men not women. A recent study showed prenatal sex discrimination is much more prevalent in urban areas than in rural areas (Bhat and Zavier 2007). Bose (2001) pointed out the recent steep decline in child sex ratios the result of greater availability of sex screening technologies, especially in an urban area. Prenatal sex discrimination became the modern approach to family planning in urban India. Percent of scheduled tribe population is positively associated with CSR. Traditionally, the sex ratio patterns among SC and STs have been presumed to be more balanced than the overall population. The SC and ST population is usually poor, has marginal land assets and is a major supplier of casual and agricultural labour (Saha and Paul 2017). Socially and culturally, these two groups are quite different from the overall population with women's autonomy being much greater. Thus, the increase in the SC and ST population in the total population may have a link with a favourable CSR. The region is one of the most significant predictors of

CSR irrespective of the models chosen. The northern region has a significantly lower sex ratio then all other regions of India. This is mainly because of states like Punjab and Haryana, where female foeticide has been high and which have strong social and cultural norms. Although we have seen from the trend analysis that child sex ratio has improved over time in both the states. Punjab has shown an increase of 61 points, Haryana has shown an increase of 23 points in the child sex ratio. Several studies have shown that a serious effort towards improving the sex ratio at birth or the child sex ratio has been effective (Das Gupta, M. et al. 2003). Several efforts have been made in order to bring about gender equality, including the equal law for property ownership and equal employment opportunities. Various approaches have been followed in order to reduce sex-selection such as awareness generation in the society in favour of the female child, cash incentive programmes for girls, and prevention of sex-selective abortion (Sharmistha Basu et al. 2015). Various state governments have made different efforts to solve the problem of skewed child sex ratio, which in turn has helped in the improvement of the overall sex ratio.

Policy implications

This study suggests a need to bring in more socially inclusive policies and programs by the government to help provide equal status for women. Timely interventions in this regard can help avoid further imbalance in the child sex ratio. Although women-oriented policies and programs can yield positive results to improve the child sex ratio, their impact may not be sustainable.

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Appendix:

Changes in the number of districts over a period of time in major states of India from 1981 to 2011

States	1981	1991	2001	2011
Uttar Pradesh	48	54	70	71
Punjab	12	12	17	20
Haryana	12	16	19	21
Maharashtra	26	30	35	35
Karnataka	19	20	27	30
Kerala	12	14	14	14
Tamilnadu	17	21	30	32

Source: Census of India, 1981-2011