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PROXIMATE DETERMINANTS OF SEX RATIO AND ITS REGIONAL VARIATIONS IN INDIA

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Abstract

Paper analyzes the regional variations in the overall and child sex ratios, female mortality disadvantage and their impact of decline in female population in India using data from Census of India, SRS, and NFHS II. An index developed by Hill and Upchurch (1995) used to estimate region-wise female mortality disadvantage. The results show that the highest decline in the child sex ratio observed in north/ north-west part of India. In this region in many states the sex ratio at birth sharply decline even from the first order birth and continue decline up to third order birth. In southern region in most of the states the sex ratio at birth decline after second order birth. The median value of the female mortality disadvantage is highest in north/ northwest followed by central/ western region, south and lowest in east/northeast. More than half missing child females belonged to north/ northwest region, followed by one third in central & western region. South and east/northeast regions shared relatively low proportion of missing female child population. Multivariate regression analysis shows that gender mortality differentials at childhood age, proportions of Hindu population, urban population and cultivators have influenced the decline in child sex ratio.

Introduction:

One of the significant contributors to the adverse child sex ratio in India is the practice of elimination of female foetus. In the context of fertility transition, sex composition of the children in the family also depend on the perceived desire for ideal number of children particularly the males due to strong son preference by the society. The prevalence of patriarchy especially, in many states of northern part of India and huge dowry demand has negative influence on the desire for daughters that leads to termination of female foetus and thus unfavorable sex ratio for female. Empirical evidences indicated that the phenomenon of sex determination and sex selective abortion is now concentrating not only in towns and cities but also approaching in rural areas with the availability of better road and transport facilities (Babita Sinha, P.N. Mari Bhat and S.C. Gulati 2005).

The development of science and technologies made available Prenatal Diagnostic Technology such as ultrasound imaging foetoscopy, alpha-fetoprotein measurement and chronic villi sampling or biopsy for detecting the sex of the foetus and termination of female foetus. Arnold, Kishore and Roy (2002), using NFHS-I & II data, indirectly estimated more than 100,000 sex selective abortion annually that are followed by ultrasound or amniocentesis in India. For curbing the menace of female foeticide, the government of India brought into force the Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse) Act on 20th September 1994. The act came into force with effect from 1.1.1996). Though, Government of India has undertaken various steps to prevent the practices of female infanticide and foeticide. Unfortunately, sex determination tests have continued and, in fact, spread more rapidly even to remote areas with the advent of ultrasound. The acts and rules framed hereunder were, therefore amended and the same came in force with effect from 14th February 2003 and title of the act changed to "Pre-conception and Pre-natal Diagnostic Techniques (Prohibition of Sex-selection) Act (PC & PNDT Act)". It prescribes stringent punishment to those who misuse them for sex selection.

2001 Census of India shocked the whole nation by reporting a sharp decline in the child sex ratio (0-6) in the past decade. It has declined from 976 in 1961 to 927 in 2001. In India, which is mainly strong patriarchal and patrilineal society, the preference for son is determined by their socio-cultural, economic, religious and legal utility. However, there does existed variation in the son preference from north to south parts of India depending on how above factors play their roles. In the context of fertility decline in India, the desire for at least one son is more prominent. It leads to adopt permanent method of contraception if the 2nd order birth is also male as the couple will rarely go for third child and thus it contributes to unfavorable sex ratio. The imbalances in sex composition of children i.e. unfavorable for females; further aggravated due to gender differential treatment of the girl's child leading to relatively high infant and child morbidity and mortality. The higher child mortality for girls than that of boys clearly indicates the existence of female disadvantage in the society.

Empirical analyses (Retherford and Roy, 2003) also indicated that in India sex selective abortion is higher among urban women, middle and higher educated women and

women living in households with high standard of living. They attributed this phenomenon to more awareness and access to sex determination and abortion services, birth planning and greater use of contraception. This phenomenon found strong in North, West and East groups of States than in South group of states. In fact, the mentality of sex selective abortion is diffusing from higher socio-economic status group to lower socio-economic status and if the stringent measures are not taken up it will diffuse in most part of India leading to further imbalance in sex- ratio and thus lead to long term impact on demographic imbalance.

Objectives:

The main objectives of the present paper are:

(a) To analyze the regional variations in the overall and child sex ratios;
(b) To estimate region-wise the female mortality disadvantage;
(c) To analyze the impact of decline in sex ratio on missing females at the regional as well as at national level; and
(d) To measure the proximate determinants of sex ratio.

Data

Data for the present study has been taken from Census of India 1991 and 2001. In addition information collected from the reports of Central Bureau of Health Intelligence (CBHI), Sample Registration System (SRS) office of the Registrar General of India, National Family Health Survey II (NFHS II) and Human Development Reports.

Methodology

To study the regional variation in sex ratio the States/UTs are grouped into four regions - based on the geographical locations as given below.

Regions	**States/UTs**	**Number of States/UTs**
North/North West India	Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttaranchal and Uttar Pradesh	9
South India	Andaman & Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Pondicherry and TamilNadu	7
East / North East India	Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal	11
Central & Western India	Chhattisgarh, Dadra & Nagra Haveli, Daman & Diu, Goa, Gujarat, Madhya Pradesh, Maharashtra and Orissa	8

To measure female mortality disadvantage for the age groups 0-1, 1-4 and 0-5 an index developed by Hill and Upchurch (1995) has been used. For a population *i* age range x, x+n, the index $Ii(x, x+n)$ of female disadvantage is given by

$$Ii(x, x+n) = ({}_nq_x^f / {}_nq_x^m) - [({}_nq_x^f / {}_nq_x^m)^s :_5 q_0^m]$$

Where $[({}_nq_x^f / {}_nq_x^m)^s :_5 q_0^m]$ is the standard ratio from the Appendix Table 1 given the level of under five male mortality.

A positive value of I indicates a female disadvantage (higher female to male mortality than expected gives the overall level of under five mortality) whereas negative value indicates a female advantage (relative to that expected). Here the difference of ratios are used because once the epidemiological sex difference is controlled, the remaining difference is an absolute indicator of discrimination (Hill and Upchurch, 1995).

Paper also estimates the missing females in different age groups by assuming 3 levels of normal sex ratio (100 103, and 105). Sex ratio is measured by taking number of males per 100 females. To study the proximate determinants of declining sex ratio of children (0-6 age group), the multiple regression analysis was carried out. The cross-sectional data for States/UTs of India include the following variables.

Demographic factors: Ratio of female to male child mortality and ratio of female to male infant mortality

Social and Cultural factors: proportion of SC population, proportion of Hindu population and proportion of Sikh population;

Economic and Developmental factors, Female literacy rate and percentage of urban population, percentage of population living below poverty line, percentage of population as cultivators, female work participation rate.

Results and Discussion:

Sex Ratio and Its Regional Variation:

As can be seen from tables 1 and 2 that though there is slight (6 point) increase in overall sex ratio in India during 1991-2001 but during the same period there was unfortunate high (18 points) decline in the child sex ratio (0-6 age group). Region-wise highest decline in the child sex ratio observed in North/ North-West part of India. In this region the most affected states/UT are Punjab, Haryana, Himachal Pradesh and Chandigarh where the decline in child sex ratio found more than 50 points. In this region all the states recorded decline in child sex ratio as well as in overall sex ratio except in two states Rajasthan and Uttar Pradesh wherein, increase in overall sex ratio was noticed. For the South and East/North East regions, all the states / UTs (except Sikkim) recorded improvement in the overall sex ratio. Again unfortunately (except in Kerala,

Lakshadweep and Pondicherry of South India) all the States showed decline in the child sex ratio. But, the decline in these regions was not as high as recorded in Northern states and Central & western part of India.

In central and western India there was sharp decline in the overall sex ratio with respect to Dadra & Nagar Haveli and Daman & Diu UTs. It is also interesting to note that the overall sex ratio has increased in the state of Gujarat (65 points) and Orissa (1 point) but the corresponding child sex ratio declined by 45 and 14 points, respectively.

The mean overall as well as child sex ratio is lowest in North/North West India in both the censuses compared to other regions (Table 2). The intra regional variation in overall sex ratio showed a declining trend from 1991 to 2001 in South (7.0 to 6.7) and East/North East (3.6 to 3.4) India, while in other two regions it increased from 6.5 to 7.0 percent in North/North West and 1.9 to 11.0 percent in central and western India. Similar trend was observed with respect to child sex ratio. This indicated that the declining trend of Overall sex ratio and child sex ratio of North/North west and Central & western India with much variation in their magnitude among the states/UTs than the other two regions (Fig. 1).

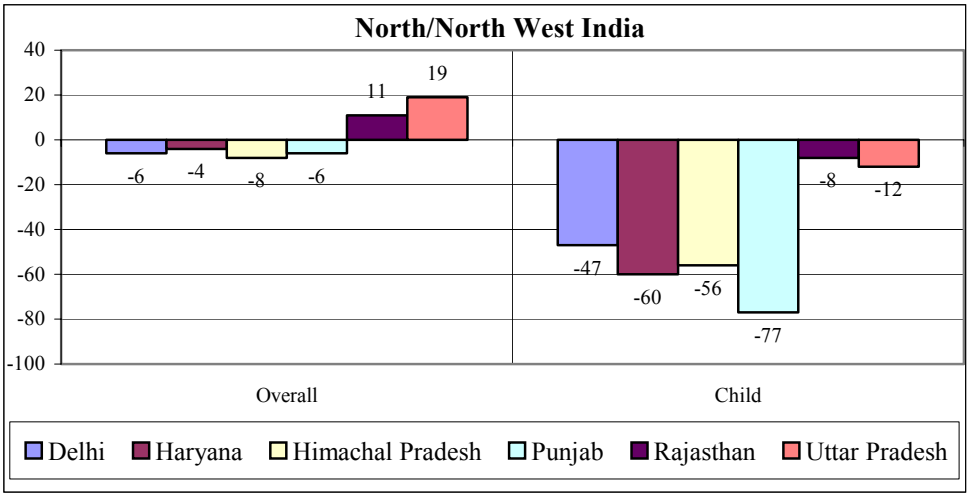
Table 1: Overall and Child Sex Ratio in India & States/UTs for 1991 and 2001

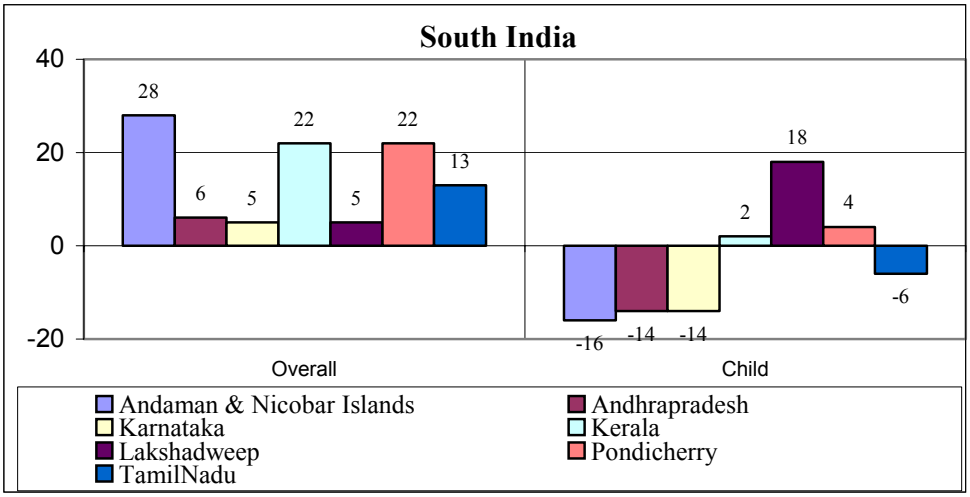
Regions	States/UTs	Overall Sex Ratio		Change	Child Sex Ratio (0 - 6)		Change
		1991	2001		1991	2001	
India		**927**	**933**	**6**	**945**	**927**	**-18**
North / North-West India	Chandigarh	790	777	-13	899	845	-54
	Delhi	827	821	-6	915	868	-47
	Haryana	865	861	-4	879	819	-60
	Himachal Pradesh	976	968	-8	951	896	-56
	Jammu & Kashmir	923	892	-31	NA	941	
	Punjab	882	876	-6	875	798	-77
	Rajasthan	910	921	11	916	909	-8
	Uttaranchal	NA	962		NA	908	
	Uttar Pradesh	879	898	19	928	916	-12
South India	Andaman & Nicobar Islands	818	846	28	973	957	-16
	Andhra Pradesh	972	978	6	975	961	-14
	Karnataka	960	965	5	960	946	-14
	Kerala	1036	1058	22	958	960	2
	Lakshadweep	943	948	5	941	959	18
	Pondicherry	979	1001	22	963	967	4
	Tamilnadu	974	987	13	948	942	-6
East / North East India	Arunachal Pradesh	859	893	34	982	964	-18
	Assam	923	935	12	975	965	-10
	Bihar	911	919	8	959	942	-17
	Jharkhand	NA	941		NA	965	
	Manipur	958	978	20	974	957	-17
	Meghalaya	955	972	17	986	973	-13
	Mizoram	921	935	14	969	964	-5
	Nagaland	886	900	14	993	964	-30
	Sikkim	878	875	-3	965	963	-2
	Tripura	945	948	3	967	966	-1
	West Bengal	917	934	17	967	960	-7
Central & Western India	Chhattisgarh	NA	989		NA	975	NC
	Dadra & Nagra Haveli	952	812	-140	1013	979	-33
	Daman & Diu	969	710	-259	958	926	-32
	Goa	967	961	-6	964	938	-27
	Gujarat	934	999	65	928	883	-45
	Madhya Pradesh	931	919	-12	952	932	-20
	Maharashtra	934	922	-12	946	913	-33
	Orissa	971	972	1	967	953	-14

Table 2: Regional Variation in the overall and child sex ratios

Regions	1991 Census			2001 Census		
	Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation
Overall Sex Ratio						
North / North-West India	881.5	57.4	6.5	886.2	62.1	7.0
South India	954.6	66.7	7.0	969.1	64.7	6.7
East / North East India	915.3	33.0	3.6	930.0	31.5	3.4
Central & Western India	951.1	18.1	1.9	910.6	100.2	11.0
Child Sex Ratio						
North / North-West India	909.1	27.1	3.0	877.7	48.2	5.5
South India	959.5	12.3	1.3	955.9	8.8	0.9
East / North East India	973.7	10.5	1.1	962.0	7.6	0.8
Central & Western India	961.0	26.3	2.7	937.3	31.8	3.4

Figure 1: Changes in Overall and Child Sex Ratios (0-6) During 1991-2001 in different regions of India




South India
40
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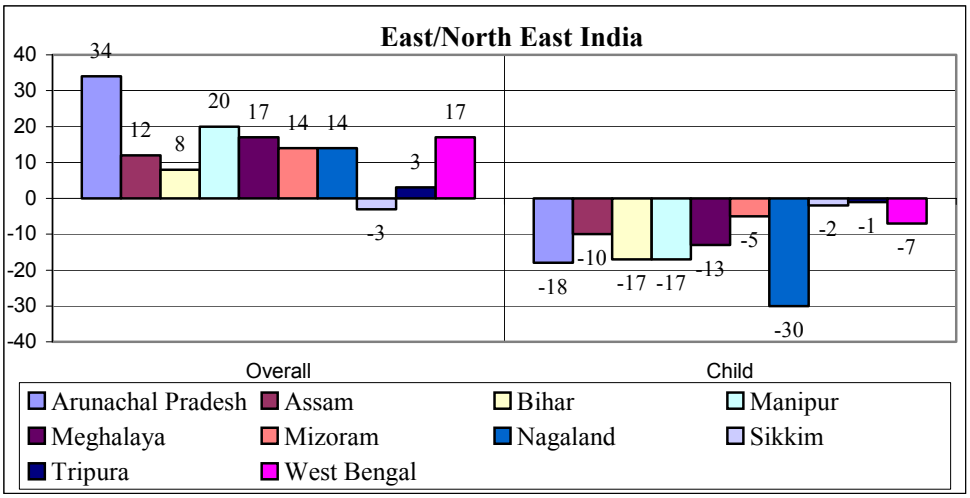
-20
28
6
5
22
5
22
13
-16
-14
-14
2
18
4
-6
Overall
Child
Andaman & Nicobar Islands
Andhrapradesh
Karnataka
Kerala
Lakshadweep
Pondicherry
TamilNadu


East/North East India
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-40
34
12
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-13
-5
-30
-2
-1
-7
Overall
Child
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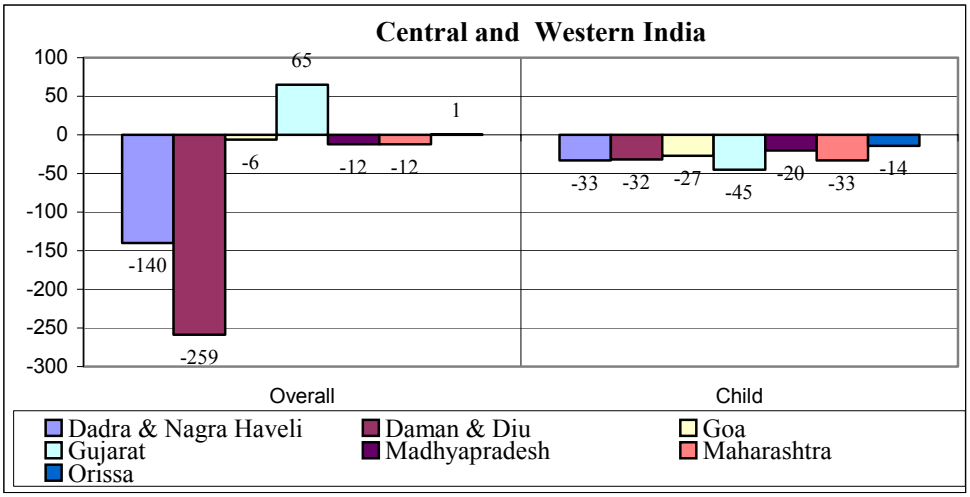
Assam
Bihar
Manipur
Meghalaya
Mizoram
Nagaland
Sikkim
Tripura
West Bengal



Sex ratio at birth by birth order

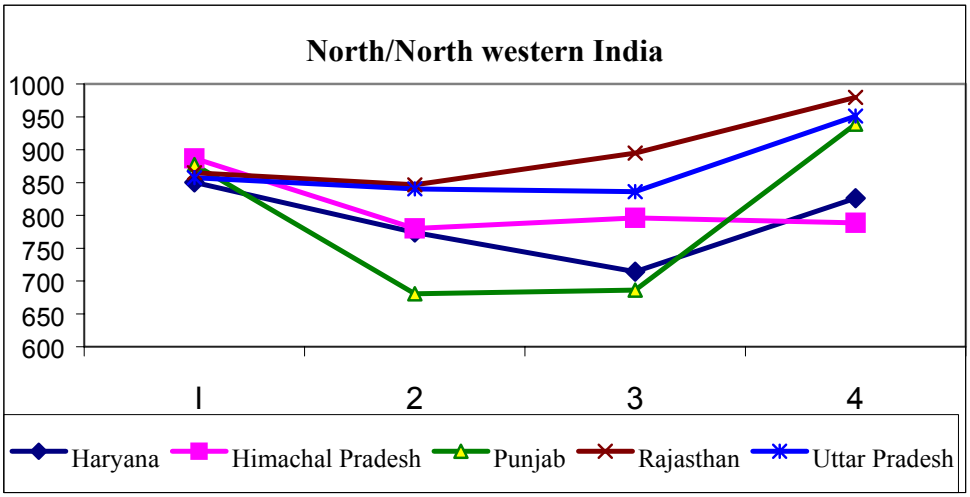
Using SRS (2002) data, an attempt has been made to calculate the sex ratio at birth by order of birth. It is interesting to note that in North and North-West regions in the states of Punjab, Haryana and Himachal Pradesh the Sex ratio at birth sharply decline from the first order birth to second order birth and continue decline up to third order birth. This indicates that majority of the couples in these states are more conscious for the birth of desired sex (male) of the child even after birth of the first child, as some of them might have first order female birth. It can be clearly depict from table 3 and figure 2.

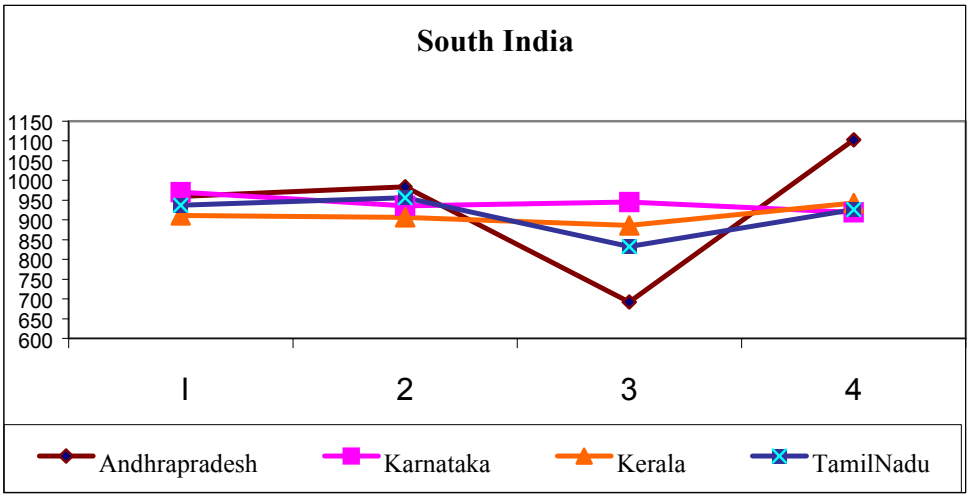
The pattern of sex ratio by order of birth in Southern states found to be somewhat different. Here the sex ratio at birth decline sharply after second order birth in the case of Andhra Pradesh and Tamil Nadu. It is possible that in these two states majority of the couples after two children look for desired (male) sex of the next birth. Even in Kerala there was slight decline in the sex ratio after second birth order. Karnataka has the consistent pattern of sex ratio at birth by order of birth. It is to mention that as per SRS Karnataka has the highest sex ratio at birth (952 females per 1000 males) among all the states of India.

Table 3: Sex ratio at birth by birth order for major states and India using SRS 2002

Regions	States / UTs	Birth order					Total
		I	2	3	4	5+	
India		**903**	**892**	**861**	**920**	**877**	**892**
North / North West India	Haryana	850	774	714	826	894	804
	Himachal Pradesh	887	780	796	788	620	826
	Punjab	877	680	686	939	872	775
	Rajasthan	865	847	895	980	961	890
	Uttar Pradesh	857	840	836	951	864	864
South India	Andhra Pradesh	959	984	692	1103	1236	945
	Karnataka	971	935	945	919	973	952
	Kerala	911	906	886	942	1063	911
	Tamil Nadu	937	956	832	926	780	926
East/North East India	Assam	958	953	970	1042	801	945
	Bihar	853	866	870	876	894	870
	West Bengal	928	998	908	996	917	949
Central & Western India	Gujarat	879	844	807	803	806	844
	Madhya Pradesh	929	1004	857	815	920	920
	Maharashtra	908	880	871	950	972	899
	Orissa	914	961	939	1011	954	944

Figure 2: Estimated sex ratio at birth by birth order in different regions of India




South India
1150
1100
1050
1000
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700
650
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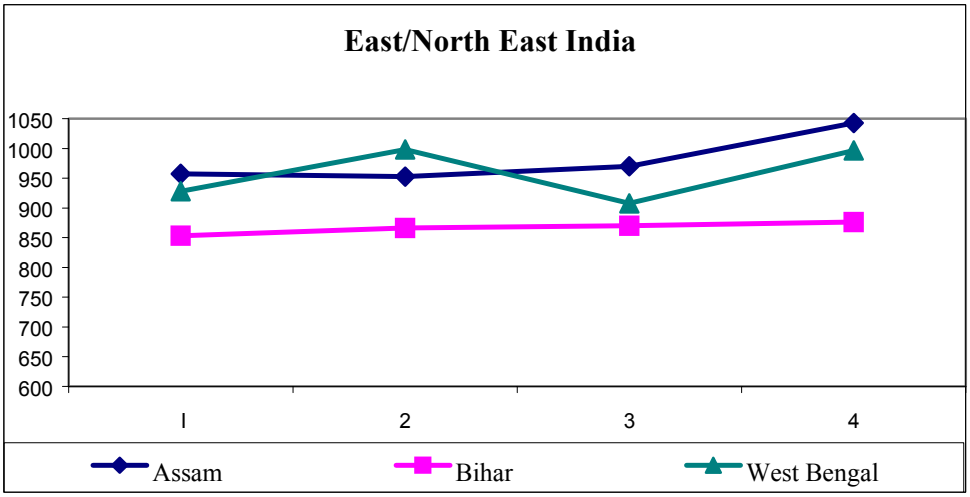
1
2
3
4
Andhrapradesh
Karnataka
Kerala
TamilNadu


East/North East India
1050
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850
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750
700
650
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1
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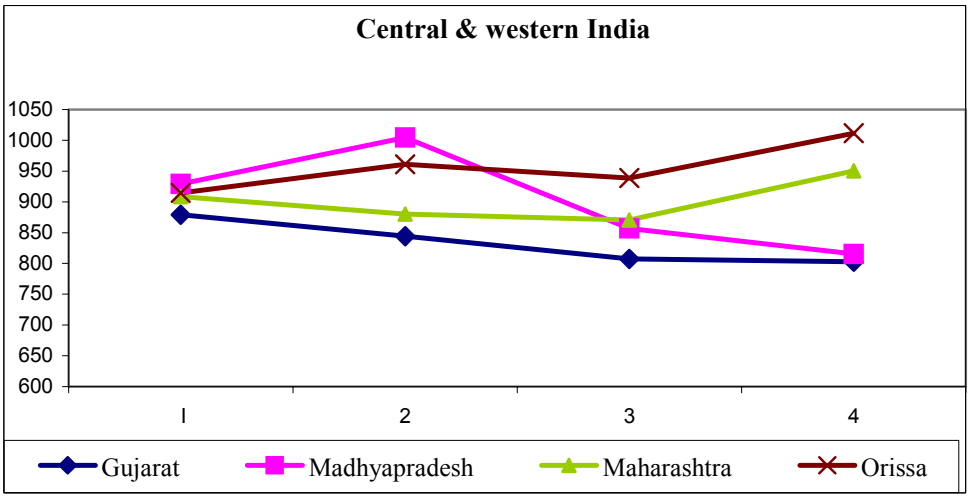
Assam
Bihar
West Bengal


Central & western India
1050
1000
950
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850
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750
700
650
600
1
2
3
4
Gujarat
Madhyapradesh
Maharashtra
Orissa

In East/North east India Bihar has sex ratio at birth 850 to 900 with marginal increase with each successive higher birth order. For Assam and West Bengal no consistent pattern of sex ratio at birth observed except both the states have sex ratio at birth above 900 for each order of birth. In central and western region Gujarat has the lowest sex ratio 879 at first order birth and it declines at each successive order of birth. For Maharashtra the SRB marginally declined for higher order of births. Surprisingly, for Madhya Pradesh and Orrisa, the SRB increases from 1st to 2nd order birth and then it declined for 3rd order birth. For all the regions for the 4 and higher order births no consistent pattern is observed. It might be due to relatively less number of births at higher order.

Measurement of gender inequality in mortality

Empirical evidences show that due to biological reasons female mortality rates should be lower than that for males at all ages. Thus, if mortality level falls, the female advantage in each age range should increase. However, if in a society there does exist excess of girl child mortality than that of boys, it clearly indicates the existence of female discriminations in the society.

Using Hill & Upchurch (1995) method an attempt has been made to measure gender inequality in terms of female mortality disadvantage. In order to measure the female mortality disadvantage the method needs a standard population of female mortality advantage. Observed disadvantages in female mortality of the study population are measured against the standard population to identify excess female mortality (see Hill & Upchurch, 1995). The standard level is selected based on the mortality level during last 10 years. In the present analysis difference between observed ratio of female to male child mortality (using data from the NFHS-2) and the standard level ratio of female to male mortality against given male mortality obtained from Hill & Upchurch (1995) method provided an index of female disadvantage in child mortality for various states of India. The calculated value of indices of female mortality disadvantage is given in Table 4. The index has been estimated for India and 24 states /UTs of four regions.

The analysis shows that the index of female disadvantage is higher for young age (1- 4 age group) than the other two childhood measures (0-1 and 0-5 age groups). The index of the age 0-1 found negative for Delhi and Himachal Pradesh in North/ North West, Karnataka and Kerala in South and for West Bengal in East/ North East region in infancy. During young childhood negative indices are reported in only one state (Kerala) in south India and for 5 states in East / North East India. In this age group (1-4) care of child is more important than genetic reasons on determining mortality risks. This reverse of sex differentials in mortality with increasing age has been observed in other studies in South Asia and is thought to reflect the relative medical and nutritional neglect of the girl child (Das Gupta, 1987, Basu, 1989, NFHS-2 report). This clearly indicates the existence of gender discrimination in childcare.

For mortality under age 5, the negative indexes were observed for only one state in North/ North West (Himachal Pradesh), one in South (Kerala) and for two in East /

North East India (Meghalaya and Mizoram). Among the regions in the age (1- 4) it is to be noted that higher girl child mortality disadvantage is noticed in North / North West Indian States especially Punjab and Haryana. For instance in the state Haryana in 1991 the child sex ratio was below 900 girls per 1000 boys for all the districts with the state average of 897. The situation has worsened since 1991: almost all the district recorded child sex ratio less than 850 girls per 1000 boys in 2001. District of Ambala, Kurukshestra, Kaithal, Sonopat and Rohtak are critical with less than 800 girls to 1000 boys. In Kurukshestra district, the child sex ratio is just 770 girls to 1000 boys. The falling of child sex ratio is definitely a matter of concern. The situation is going to be worse in future because the CSR is not only low but also declining with rising incidence of female feticides.

The female mortality advantage is noticed only in Kerala in South region in all the child hood measures, which is quite obvious as Kerala is socially and demographically developed State. Female mortality advantage is not noticed in all the childhood age groups in any of the States/ UTs of Central & Western region. Similarly in North/ North West region for none of the states mortality advantage is noticed during young childhood. However, for majority of the states in East / North East region, the girl child mortality advantage is noticed (5 out of 9 states). This trend may probably due to better implementation of recent family welfare programmes introduced by the government especially for North Eastern states.

In the form of boxes plotted in figure 3 the calculated values of the index of female mortality disadvantages for infant, young and under 5 mortality are summarized. For infant mortality the median difference between observed and standard ratios found highest in north/ north west region (0.1770) followed by central/western region (.09065), east/north east region (0.09045), and lowest in southern region (.0641). It shows that in north/north west states at the infancy age the female mortality disadvantage is relatively higher than any other regions in India. Except in Himachal Pradesh and Delhi, the other states/ UTs have high positive indexes. This indicates that in north/ northwest regions in most of the states especially in Punjab, Haryana and Uttarpradesh the lower child sex ratio is mainly due to gender discrimination for the care of female child with respect to both medical and non-medical care.

For the young child mortality the evidences for female mortality disadvantages found highest for north/northwest regions and negative for east/north east region. It shows that in north/ northwest region the further gender discrimination in mortality starts after the age one. As can be seen the median differences between observed and standard ratio found 0.7273, 0.3000, -0.0347 and 0.3847 for north/ northwest, south, east/north east and central/western regions, respectively.

Obviously under 5 mortality combines the effect of sex differences of infant and young child mortality. As can be seen from figure 3 that median value of the female mortality disadvantage is highest in north/ northwest (0.2913) followed by central/ western region (0.1688), South (0.1397) and lowest in east/northeast (0.0489). These findings may be attributed to variations in the introduction of various health measures

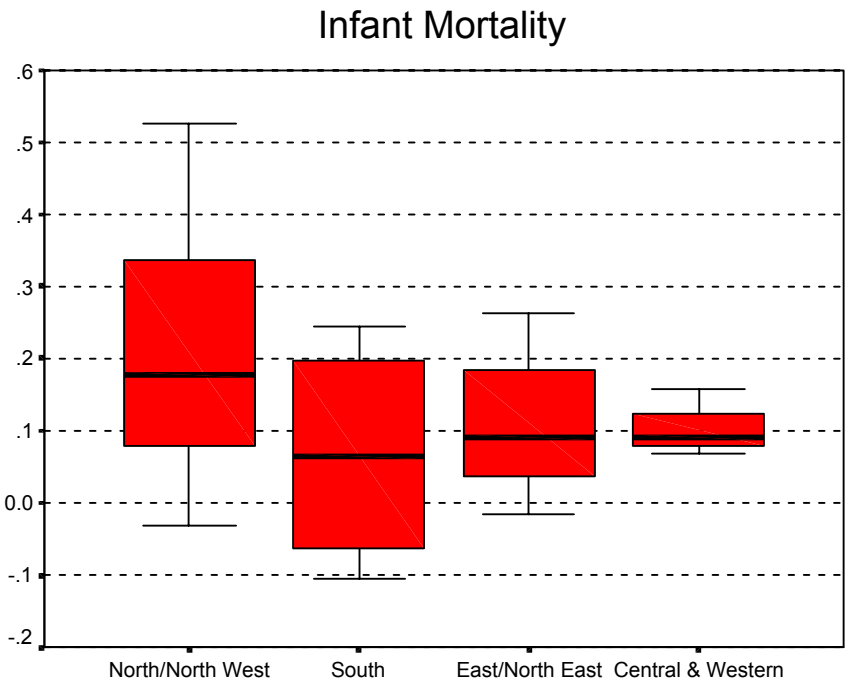
undertaken by different states in India that resulted in variation in reduction of female mortality disadvantages from one region to another.

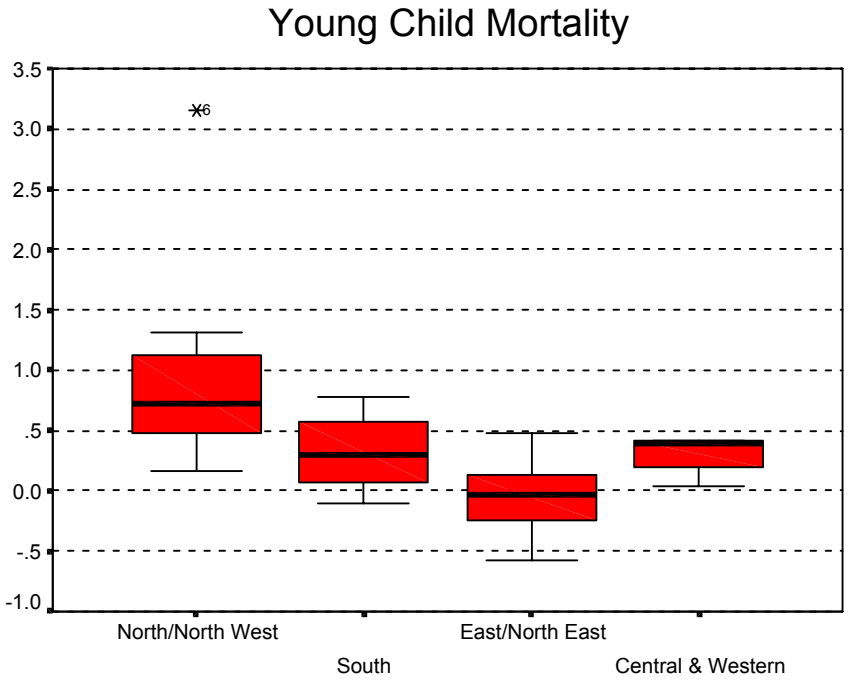
The overall analyses indicated that decline in the child sex ratio in north/northwest region is more due to higher female infanticides and discrimination of female child at the age of 1-4 and also might be due to sex selective abortion practices especially in Punjab, Haryana and Himachal Pradesh as compared to other regions. Sex selective abortion results a lower sex ratio at birth that is manipulated by human beings by way of female foeticide as indicated by the lower sex ratio at birth (Table 3) especially after the first order of birth in most of the northern part of India.

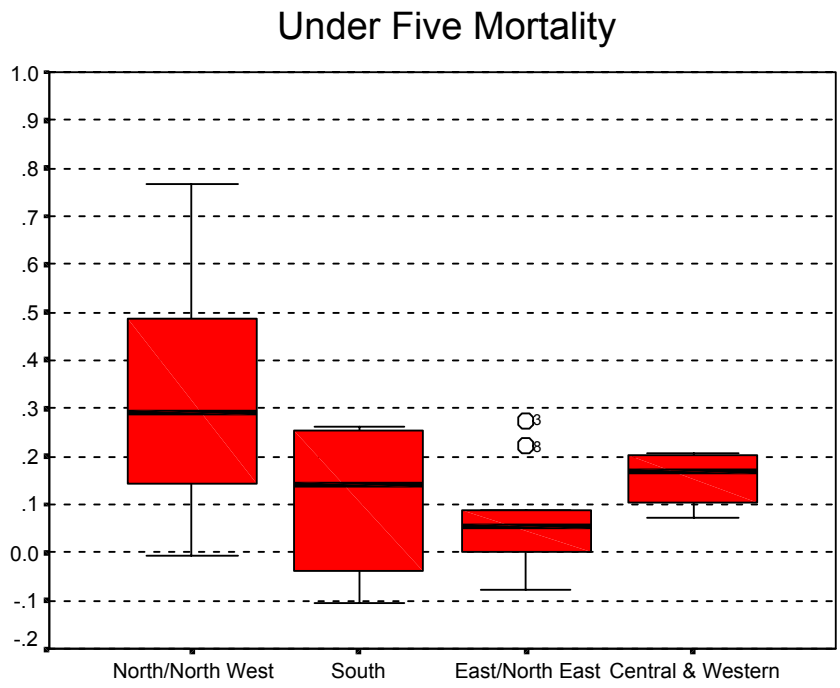
Table 4: Index of female mortality disadvantage for India and States/UTs (NFHS2)

Region	State/UTs	Index of female mortality disadvantage			Level of male mortality rate under 5 used
		Infant mortality ($_1q_0$)	Child mortality ($_4q_1$)	Under five mortality ($_5q_0$)	
India		0.1575	0.5779	0.2516	0.100
North / North-West India	Delhi	-0.0020	0.3882	0.0564	0.075
	Haryana	0.4616	1.3124	0.6173	0.075
	Himachal Pradesh	-0.0315	0.1573	-0.0085	0.075
	Jammu & Kashmir	0.1741	0.5858	0.2305	0.100
	Punjab	0.5259	3.1579	0.7676	0.075
	Rajasthan	0.1799	0.8689	0.3309	0.125
	Uttar Pradesh	0.2117	0.9442	0.3577	0.125
South India	Andhra Pradesh	0.1494	0.7787	0.2484	0.100
	Karnataka	-0.0212	0.2320	0.0310	0.100
	Kerala	-0.1059	-0.1020	-0.1055	0.050
	Tamilnadu	0.2459	0.3681	0.2622	0.075
East / North East India	Assam	0.0381	-0.1063	0.0007	0.100
	Bihar	0.2030	0.4785	0.2740	0.125
	Manipur	0.1840	-0.2081	0.0415	0.075
	Meghalaya	0.0197	-0.2891	-0.0766	0.150
	Mizoram	0.1001	-0.2473	-0.0235	0.075
	Nagaland	0.0630	0.0368	0.0562	0.075
	Sikkim	0.2637	0.1261	0.2208	0.100
	Tripura	0.1622	-0.5683	0.0526	0.075
	West Bengal	-0.0146	0.4159	0.0883	0.075
Central & Western India	Gujarat	0.0679	0.3550	0.1402	0.100
	Madhya Pradesh	0.0902	0.4211	0.1975	0.150
	Maharashtra	0.1573	0.4143	0.2073	0.075
	Orissa	0.0911	0.0326	0.0710	0.125

Figure3: Distribution of the Index of Female mortality Disadvantages in different childhood measures by Regions in India







Estimation of Missing Females

Improvement in maternal as well as infant care is beneficial for the live birth and survival of children. But in many societies and states in India male children gets more attention and care both medical and non-medical than females and thus contributing child sex ratio in favor of males since infancy. In this section attempt has been made to estimate the number of female population missing (including birth averted) based on the three levels of (100,103 & 105 males per 100 females) of normal sex ratio at birth using 2001 census data. We have estimated the female population missing for the age group (0-6), (10-19) and for all the ages.

It can be seen from the table 5 that at medium level (103) of estimation for the age group of 0-6, the highest female population missing found in Punjab (22.3 %) followed by Haryana (19.1%), Chandigarh UT (15.3%) and Delhi (12.2%). It is also observed that proportion of female population missing for the age 0-6 found highest in the North/North West region (8.2%) followed by Central & Western region (5.4%), South region (2.0%) and East /North East region (1.8%) (Table 6). At normal sex ratio of 105 also in all the states of North/ North West region, the female population missing is higher. The positive values indicated that male population is higher than the normal sex ratio of 105. In case of East/North East regions as can be observed from the table 6 that at 105 normal sex ratio the child sex ratio has negative value (-0.2) indicating that the sex ratio is lower than 105. In South India, except Karnataka and Tamil Nadu all the states have low negative values. Though, Karnataka and Tamil Nadu have +ve values but it is not as high as observed in most of the northern states. In Central and Western regions, 6 out of 8 states /UT, have +ve values. The –ve values have been observed only in Chattisgarh and

Dadra& Nagra Haveli. In this region Gujarat has reported the highest percentage (8.2%) of missing child female population in the age group 0-6.

Table 5: Percentages of female population missing in different age groups assuming three levels of normal sex ratios

Regions	States/UTs	2001 census (0-6)			2001 census (10-19)			2001 census (overall)		
		Normal Sex ratio			Normal Sex ratio			Normal Sex ratio		
		100	103	105	100	103	105	100	103	105
India		7.8	4.8	2.8	11.6	8.6	6.6	7.2	4.2	2.2
North / North-West India	Chandigarh	18.3	15.3	13.3	18.0	15.0	13.0	28.8	25.8	23.8
	Delhi	15.2	12.2	10.2	21.3	18.3	16.3	21.8	18.8	16.8
	Haryana	22.1	19.1	17.1	8.3	5.3	3.3	16.2	13.2	11.2
	Himachal Pradesh	11.7	8.7	6.7	6.8	3.8	1.8	3.3	0.3	-1.7
	Jammu & Kashmir	6.2	3.2	1.2	13.4	10.4	8.4	12.1	9.1	7.1
	Punjab	25.3	22.3	20.3	6.1	3.1	1.1	14.2	11.2	9.2
	Rajasthan	10.0	7.0	5.0	23.5	20.5	18.5	8.6	5.6	3.6
	Uttaranchal	10.2	7.2	5.2	31.0	28.0	26.0	3.9	0.9	-1.1
	Uttar Pradesh	9.2	6.2	4.2	15.9	12.9	10.9	11.4	8.4	6.4
South India	Andaman & Nicobar	4.5	1.5	-0.5	3.0	0.0	-2.0	18.3	15.3	13.3
	Andhra Pradesh	4.1	1.1	-0.9	15.6	12.6	10.6	2.2	-0.8	-2.8
	Karnataka	5.7	2.7	0.7	7.8	4.8	2.8	3.7	0.7	-1.3
	Kerala	4.1	1.1	-0.9	7.5	4.5	2.5	-5.5	-8.5	-10.5
	Lakshadweep	4.3	1.3	-0.7	6.3	3.3	1.3	5.5	2.5	0.5
	Pondicherry	3.4	0.4	-1.6	4.2	1.2	-0.8	-0.1	-3.1	-5.1
	Tamilnadu	6.2	3.2	1.2	1.5	-1.5	-3.5	1.3	-1.7	-3.7
East / North East India	Arunachal Pradesh	3.8	0.8	-1.2	4.8	1.8	-0.2	12.0	9.0	7.0
	Assam	3.6	0.6	-1.4	2.9	-0.1	-2.1	7.0	4.0	2.0
	Bihar	6.1	3.1	1.1	20.5	17.5	15.5	8.8	5.8	3.8
	Jharkhand	3.6	0.6	-1.4	9.7	6.7	4.7	6.3	3.3	1.3
	Manipur	4.5	1.5	-0.5	9.9	6.9	4.9	2.3	-0.7	-2.7
	Meghalaya	2.8	-0.2	-2.2	5.2	2.2	0.2	2.9	-0.1	-2.1
	Mizoram	3.7	0.7	-1.3	1.9	-1.1	-3.1	6.9	3.9	1.9
	Nagaland	3.8	0.8	-1.2	5.9	2.9	0.9	11.1	8.1	6.1
	Sikkim	3.9	0.9	-1.1	21.1	18.1	16.1	14.3	11.3	9.3
	Tripura	3.5	0.5	-1.5	2.9	-0.1	-2.1	5.5	2.5	0.5
	West Bengal	4.2	1.2	-0.8	8.0	5.0	3.0	7.1	4.1	2.1
Central & Western India	Chhattisgarh	2.6	-0.4	-2.4	1.9	-1.1	-3.1	1.1	-1.9	-3.9
	Dadra & Nagra Haveli	2.1	-0.9	-2.9	39.9	36.9	34.9	23.1	20.1	18.1
	Daman & Diu	8.0	5.0	3.0	13.5	10.5	8.5	40.8	37.8	35.8
	Goa	6.7	3.7	1.7	8.2	5.2	3.2	4.1	1.1	-0.9
	Gujarat	13.2	10.2	8.2	17.8	14.8	12.8	8.6	5.6	3.6
	Madhya Pradesh	7.3	4.3	2.3	6.6	3.6	1.6	1.4	-1.6	-3.6
	Maharashtra	9.5	6.5	4.5	19.3	16.3	14.3	8.4	5.4	3.4
	Orissa	5.0	2.0	0.0	13.2	10.2	8.2	2.8	-0.2	-2.2

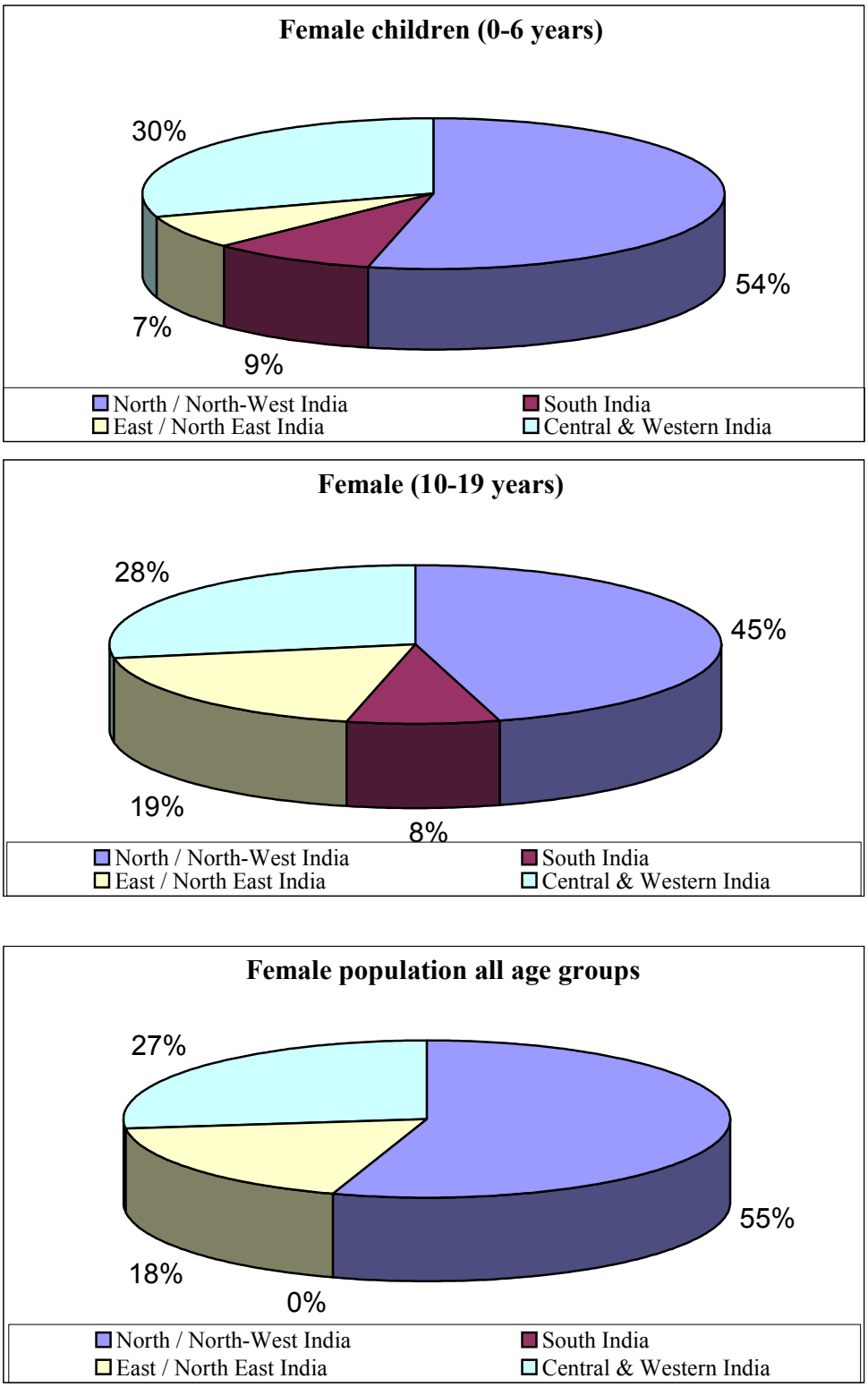
The declining sex ratio for the age group (0-6) started since 1991 census had its spill over effect for the age group of 10-19 as well as for all the age groups. The magnitude of proportion of female population missing is higher for the North/North west and east/northeast region compared to other two regions in the overall age groups. For the states like Kerala and Pondichery in all the age groups the values are negative at all levels of estimation indicating higher female population than male population. Overall for India as a whole, at medium level of estimation of 103, highest proportion of female population missing is in the age group of 10-19 (8.6%) followed by in the age group 0-6 (4.8%) and for all the age groups (4.2%).

Table 6 provides the region-wise total missing females on account of gender discrimination assuming three levels of normal sex ratio 100, 103 and 105 males per 100 females. If we consider 103 as medium level sex ratio then it is estimated that in 2001 the number of females missing at the age groups (0-6), (10-19) and all the ages are 440232, 1222262 and 2511683, respectively. Region-wise, for the age group (0-6) more than half (54%) belonged to north/ northwest region, followed by 30% in central & Western region. South and East/northeast regions shared relatively low proportion of missing female child population. Similar patterns are observed when we consider 10-19 and all the age group female population (See figure 4).

Table 6: Region-wise female population missing in different age groups assuming three levels of normal sex ratios (males per 100 females) by region

Regions	2001 census (0-6)			2001 census (10-19)			2001 census (overall)		
	Normal Sex ratio			Normal Sex ratio			Normal Sex ratio		
	100	103	105	100	103	105	100	103	105
Percentage to the female missing									
North / North-West India	11.2	8.2	6.2	18.5	15.5	13.5	11.5	8.5	6.5
South India	5.0	2.0	0.0	6.1	3.1	1.1	1.2	-1.8	-3.8
East / North East India	4.8	1.8	-0.2	13.6	10.6	8.6	7.6	4.6	2.6
Central & Western India	8.4	5.4	3.4	13.0	10.0	8.0	7.2	4.2	2.2
Region-wise missing female population									
North / North-West India	321765	235667	178269	663534	556064	484418	1863991	1379166	1055950
South India	99819	40131	338	195444	99017	34733	187867	---	---
East / North East India	84995	32262	--	292027	227717	184844	758422	457556	256978
Central & Western India	206154	132172	82851	441347	339462	271539	1158698	674962	352470
Total for India	**712733**	**440232**	**261458**	**1592352**	**1222262**	**975534**	**3968978**	**2511683**	**1665398**
Region-wise percentage of female population missing									
North / North-West India	45.15	53.53	68.18	41.67	45.49	49.66	46.96	54.91	63.41
South India	14.01	9.12	0.13	12.27	8.10	3.56	4.73	---	---
East / North East India	11.93	7.33	---	18.34	18.63	18.95	19.11	18.22	15.43
Central & Western India	28.92	30.02	31.69	27.72	27.77	27.83	29.19	26.87	21.16
India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Figure 4: Region wise missing females in India by age groups



The determinants of child sex ratio:

The determinants of child sex ratio is analyzed by carrying out multiple regression analysis for 26 States/UTs. Here in this analysis sex ratio is measured in terms of number of females per 1000 males. The results are presented in Table 7. It can be observed from the table that both the demographic factors viz., ratio of female to male infant mortality and child mortality have influenced negatively to the level of child sex ratio which is quite obvious that higher the female to male child and infant mortality ratios, lower will be the child sex ratio. Of the social and cultural factors, the proportion of SC population showed positive influence on the child sex ratio, which suggests that because of their economic backwardness the SC community might not have opted for the prenatal sex regulation measures. Whereas the proportion of Hindu population has significant negative influence on the child sex ratio indicating significant discrimination against girl child and also might be due to prevalence of prenatal sex regulation measures in the Hindu religion. The proportion of Sikh population also has negative impact on Child sex ratio but its influence was not significant as the Sikh population is concentrated only in Punjab and to some extent in Haryana. Among the economic and developmental factors, the female literacy rate exhibited negative coefficient but not significant. However, the negative coefficient for female literacy rate suggest that higher the level of female literacy lower will be the child sex ratio indicating better knowledge about the sex determination tests and thereby higher usage of sex determination tests by literate women. The variable percentage of urban population exhibited significant negative influence on the level of child sex ratio. This indicated that higher the proportion of urban population, more accessibility of such services in the cities and towns (Table 7).

Table 7 Proximate Determinants of Declining child sex ratio in India

Determinants	Regression coefficients	T Statistic
R^2	0.90	
Intercept	1135.37	17.98
Demographic factors		
Female to Male child mortality ratio	-24.4723	-1.3112
Female to Male infant mortality ratio	-67.7058	-1.5391
Social & Cultural factors		
Proportion of SC population	1.7971	1.6496
Proportion of Hindu population	-1.0807***	-3.7070
Proportion of Sikh Population	-1.3967	-1.5445
Economic & Developmental factors		
Female Literacy	-0.9539	-1.6918
Percentage of urban population	-0.7654**	-2.2607
Percentage of population below poverty line	0.9239*	1.9211
Percentage of cultivators	-1.7515***	-3.5279
Female work participation rate	2.0638***	2.7932

The economic factor like percentage of cultivators population has significant negative influence on the level of child sex ratio which suggests that agriculture dominated families have strong son preference. The percentage of population Below Poverty Line (BPL) has positive significant influence on the level of child sex ratio. This means that the people of BPL might not have discrimination for male or female child because of their economic position to undertake such facilities. The sex selective tests are very costly and it is not easily accessible and affordable for poor people. The female work participation rate also showed positive significant influence indicating female advantageous position. It indicates that higher the female work participation rate lower will be the discrimination against girl child especially for health and nutrition. The coefficient of multiple determination (R^2) is 0.90 indicating 90% of the variation in the dependent variable (child sex ratio) is explained by the various factors included in the model.

Conclusions

The results show that the highest decline in the child sex ratio observed in north/ north-west part of India. In these states the sex ratio at birth sharply decline from the first order birth and continue declined up to third order birth. This indicates that majority of the couples in various states of this region are more conscious for the birth of desired sex (male) of the child even after birth of the first child, as some of them might have first order female birth. The pattern of sex ratio by order of birth in southern states found to be somewhat different. Here, in most of the states the sex ratio at birth decline after second order birth. The analysis shows that the index of female disadvantage is higher for young age (1- 4) that clearly indicates the existence of gender discrimination in childcare. In India more than half missing child females (0-6) belonged to north/ northwest region, followed by one third in central & western region. South and east/northeast regions shared relatively low proportion of missing female child population. The child sex ratio in north/northwest region is more due to higher female infanticides and discrimination of female child at the age of 1-4 and also might be due to sex selective abortion practices especially in Punjab, Haryana and Himachal Pradesh as compared to other regions. Sex selective abortion results a lower sex ratio at birth that is manipulated by human beings by way of female foeticide as indicated by the lower sex ratio at birth especially after the first order of birth in most of the northern part of India.

The falling of child sex ratio is definitely a matter of concern. The situation is going to be worse in future because the CSR is not only low but also declining with rising incidence of female feticides. In the Indian context, there is strong preference for sons. This preference is influenced by various socio-cultural and economic factors; such as the son being responsible for carrying forward the family name and occupation especially in the agricultural sector. Sons are desired because they are considered as a source of support during old age and for performing religious rites at the time of cremation and subsequently. The practice of dowry and daughter being viewed as *"paraya dhan*" (to be married and sent away) is yet another reason why sons are preferred to daughters. If this phenomenon continues, then a stage will reach when it would difficult to make up for the missing girls. Society needs to recognize this discrimination. Girls have right to live just

as boys do. If the stringent measures are not taken up it will lead to further imbalance in sex- ratio and will have long-term impact on demographic imbalance.

Appendix 1

Expected Sex Ratio of Infant, Young and Under Five Mortality for Specified Levels of Male Under Five mortality - Historical Experience of North Western Europe (1820-1964)

Male under Five mortality	Infant mortality ($_1q_0$)	Young child mortality ($_4q_1$)	Under five mortality ($_5q_0$)
0.025	0.767	0.814	0.774
0.050	0.778	0.852	0.795
0.075	0.786	0.876	0.810
0.100	0.793	0.896	0.823
0.125	0.801	0.910	0.835
0.150	0.810	0.921	0.847
0.175	0.817	0.930	0.857
0.200	0.823	0.941	0.867
0.225	0.830	0.950	0.877
0.250	0.837	0.958	0.887
0.275	0.843	0.964	0.894
0.300	0.846	0.966	0.899

Reproduced from: Population and Development Review (1995), **21** (1)

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