Declining Sex Ratio of the Child Population in India: A Decomposition Analysis

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Abstract

If the omission/misreporting of ages of male/female children is assumed to be equal, child sex ratio is the result of sex ratio at birth and sex differential in mortality. This study aims to understand the impact of both the sex ratio at birth and sex differential in mortality on the change in child sex ratio during 2001-2011 in India and its major states. The result shows that in 2011, at the national level, the skewed child sex ratio could be explained due to distortion in sex ratio at birth by two-thirds and in high female child mortality by about one-third. Whereas, in 2001, the contribution of sex ratio at birth was two-fifths and the contribution of high female child mortality was three-fifths towards determining the child sex ratio.

Background

The release of the Population Census, 2011 in India unleashed a huge wave of debate among researchers and program and policy makers about the declining child sex ratio (0-6 years). The report reinforces the debate on biological determinants in general, and on the socio-cultural and behavioural aspects of the sex ratio in particular, which is defined as the number of females per 1000 males in a population. Primarily, the sex ratio is affected by trends in fertility, mortality and sex ratio at birth (Malhotra & Kant 2006). Insufficient socioeconomic development in India does not necessarily explain the differential in female-to-male ratio of birth as reviewed by the study (Subramanian & Corsi 2011), where households with high education and wealth were found to have a concentration of an imbalanced sex ratio.

Usually the sex ratio at birth is 934-961 female births per 1000 male births (104-107 male births per 100 female births) (Ganatra 2008). Normally female infants and female children have an advantage in survival over boys of the same age (Waldron, 1998) with lesser vulnerability to perinatal conditions (including birth trauma, intrauterine hypoxia and birth asphyxia, prematurity, respiratory distress syndrome and neonatal tetanus), congenital anomalies, and infectious diseases such as intestinal infections and lower respiratory infections (United Nations, 2011). However, in many south Asian countries, female children do not have this advantage of higher survival. The strong preference for male children results in the discrimination of girls, right from birth. During the neo-natal stage when biological factors are more dominant in determining mortality, female children in these south Asian countries have the advantage of higher survival. However, beyond the neo-natal stage when environmental and behavioral factors determine mortality, female children lose their advantage and suffer higher mortality in comparison with their male counterparts. In most of the populations, though girls have the disadvantage in number at the time of birth, their advantage of relatively higher survival compared to boys, compensates the disadvantage in birth to some extent. But in countries like India, female children are at a disadvantage on both counts. First, at birth there are lesser female births than males and second, they die in higher proportion. Over and above, the extent of biological disadvantage in number at the time of birth is escalated by systematic elimination of female fetuses even before birth (Kishor 1993; Sen 1992; Das Gupta 1987).

Theoretically, if omission/misreporting of ages of children is assumed to be equal for male and female children, the child sex ratio is the result of sex ratio at birth and sex differential in mortality. This study aims to understand the contribution of both the sex ratio at birth and child mortality to the change in child sex ratio in India and its major states during 2001-2011. The findings of this study are expected to offer a platform to the National Advisory Council Working Group on Gender and the Sex Ratio (Naqvi & Kumar 2012) instituted by the Planning Commission, Government of India to formulate more precise policy recommendations to improve the child sex ratio.

Child Sex Ratio, 1971-2011, and Relative Contribution of Sex Ratio at Birth and Sex Differential of Child Mortality to Overall Child Sex Ratio

The consistent decline in child sex ratio needs paramount attention. Though India has managed to improve the overall sex ratio from 930 females per 1000 males in 1971 to 940 females per 1000 males in 2011, the child sex ratio continued to decline from 976 females per 1000 males in 1961 to 914 females per 1000 males in 2011 (Figure 1). The results of the 2011 Census have drawn the attention of researchers and program and policy makers to glean the future direction of the child sex ratio. The convergence in statistics in the overall sex ratio and child sex ratio was recorded in 2001 (976 females per 1000 males) (Figure 1). In India, the context of the child sex ratio must be interpreted with caution as age-specific sex ratios can be highly distorted by differential age misreporting by sex, and underreporting of female children, which seems to have been quite substantial between the 1981 and 1991 Censuses (Guillot, 2002).

In order to understand the relative contribution of Sex Ratio at Birth and mortality differential to the Overall Child Sex Ratio, we have decomposed the change in sex ratio of the child population during 2001-2011. The required information is - Sex ratio of the child (0-6 years) population (CSR); the estimated Sex Ratio of Survival Ratio (SRSR); and the Implied Sex Ratio at Birth (ISRB). The information on the CSR was obtained from two consecutive rounds (2001 and 2011) of the decennial population census conducted by the Ministry of Home Affairs, Government of India. The estimates on SRSR (converse of mortality rates) were computed using the record of survival probabilities for the defined age groups. In this case, the survival ratios (${}_7L_0$) were estimated for both male and female from the life tables provided by the Sample Registration Systems (SRS), Ministry of Home Affairs, Government of India. Child survival, defined as the chance of surviving from birth to 0-6 years, can be framed as follows:

$$ {}_7L_0 = (L_0 + {}_4L_1 + {}_{1.6}L_5 + {}_{0.4}L_6)/7*100000 $$

The ISRB for children born six years preceding the survey was computed indirectly using the combined information of the CSR given in the Census, and the SRSR computed from using life table survival probabilities. In the absence of direct data, the sex ratio at birth (SRB) was estimated indirectly as ISRB. While estimating the ISRB, the following assumptions were made:

1) In 2001 and 2011 census there is no undercount of children or if it is there, it is the same for boys and girls,
2) The Sample Registration System (SRS) gives an accurate picture of sex differentials in mortality, and
3) There are no drastic changes in the mortality differentials of male and female children during 1994-2001 and from 2004-08 to 2009-11.

The equation is composed as follows:

$$ISRB^{(2001)} = CSR\ (0\text{-}6)^{2001} / SRSR^{(1994\text{-}2001)}$$

$$ISRB^{(2011)} = CSR\ (0\text{-}6)^{2011} / SRSR^{(2004\text{-}2008)}$$

Thus, the ISRB was estimated for two time periods, 2001 and 2011, for the major states of India based on the SRSR information available for selective states, included in our analysis. It helps for better comparison and also to understand the trends and patterns across major states. Finally, to decompose the relative contribution of both the sex ratio at birth and child mortality on the CSR in India and its major states during 2001-2011, the formula is framed as follows:

$$CSR^{2011} - CSR^{2001}$$

$$=[(ISRB^{2011}-ISRB^{2001})*\{(SRSR^{2001}+SRSR^{2011})/2\}]+[(SRSR^{2011}-SRSR^{2001})*$$
$$\{(ISRB^{2001}+ISRB^{2011})/2\}]$$

Where CSR= sex ratio of child population; ISRB= implied sex ratio at birth; and SRSR= sex ratio of survival ratio.

Here the analysis is carried out in two different ways:

a) an attempt is made to decompose the change in the child sex ratio during 2001-2011 into changes in sex ratio at birth and sex differential in mortality represented in Table 3;
b) the distortion in child sex ratios in 2001 and 2011 is decomposed into distortion due to skewed sex ratio at birth and due to child mortality as represented in Table 4 and Table 5 respectively.

Here the distortion is measured as the difference in the census sex ratio and ideal sex ratio. The ideal sex ratio of children is under the assumption of normal sex ratio of births at 945 female births per 1000 male births (105 male births per 100 female births) and higher survival of female children resulting in SRSR of 1010, as observed in Tamil Nadu. Under these two assumptions, the ideal sex ratio of the child population works out to 952 females per 1000 male children.

Table 1 represents the decomposition of change in the Sex Ratio of the Child Population considering the 2001-2011 estimates. It is evident that at the national level, the mortality differential favors the male child. It is also interesting to note that SRSR in Kerala and Karnataka is 1000, indicating that there is no sex differential in child mortality in 2011, and that the male child mortality is almost similar to that of the female child. In Andhra Pradesh and Tamil Nadu, the sex differentials in mortality are in favor of girl children; in other words girls have higher survival chances or lower mortality compared to boys. But, the SRB in 2011 is the same as it was in 2001 in Kerala; however, an increase in SRB has been documented in Haryana and Punjab during 2001-2011.

Table 2 demonstrates the reconstruction of the child sex ratio for 2001 and decomposition of distortion. Assuming that the sex ratio at birth is 945 female births per 1000 male births and the sex ratio of child survival ratio is 1010 female to 1000 males, the normal child sex ratio works out to 952 female children to 1000 male children, in the age group, 0-6. Ideally, each state should have this sex ratio. Nationally, out of the 25 point distortion in child sex ratio in 2001 (927 female/1000 male) to normal (952 female/1000 male), 64% could be attributed to adverse mortality differentials, whereas the remaining 36% to the lower proportion of female births. The distortion in CSR in Uttar Pradesh and Tamil Nadu is evident due to 86% and 80% mortality differential respectively. Child mortality is higher among males than among females in Kerala and West Bengal.

On the other hand, Table 3 displays the reconstruction of the child sex ratio for 2011, where the assumptions were similar to those adopted to construct Table 4. Therefore, the difference of (952-914) =38 in CSR during 2001-2011 could be divided by 37%; this is due to adverse mortality differentials and 63% is due to lower proportion of female births. State-wise, the higher share of lower proportion of female births in Haryana (82%), Punjab (84%), and Jammu and Kashmir (85%) indicate the probability of high female feticide, and this trend is evident in states like Maharashtra, Rajasthan and Uttar Pradesh.

Conclusion

Researchers have long been interested in the causes of sex ratio decline in India. In the light of the figures revealed by the 2011 Census, which shows the lowest child sex ratio in India, this debate has gained new proportions. This study reconfirms that the skewed sex ratio is the result of the lower proportion of female births. Several previous studies have focused on this issue. The explanation often cited till 1971 was that it was due to an undercount of females. This explanation, if valid, would imply that the increase in the sex ratio during the twentieth century was due to the further deterioration in the undercount of females in the census. The debate was influenced by a comprehensive study of the sex ratio in India from 1901 to 1961 by Visaria (1972). Visaria considered the possible explanations for the high sex ratio in India and concluded, convincingly, that it was due to the unusually high mortality faced by females relative to males. It is now acknowledged that, although the recorded Indian sex ratio is probably biased to a certain extent by sex-selective under-enumeration, the predominance of males in India's population and the upward trend during the twentieth century are real and reflect the excess mortality of females in the subcontinent (Sudha & Rajan, 2001). Recently, the use of sex determination tests during pregnancy followed by abortion of fetuses emerged as a significant factor that has a strong influence on the sex ratio at birth in India (Arnold et al., 2002). There is considerable evidence that the practice of sex-selective abortion cuts across all socioeconomic groups (Ganatra et al., 2000). In several studies, sex-selective abortion is reported to be a family building strategy, but some studies reported that sex-selective abortion is practised by couples who already have a living son or no children (Ganatra et al., 2000).

Although abortion was made legal in India in 1971, it is only recently that pre-natal diagnostic techniques became widely available. Recognizing the failure of the Medical Termination of Pregnancy (MTP) Act of 1972 to make legal abortions widely available, the Government amended the Act in 2002 and again in 2003 (Government of India, 2002). These amendments rationalized the criteria for physical standards of abortion facilities - fixing different appropriate criteria for conducting first-trimester and second-trimester abortions. Further, amendments have also been introduced in the Prenatal Diagnostic Techniques (Regulation and Prevention of Misuse) (PNDT) Act of 1994. This was necessitated as the PNDT Act had failed to curb the practice of testing for sex determination and consequent sex-selective abortion in the country. With the recent amendment to the PNDT Act, preconception and pre-implantation procedures for sex selection are banned in the country.

Local authorities have also been given powers to ensure the enforcement of the Act. With these measures, the government expects to prevent women from resorting to sex-selective abortions, which are conducted during the second-trimester and carry a high risk of complications. However, the declining child sex ratio is raising doubts about the proper implementation of this Act. There is growing evidence that many of India's health problems arise from improper implementation and failure of policy, lack of timely intervention and poor reach of existing facilities.

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Table 1. Decomposition of change in Child Sex Ratio during 2001-2011.

States	Child Sex Ratio (SR)		Sex Ratio of Survival Ratio (SRSR)		Implied Sex Ratio at Birth (ISRB)		Change in SR	Change in SRSR	Change in ISRB	Average of SRSR	Average of ISRB	Absolute contribution of mortality differential to SR	Absolute contribution of ISRB to SR	Relative contribution of mortality differential to SR	Relative contribution of ISRB to SR
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	2001	2011	2001	2011	2001	2011	b-a	d-c	f-e	(c + d)/2	(e+ f)/2	(h*k)/1000	(i*j)/1000	(l/g)*100	(m/g)*100
Maharashtra	917	883	1001	999	916	884	-34	-2	-32	1000	900	-2	-32	5	95
Madhya Pradesh	940	912	995	995	945	917	-28	0	884	-34	931	0	-28	-	-
Rajasthan	909	883	989	992	919	890	-26	3	-29	991	905	3	-29	-10	110
Andhra Pradesh	964	943	1010	1003	954	940	-21	-7	-14	1007	947	-7	-14	32	68
Uttar Pradesh	916	899	977	987	938	911	-17	10	-27	982	924	9	-26	-54	154
Orissa	950	934	989	998	961	936	-16	9	-25	994	948	9	-25	-53	153
West Bengal	966	950	988	1003	978	947	-16	15	-31	996	962	14	-30	-90	190
INDIA	**927**	**914**	**993**	**995**	**934**	**919**	**-13**	**2**	**-15**	**994**	**926**	**2**	**-15**	**-14**	**114**
Bihar	944	933	987	991	956	941	-11	4	-15	989	949	4	-15	-35	135
Karnataka	949	943	997	1000	952	943	-6	3	-9	999	947	3	-9	-47	147
Kerala	963	959	1004	1000	959	959	-4	-4	0	1002	959	-4	0	96	4
Tamil Nadu	939	946	999	1010	940	937	7	11	-3	1005	938	10	-3	147	-47
Gujarat	878	886	1000	994	878	891	8	-6	13	997	885	-5	13	-66	166
Haryana	820	830	992	986	827	842	10	-6	15	989	834	-5	15	-50	150
Punjab	793	846	987	991	803	854	53	4	50	989	829	3	50	6	94
Jammu & Kashmir	-	859	-	996	-	862	-	-	-	498	431	0	0	-	-

Note: Hyphen '-' indicates information not available

Table 2. Decomposition of Distortion in Child Sex Ratio, 2001

States	**Child Sex Ratio (SR)**		**Sex Ratio of Survival Ratio (SRSR)**		**Implied Sex Ratio at Birth (ISRB)**		**Change in SR**	**Change in SRSR**	**Change in ISRB**	**Average of SRSR**	**Average of ISRB**	**Absolute contribution of mortality differential to SR**	**Absolute contribution of ISRB to SR**	**Relative contribution of mortality differential to SR**	**Relative contribution of ISRB to SR**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
	2001	**ASR**	**2001**	**ASRSR**	**2001**	**AISRB**	**b-a**	**d-c**	**f-e**	**(c + d)/2**	**(e+ f)/2**	**(h*k)/1000**	**(i*j)/1000**	**(l/g)*100**	**(m/g)*100**
Punjab	793	952	987	1010	803	943	159	23	139	999	873	20	139	13	87
Haryana	820	952	992	1010	827	943	132	18	116	1001	885	16	116	12	88
Gujarat	878	952	1000	1010	878	943	74	10	65	1005	910	9	65	12	88
Rajasthan	909	952	989	1010	919	943	43	21	23	1000	931	20	23	45	55
Uttar Pradesh	916	952	977	1010	938	943	36	33	5	994	940	31	5	86	14
Maharashtra	917	952	1001	1010	916	943	35	9	26	1006	929	8	27	24	76
INDIA	**927**	**952**	**993**	**1010**	**934**	**943**	**25**	**17**	**9**	**1002**	**938**	**16**	**9**	**64**	**36**
Tamil Nadu	939	952	999	1010	940	943	13	11	3	1005	941	10	3	80	20
Madhya Pradesh	940	952	995	1010	945	943	12	15	-2	1003	944	14	-2	-	-
Bihar	944	952	987	1010	956	943	8	23	-14	999	950	22	-14	273	-173
Karnataka	949	952	997	1010	952	943	3	13	-9	1004	947	12	-9	410	-310
Orissa	950	952	989	1010	961	943	2	21	-18	1000	952	20	-18	999	-899
Kerala	963	952	1004	1010	959	943	-11	6	-17	1007	951	6	-17	-52	152
Andhra Pradesh	964	952	1010	1010	954	943	-12	0	-12	1010	949	0	-12	0	100
West Bengal	966	952	988	1010	978	943	-14	22	-35	999	960	21	-35	-151	251
Jammu & Kashmir	-	952	-	1010	-	943	-	-	-	505	471	0	0	-	-

Note: Hyphen '-' indicates the information not available
ASR: Assumed Child Sex Ratio
ASRSR: Assumed Sex Ratio of Survival Ratio
AISRB: Assumed Implied Sex Ratio of Birth.

Table 3. Decomposition of Distortion in Child Sex Ratio, 2011

States	Child Sex Ratio (SR)		Sex Ratio of Survival Ratio (SRSR)		Implied Sex Ratio at Birth (ISRB)		Change in SR	Change in SRSR	Change in ISRB	Average of SRSR	Average of ISRB	Absolute contribution of mortality differential to SR	Absolute contribution of ISRB to SR	Relative contribution of mortality differential to SR	Relative contribution of ISRB to SR
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
	ASR	**2011**	**ASRSR**	**2011**	**AISRB**	**2011**	**b-a**	**d-c**	**f-e**	**(c + d)/2**	**(e+ f)/2**	**(h*k)/1000**	**(i*j)/1000**	**(l/g)*100**	**(m/g)*100**
Haryana	952	830	1010	986	943	842	-122	-24	-101	998	892	-21	-101	18	82
Punjab	952	846	1010	991	943	854	-106	-19	-89	1001	898	-17	-89	16	84
Jammu & Kashmir	952	859	1010	996	-	862	-	-	-	1003	431	0	0	-	-
Maharashtra	952	883	1010	999	943	884	-69	-11	-59	1005	913	-10	-59	15	85
Rajasthan	952	883	1010	992	943	890	-69	-18	-52	1001	916	-16	-53	24	76
Gujarat	952	886	1010	994	943	891	-66	-16	-51	1002	917	-15	-51	22	78
Uttar Pradesh	952	899	1010	987	943	911	-53	-23	-32	999	927	-21	-32	40	60
Madhya Pradesh	952	912	1010	995	943	917	-40	-15	-26	1003	930	-14	-26	-	-
INDIA	**952**	**914**	**1010**	**995**	**943**	**919**	**-38**	**-15**	**-24**	**1003**	**931**	**-14**	**-24**	**37**	**63**
Bihar	952	933	1010	991	943	941	-19	-19	-1	1001	942	-18	-1	94	6
Orissa	952	934	1010	998	943	936	-18	-12	-7	1004	939	-11	-7	63	37
Andhra Pradesh	952	943	1010	1003	943	940	-9	-7	-2	1007	941	-7	-2	73	27
Karnataka	952	943	1010	1000	943	943	-9	-10	0	1005	943	-9	0	105	-5
Tamil Nadu	952	946	1010	1010	943	937	-6	0	-6	1010	940	0	-6	0	100
West Bengal	952	950	1010	1003	943	947	-2	-7	5	1007	945	-7	5	331	-231
Kerala	952	959	1010	1000	943	959	7	-10	16	1005	951	-10	17	-136	236

Note: Hyphen '-' indicates the information not available

ASR: Assumed Child Sex Ratio

ASRSR: Assumed Sex Ratio of Survival Ratio

AISRB: Assumed Implied Sex Ratio of Birth

Figure 1. Trend of sex ratio of total population and child population, India, 1961-2011