

***Population Association of America***  
***Annual Meeting 2019***

***Title: Skewed Child Sex Ratios in India: Continuity and Change***

*Author:* Aradhana Singh

† Jawaharlal Nehru University, New Delhi, India

Presenting Author: **Aradhana Singh**

Doctoral Student, Jawaharlal Nehru University, New Delhi, India

Email: [aradhanas113@gmail.com](mailto:aradhanas113@gmail.com)

**Introduction**

The historic masculinization of the population at birth and initial ages in the country continues in spite of several initiatives from the government of India to balance the female-male populations. It has been more than two decades since the inception of the Pre-Conception and Pre-Natal Diagnostic Techniques (Prohibition of Sex Selection) Act (PC-PNDT Act), but the impact of the initiative is limited as the problem of sex-selective abortions continue to persist (Sen, 2003; Jha *et al.*, 2011; Myers, 2012; Arokiasamy and Goli, 2012; Stallard, 2016). The reports and the factsheet based on the National Family Health Survey (NFHS) IV (IIPS and MoHFW, 2017) and a few studies using this information (Radkar, 2018) from the factsheets present socio-economic and geographical pattern of Sex Ratio at Birth (SRB) in India but they hide much more than they reveal and to the extent misreport the estimates. Unlike the NFHS (2015-16) factsheets, findings based on Sample Registration System (SRS) data do not support the logic of disappearance of excess female child mortality. Therefore, the release of unit level information has facilitated us to re-examine the estimate of the NFHS IV factsheets and studies based on them. The NFHS factsheets show that the Child Sex Ratio (CSR) has been improved and the SRB is worsening (IIPS and MoHFW, 2017), which indicate a disappearance of excess female child mortality in India which is impossible by any logic and thus not true. This ambiguity shows that there is a need to recheck the estimates presented in the NFHS IV factsheets by re-estimating it from the unit level data. At an outset, we have three-fold objectives for this study. First, to re-estimate SRB and CSR by socio-economic groups, states, and districts using unit level information of NFHS IV (2015-16). Second, is to present the trends in SRB and CSR with a uniform definition by states and socio-economic groups since 1990s using

successive rounds of NFHS. Third, is to estimate the recent correlates of skewed CSR, SRB, and SRLB in India.

## **Background**

In most societies in the world, culturally females have always a lower perceived value than males. Historically lower perceived utility of girls over boys continuously making girls marginalized in terms of their numbers in the population. In 1662, John Graunt was the first to observe the difference between the number of males and females at birth, which set a curiosity among researchers to look into this disparity in the number of males and females in a population (Chahnazarian, 1990; Campbell, 2001). In India, this deficit of females had been evident from the very first Indian decennial Census in 1872 (Visaria, 2005). The overall sex ratio (female per thousand males) has declined from 972 (1901) to 940 (2011) in 110 years (Appendix Table 1). In late 1990s Amartya Sen came with the magnitude of the masculinization and analyzed the number of "missing girls" from the population of Asia. After that many demographers estimated the missing girls from Indian population (George, 2006, Kulkarni, 2007; Sahni et al., 2008; Gupta et al., 2009; Jha et al., 2011). A Growing number of studies also report a continuous decline in the sex ratio in initial ages (0-6) (see appendix table 2) and at birth (Kundu and Sahu, 1991; Rajan *et al.*, 1991; Raju and Premi, 1992; Nair, 1996; Premi, 2001; Agnihotri, 2000, 2003; Guilmoto and Depledge, 2008; Arokiaswamy and Goli, 2012). Moreover, this ascendancy of the number of males in population exists in every stage of life cycle except in older population, because of different type of neglect in terms of health, nutrition, hygiene and financial resources faced by females at the time of birth, childhood, adolescence, marriage, pregnancy, and illness. The previous studies attribute the India's distorted child sex ratios to the factors like, sex-selective abortions, female infanticide and foeticides and excess female child mortality and also due to under-enumeration of female population (Das Gupta 1987; Kishore 1993; Sen 1992; Bhat, 2002; Arnold, Kishor and Roy, 2002; Bhat and Zavier, 2007; Arokiaswamy, 2004; Visaria, 2005; Malhotra and Kant, 2006; Bongaarts and Guilmoto, 2015). The economic survey of 2018 come up with the concept of "son meta preference" which depicts the level of son preference in the society and how the couples are stopping their fertility after achieving the desired number of the son in their family.

## **Context and Rationale**

Although, previous studies have already revealed the possible reasons of skewed sex ratio at birth and early ages, the analyses using the most recent NFHS data released in January 2018 will make us cognizant of the recent positive or negative change in SRB and CSR across different geographical and socio-economic settings. This study is meant to document the most recent socio-economic and geographic trend and patterns considering uniform definition across the successive rounds of NFHS. This study tests how far “north-west and south-east” divide, “Bermuda triangle” and “rice and wheat belt” hypotheses previously used to explain the geographical pattern of sex ratio (Miller 1981, Kishor, 1993; Raju, 1997; Agnihotri, 1994), are still valid in the present context. For the first time, NFHS allow us to estimate district level SRB and Sex Ratio at Last Birth (SRLB) which helps to test above said hypotheses with robust measures. This study also tries to bring out the driving factors of SRB, CSR, and SRLB in the context of socio-economic settings in the country. The economic Survey (2018) has taken note of the behavioural pattern of Indian parents who prefer to have children “until the desired number of sons is born” and termed it as “Meta Son Preference” (Government of India, 2018), but hardly there is any study which comprehensively documented the impact of stopping rule behaviour<sup>1</sup> on SRLB.

## **Data**

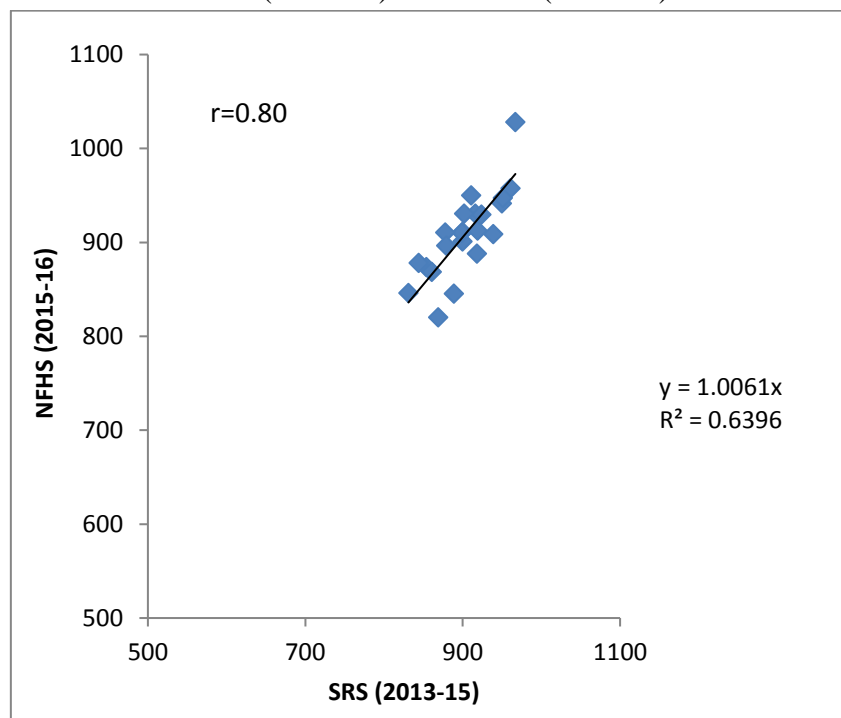
This study used the census data for analyzing the long-term trends (1961 to 2011) in overall sex ratio and sex ratio of children in 0-6 year age group. The NFHS data (1992-93, 1998-99, 2005-06 and 2015-16) has been used to analyze the emerging geographical and socio-economic pattern of CSR, SRB, and SRLB. The appropriate weight has been used to make the estimates representative and to account for multistage sampling design. The NFHS IV (2015-16) data is being analyzed to see the socio-economic correlates of CSR, SRB, and SRLB.

## **Methods**

The methodology in this paper involves calculation of CSR from census by using sex-wise population in 0-6 year age group. The direct estimation of CSR, SRB and the SRLB was carried out using unit level information from the successive round of NFHS. The CSR is estimated as female/male ratio of living child population of 0 to 72 months, while the SRB and SRLB were calculated as female/male ratio of total births in the five complete calendar years:1987-1991 (NFHS I), 1993-1997 (NFHS II), 2000-2004 (NFHS III) and 2010-2014 (NFHS IV). Further the geographical pattern of CSR, SRB, and SRLB is represented through Arc GIS.

For validation of our estimates, we compare it with SRBs from SRS data. Figure 1 shows a correlation between the estimated SRBs based on NFHS (2015-16) and SRS (2013-15). The correlation ( $r$ ) is as high as 0.80, which shows there is not much deviation of our estimated from SRS estimates.

Figure 1 Correlation between the estimates of SRB from SRS (2013-15) and NFHS (2015-16)



Binary logistic regression is used to find out the drivers of skewed sex ratio in child population, at birth, and at last birth. In this model, the dependent variables are the number of males compare to females in 0-6 year age group and number of males compared to females at birth and last birth. All the background characteristics (sex preference, social groups, religion, educational status,

wealth quintile, place of residence and region) are independent variables. The mathematical expressions of the models are given elsewhere (see Retherford and Choe, 1991)

We used human fertility decision model to assess the effect of stopping rule behaviour on SRLB which stimulate that couple's parity progression continues until they achieve the desired sex composition.

Assumptions made here are as follows:

If the woman has the child at parity  $i$

1. The probability of having a boy =  $p$
2. The probability of having a girl =  $1-p$

If the sex ratio is 105 (biological or normal sex ratio)

3. Then  $p = 0.512$
4.  $1-p = 0.488$
5. The probability of having all girls at parity  $I = (1-p)^i$ .

If women move to next parity  $i+1$

6. Probability of having all girls at parity  $i+1 = (1-p)^{i+1}$ . \*the probability of having all girls will decline and having all boys will have increased by moving to next parity  $i+1$ .

## Findings

### Trends in sex preference, CSR, SRB, and SRLB

The estimates based on the four rounds of NFHS found that the sex ratio of the child population is continuously masculinizing (Table 1). There was strong son preference<sup>2</sup> in 1992-93 but over the period it is decreasing, and by 2015-16 it is decreased by half to the level of 1992-93 (46.25 % in 1992-93 to 26.43% in 2015-16). Nevertheless, the CSR, SRB, and SRLB have not shown a remarkable improvement. The proportion of women preferring for a girl child is very less during the entire period, as it was only 2.86% in 1992-93 and 3.63 in 2015-16. SRB shows a declining trend from 1992-93 to the 2015-16. The SRLB is adverse compared to all the other indicators of sex ratio. It was 873 in 1992-93 which declined to 803 girls in 2015-16. The decline in CSR (0-6

year age group) is also at the alarming stage. The number of girls per thousand boys in the 0-6 year age group is decreased to 916 in 2015-16 from 944 in 1992-93.

**Table 1:** Trends in Sex Preference, Sex Ratio at Birth and Child Sex Ratio (0-6 age) in India, 1992-93 to 2015-16

Indicator	1992-93	95% CI		1998-99	95% CI		2005-06	95% CI		2015-16	95% CI	
	Percent/ Ratio	LL	UL	Percent/ Ratio	LL	UL	Percent/ Ratio	LL	UL	Percent/ Ratio	LL	UL
Son Preference	46.25	46.01	46.49	35.2	34.99	35.41	35.2	34.99	35.41	26.43	26.33	26.54
Daughter Preference	2.86	2.78	2.94	2.14	2.07	2.2	2.14	2.07	2.2	3.63	3.58	3.68
No Preference	50.87	50.63	51.11	62.65	62.43	62.86	62.65	62.43	62.86	69.92	69.81	70.04
Sex Ratio at Birth per 1000†	941	929	953	938	926	950	919	908	930	911	904	918
Sex Ratio at Last Birth per 1000†	873	856	890	791	781	801	805	787	824	803	796	810
Sex Ratio at Last Birth per 1000† when last two births were male	992	965	1020	977	951	1005	1003	976	1031	1014	1001	1027
Sex Ratio at Last Birth per 1000† when Last Two Births were Female	717	697	738	649	631	667	590	572	607	517	510	524
Sex Ratio at Last Birth per 1000† when Last Two Births were One Male and One Female	784	766	802	742	725	759	725	708	741	681	675	687
Child Sex Ratio per 1000 in 0-6 Age†	944	932	956	923	912	935	913	902	924	916	909	923

Note: SRB is calculated for children born five complete calendar years taken from birth history data of all the four rounds of NFHS.

### The socio-economic pattern of CSR

Sex ratio among the child population (0-6) is considerably varied by socio-economic background characteristics (Table 2). Among women with son preference, the CSR is as low as 776 females per thousand males in 2015-16 compared to those with no son preference (941). In India, socio-economic background characteristics of women have been showing a strong influence on many demographic indicators. Our estimates of CSR by social groups shows that initially Scheduled Castes (SCs) has the lower sex ratio (895) than all other social groups in 1992-93 but the situation has changed in last 20 years; the SCs are doing better in terms of CSR while other social groups are getting worse. Scheduled Tribes (STs) are also exposed to the culture of eliminating female child or limiting the family size after attainment of the required number of sons which indirectly restrain the female birth in the presence of sex-selective abortions. Muslims (956) and Christian (978) had the better CSR in 1992-93, and they are continued to be on top in 2015-16 with 965 and 1067 girls in 0-6 year age group. Sikhs had the lowest number of girls in child population with CSR of 878 in 1992-93 and declined to 807 in 1998-99. In 2015-16, NFHS IV data captures an improvement in CSR, although this improvement is appreciable still there is a long way to reach biological normal sex ratios as it currently stands at 872 (2015-16) girls per thousand boys in 0-6 year age group.

Table 2 also shows that women with no education have the lowest CSR (929) in 1992-93 but improved to highest (949) in 2015-16. In 2015-16, the results suggest that lower the educational level better is the CSR. This pattern can be attributed to their high fertility or non-exposure to the sex determination techniques among women with no or lesser education in comparison to their higher educated counterparts. A general notion of "Higher the wealth, better the women's position" seems to be a myth. From 1992-93 (1057) to 2015-16 (951) the poorest population have better child sex ratio than richer or richest households. Initially, the urban and rural settings have the same CSR (945 each in 1992-93), but in 2015-16 the CSR has declined more in urban India and currently stands at 899 girls per thousand boys in 0-6 year age group whereas the their rural counterparts have 924 girls per thousand boys.

**Table 2:** Child Sex Ratio (0-6 year age group) by Socio-economic background characteristics in India, 1992-93 to 2015-16

Background Characteristics	1992-93			1998-99			2005-06			2015-16		
	CSR	95% CI		CSR	95% CI		CSR	95% CI		CSR	95% CI	
<b>Sex Preference</b>		LL	UL		LL	UL		LL	UL		LL	UL
Son Preference	782	765	800	786	768	804	762	741	783	776	766	786
No Preference	1057	1037	1078	979	962	996	955	938	972	941	934	947
<b>Social Groups</b>												
Schedule Caste	895	860	930	906	881	932	938	913	965	931	919	942
Schedule Tribe	994	956	1034	953	917	991	947	911	985	968	949	987
OBC	-	-	-	931	911	953	902	896	908	906	898	914
Others	947	936	959	912	892	933	896	888	904	896	885	907
<b>Religion</b>												
Hindu	945	933	957	918	906	929	908	892	924	914	908	921
Muslim	956	930	983	963	937	991	939	913	965	928	911	944
Christian	978	896	1068	903	827	986	968	887	1057	951	914	989
Sikh	878	804	959	807	711	913	740	652	838	872	819	928
Other	843	771	920	916	809	1037	975	861	1104	931	881	984
<b>Education</b>												
No Education	929	913	946	932	914	950	921	901	942	949	937	961
Primary	989	962	1017	943	917	969	902	868	938	900	895	905
Secondary	959	933	986	901	877	927	910	885	936	901	893	909
Higher	974	892	1063	873	826	923	873	820	929	917	911	922
<b>Wealth Quintile*</b>												
Poorest	1057	984	1135	921	844	1006	913	888	938	951	939	963
Poor	908	845	975	959	878	1046	935	910	961	942	931	954
Middle	935	870	1004	932	853	1017	916	891	941	887	876	898
Rich	1005	935	1079	895	820	977	885	861	910	916	905	928
Richest	957	891	1028	851	779	929	857	824	892	866	851	881
<b>Place of Residence</b>												
Urban	945	919	971	931	906	958	895	870	920	899	888	911
Rural	945	933	956	920	909	932	919	903	935	924	917	930

## The socio-economic pattern of SRB

The SRB is also worsening (794 in 1992-93 to 756 in 2015-16) over the period among the women with son preference (Table 3). Except for SCs the number of girls born per thousand boys has been worsening in all social groups from 1992-93 to 2015-16. Even among the STs, who believed to be having better SRBs in the past, shown a decreasing trend (973 in 1992-93 to 953 in 2015-16). Among all the religions, Sikhs are eliminating larger number of girls at birth and in early childhood. The SRB among Sikhs is getting slightly better from its previous values of 835 in 1992-93 to 861 in 2015-16, although such smaller improvement in a 20 years span could not help in balancing the SRB. Christian shows better SRB in comparison to other religion in India (1017 in 1992-93 and 956 in 2015-16).

In 1992-93 the SRB was found to be better among primary (968) and secondary educated women (965) in comparison to the highly educated women (934), but in 2015-16 it gets adversely worse among the former than the later educational group. The SRB is found to be lowest among the women with secondary level of education in 2015-16. The households with the poorest income quintile have the highest number of girls (1031) born per thousand boys born in 1992-93, but it reduced to 939 in 2015-16. Among all the income groups the middle (892) and richest (845) households have the lowest SRB in 2015-16. Both rural and urban India is continuously evident for missing girls at birth from last two decades (Table 3). But comparatively urban India (895) has significantly less number of girls born to every thousand boys than rural India (917) according to 2015-16 estimates.

**Table 3:** Sex Ratio at Birth by socio-economic background characteristics in India, 1992-93-93 to 2015-16

Background Characteristics	1992-93			1998-99			2005-06			2015-16		
	SRB	95% CI		SRB	95% CI		SRB	95% CI		SRB	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
<b>Sex Preference</b>												
Son Preference	794	776	812	800	782	819	795	773	817	756	746	765
No Preference	1042	1019	1067	997	977	1016	953	934	972	929	921	937
<b>Social Groups</b>												
schedule Caste	901	865	936	944	918	971	941	915	968	927	915	938
schedule Tribe	973	936	1012	941	905	979	997	958	1037	953	932	975
OBC	-	-	-	941	916	968	903	883	924	900	892	908
Others	945	928	961	925	905	946	897	872	922	888	877	900
<b>Religion</b>												
Hindu	941	924	957	936	920	953	914	898	930	907	901	914
Muslim	954	917	992	963	926	1002	944	908	982	924	908	940
Christian	1017	980	1168	944	864	1030	1018	933	1111	956	919	994
Sikh	835	737	945	832	734	942	719	633	814	861	809	916
Other	887	929	953	849	750	962	897	792	1015	912	863	964
<b>Education</b>												
No Education	930	914	946	954	936	973	940	919	961	939	928	951
Primary	968	931	1007	930	895	968	884	850	919	900	882	917
Secondary	965	928	1004	923	898	949	904	879	929	896	888	903



Higher	934	908	960	862	810	917	889	827	955	904	883	924
<b>Wealth Quintile *</b>												
Poorest	1031	944	1126	852	780	930	965	938	992	939	927	951
Poor	950	870	1037	947	867	1034	930	904	956	939	928	951
Middle	923	859	991	992	909	1083	922	897	948	892	881	903
Rich	1006	937	1081	927	849	1012	887	853	923	912	896	928
Richest	943	878	1013	947	836	1072	857	824	892	845	828	862
<b>Place of Residence</b>												
Urban	948	868	1035	942	916	969	897	873	922	895	884	906
Rural	939	923	956	937	932	942	926	908	945	917	909	925

Note: SRB is calculated for all births in the five complete calendar years (1987-1991, 1993-1997, 2000-2004 and 2010-2014) taken from birth history data of all round of NFHS 1, NFHS 2, NFHS 3 and NFHS 4.

\*Wealth Index for NFHS 1 (1992-93) and NFHS 2 (1998-99) are calculated by authors.

## The socio-economic pattern of SRLB

Among women with son preference the SRLB is as low as 638 girls per one thousand boys in 2015-16 (see Table 4). Among social groups, the SRLB is lowest in SCs (866) in 1992-93, but in 2015-16 it observed to be lowest in OBC (786) and other castes (779). Hindus and Sikhs have the lowest SRLB in 1992-93, and it is continuing to be at the worse position after two decades, as it reduced to 793 and 663 for Hindu and Sikhs in 2015-16 respectively. In 1992-93 among all the educational groups the primary educated women have better SRLB in comparison to highly educated women, but from 1998-99 in all educational categories, the figures of SRLB are declining among women with different educational attainment whereas it has shown some improvement among women with higher education. The SRLB was better among poorest (950) in 1992-93 but it started worsening and it reached to 821 girls per thousand boys in 2015-16. In 2015-16, the SRLB is found to be lower among poor (866) and richest (899) population, while SRLB in richest (765) population is lowest. In contrast to CSR and SRB pattern, the SRLB is worse in rural India (791) compared to urban (814) in 2015-16. Lower SRLB and higher CSR and SRB in rural areas suggest that they have been benefiting from higher fertility rates compared to urban areas.

**Table 4:** Sex Ratio at Last Birth by Socio-economic background characteristics in India, 1992-93 to 2015-16

Background Characteristics	1992-93			1998-99			2005-06			2015-16		
	SRLB	95% CI		SRLB	95% CI		SRLB	95% CI		SRLB	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
<b>Sex Preference</b>												
Son Preference	741	720	762	722	702	743	715	687	744	638	625	650
No Preference	957	931	984	885	861	910	821	803	840	824	817	831
<b>Social Groups</b>												
schedule Caste	866	819	916	838	805	871	831	799	864	829	813	845
schedule Tribe	909	854	967	829	771	890	922	858	991	839	816	863
OBC	-	-	-	864	831	898	790	768	812	786	777	796
Others	871	851	891	815	793	838	769	739	800	779	764	795
<b>Religion</b>												
Hindu	867	848	887	835	816	854	791	773	810	793	786	800
Muslim	936	885	989	914	865	966	883	836	934	850	831	870
Christian	1034	913	1170	935	826	1058	1008	891	1142	954	897	1015

Sikh	612	509	731	596	495	712	494	408	593	663	616	713
Other	781	689	884	654	532	796	820	687	977	818	761	879
<b>Education</b>												
No Education	866	846	886	866	843	891	835	812	858	807	793	821
Primary	904	869	940	809	765	856	776	734	820	769	752	787
Secondary	885	851	921	815	783	847	775	745	807	801	791	811
Higher	835	764	912	810	754	870	800	732	873	845	821	868
<b>Wealth Quintile *</b>												
Poorest	950	870	1037	798	703	903	889	855	925	821	805	837
Poor	866	793	946	965	852	1092	788	758	820	811	795	827
Middle	924	846	1008	874	771	989	808	777	840	796	780	811
Rich	948	869	1035	974	860	1102	769	739	800	817	801	833
Richest	899	824	982	796	702	901	757	727	787	765	747	782
<b>Place of Residence</b>												
Urban	879	845	914	849	816	883	802	771	834	814	804	824
Rural	872	853	892	840	821	859	806	788	824	798	791	805

Note: SRLB is calculated for all last births in the five complete calendar years (1987-1991, 1993-1997, 2000-2004 and 2010-2014) taken from birth history data of all round of NFHS 1, NFHS 2, NFHS 3 and NFHS 4.

\*Wealth Index for NFHS 1 (1992-93) and NFHS 2 (1998-99) are calculated by authors.

## The geographical pattern of CSR, SRB, and SRLB

The disparity in terms of sex ratio among Indian states is not a new phenomenon, and this regional inconsistency is revealed by time to time from different data sources like the census, vital statistics and sample surveys (Ramchandran and Deshpande, 1964; Agnihotri, 2000; Guilamoto and Depledge, 2008; Arokiasamy, 2004; Kumar and Sathyanarayana, 2012). As per the sex ratio scenario, a north-south divide has been noticed which is also described as rice and wheat belt divide where rice belt includes all the southern and eastern parts of the country and the wheat producing areas are mainly concentrated in western parts (Miller 1981, Kishor, 1993; Raju, 1997). Agnihotri in 1996 found that the dearth of females in the primary age group is prevalent in north and north-west part of India and termed this region as “Bermuda triangle” which includes districts of Haryana, ravine area of Madhya Pradesh, Rajasthan and western Uttar Pradesh. Here, in this paper, the analysis of recent data shows an emerging geographical pattern of sex ratio in the 0-6 year age group and at birth. Although, the most recent census (2011) continue to support the fact that the north, west, and central India is mainly contributing to the decline in the CSRs at the national level, but also hints the decline the CSR in several districts of south and eastern India (Arokiasamy and Goli, 2012). Now it's been seven years after the last census conducted, the analyses based on 2015-16 data shows an emerging pattern in CSR and SRB (see table 5, 6 and table 7).

Table 5 shows that the south Indian states like Tamil Nadu (1051), Andhra Pradesh (1006), Kerala (969) and Karnataka (949) have higher CSR than many north Indian states in the year 1992-93. In states like Andhra Pradesh and Tamil Nadu, female outnumbered the male in

child (0-6) population in 1992-93. However, over the period during 1992-93 to 2015-16, the CSR deteriorated in every south Indian state except Kerala (1025). Despite being one of the southern and rice cultivating Indian states, Telangana (912) has very less number of girls than boys in 0-6 year age group in 2015-16. In 1992-93, the northern states, Delhi (904), Punjab (887), Rajasthan (877) and Haryana (859) have the least number of girls in child population, and these states are continuing to be at the bottom till 2015-16. In 2015-16, the north-eastern states like Manipur (982), Meghalaya (1014), Mizoram (946) and Nagaland (949) have better sex ratios in comparison to many north Indian states like Delhi (835), Uttar Pradesh (904), Bihar (935) and Jammu & Kashmir (911). Overall, a majority of the Indian states have experiencing a declining trend in the number of girls per thousand boys in the child population. From 1992-92 to 2015-16, the states which have shown an improvement in child CSR are Kerala (+56), Himachal Pradesh (+44), Meghalaya (+40), Arunachal Pradesh (+30), Mizoram (+13), Rajasthan (+6) and Odisha (+1). Although, it was widely discussed and documented about north-south or east-west divide in CSR patterns by the previous studies, our trend analysis suggest that CSR is undoubtedly declining in almost all part of India and leading to an emerging geographical patterns of sex ratio imbalance in the country.

**Table 5:** Child Sex Ratios for all States of India, 1992-93 to 2015-16

States	1992-93			1998-99			2005-06			2015-16		
	CSR	95% CI		CSR	95% CI		CSR	95% CI		CSR	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
Andhra Pradesh	1006	952	1063	920	871	973	891	837	948	894	870	919
Arunachal Pradesh	894	598	1324	867	579	1283	1020	686	1519	924	759	1125
Assam	1022	952	1098	915	838	998	988	905	1079	921	885	957
Bihar	941	905	979	939	903	977	887	852	922	935	917	954
Goa	954	640	1417	847	565	1253	960	644	1425	902	740	1097
Gujarat	966	908	1028	922	901	943	902	840	969	881	856	905
Haryana	859	786	937	857	785	936	759	694	829	826	794	860
Himachal Pradesh	900	754	1072	934	767	1136	893	733	1087	944	864	1030
Jammu and Kashmir	863	707	1049	878	775	994	911	804	1031	911	848	979
Karnataka	949	779	1154	957	891	1028	945	880	1015	922	897	948
Kerala	969	888	1058	942	863	1028	925	847	1009	1025	985	1066
Madhya Pradesh	921	885	958	910	875	946	975	917	1038	919	899	940
Maharashtra	956	920	995	931	895	968	882	834	932	923	903	945
Manipur	1060	803	1403	992	750	1310	1012	766	1337	982	868	1112
Meghalaya	974	736	1286	898	678	1185	974	736	1286	1014	895	1148
Mizoram	933	625	1384	871	581	1289	1025	690	1526	946	776	1151
Nagaland	950	718	1255	922	696	1217	975	737	1288	949	796	1131
Delhi	904	798	1023	833	735	942	855	755	968	835	784	888
Odisha	934	869	1003	955	889	1026	924	860	993	935	899	973
Punjab	887	812	969	830	760	906	725	663	792	840	808	874
Rajasthan	877	824	933	883	835	934	860	808	915	883	859	908
Tamil Nadu	1051	988	1118	967	909	1029	933	869	1003	944	918	971
Tripura	961	789	1170	983	743	1299	972	735	1284	953	842	1079
Uttar Pradesh	919	893	944	936	910	962	906	881	932	904	893	915
West Bengal	969	932	1008	898	849	949	975	923	1031	953	932	975
Sikkim	-	-	-	920	616	1364	1003	674	1492	891	596	1320
Chhattisgarh	-	-	-	-	-	-	927	849	1011	966	853	1094

Jharkhand	-	-	-	-	-	-	1085	994	1185	921	886	958
Uttarakhand	-	-	-	-	-	-	911	763	1085	891	829	957
Telangana	-	-	-	-	-	-	-	-	-	912	877	948

**Table 6:** Sex Ratio at Birth for all States of India, 1992-93 to 2015-16

States	1992-93			1998-99			2005-06			2015-16		
	SRB	95% CI		SRB	95% CI		SRB	95% CI		SRB	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
Andhra Pradesh	1005	985	1025	950	899	1004	872	811	936	899	864	935
Arunachal Pradesh	971	652	1443	820	546	1213	1001	673	1489	910	747	1,107
Assam	962	895	1033	909	832	992	982	900	1072	901	866	937
Bihar	955	918	993	944	908	982	921	886	958	931	913	949
Goa	965	648	1434	878	586	1300	945	634	1403	949	779	1,154
Gujarat	980	912	1053	901	838	967	897	835	964	873	850	898
Haryana	904	828	987	877	803	958	726	640	823	846	813	880
Himachal Pradesh	852	722	1071	903	741	1099	901	739	1095	930	851	1,015
Jammu and Kashmir	880	722	1071	911	804	1031	908	761	1082	910	847	978
Karnataka	929	873	988	964	897	1035	970	903	1042	909	884	934
Kerala	961	880	1049	892	817	974	934	825	1057	1028	972	1,087
Madhya Pradesh	930	895	968	915	880	952	1014	953	1079	913	888	938
Maharashtra	961	924	1000	926	876	978	865	818	914	911	890	931
Manipur	1057	800	1399	1068	809	1413	1010	764	1335	964	852	1,092
Meghalaya	1021	773	1350	849	640	1120	929	702	1226	992	876	1,123
Mizoram	980	658	1456	936	628	1389	1032	695	1538	986	810	1,200
Nagaland	943	632	1399	884	667	1167	902	603	1337	955	785	1,163
Delhi	884	780	1000	847	748	959	859	719	1023	820	770	873
Odisha	948	882	1018	992	923	1065	886	812	968	941	905	979
Punjab	828	758	904	874	800	954	742	678	810	845	800	894
Rajasthan	893	839	950	896	842	953	897	843	955	869	845	893
Tamil Nadu	1018	957	1084	1000	931	1074	991	923	1065	950	924	977
Tripura	908	745	1104	981	742	1296	978	739	1292	936	826	1,059
Uttar Pradesh	909	884	934	972	945	999	915	890	941	896	881	912
West Bengal	963	911	1018	927	877	980	947	890	1007	947	921	974
Sikkim	-	-	-	896	599	1328	986	662	1465	802	533	1,186
Chhattisgarh	-	-	-	-	-	-	890	815	971	958	921	996
Jharkhand	-	-	-	-	-	-	1062	972	1159	930	895	968
Uttarakhand	-	-	-	-	-	-	873	716	1062	878	817	943
Telangana	-	-	-	-	-	-	-	-	-	875	841	910

SRB is getting deteriorated in almost all the states of India (Table 6). The southern India, which is known for its better demographic indicators have also not remained untouched by this demographic constraint. From 1992-93 to 2015-16 the states which have shown an improvement in SRB are Himachal Pradesh (+78), Kerala (+38), Jammu & Kashmir (+30), Punjab (+17), Mizoram (+6) and Nagaland (+12), except these states all other have declining trend from last two decades. The newly formed Telangana also have very less number of girls (875) per thousand boys at birth. In 2015-16, among major Indian states, Haryana (846) and Punjab (845) are continuously displaying lowest SRB. Since 1992-93 the north-eastern states like Mizoram (+6), Tripura (+28) Nagaland (+12) have shown positive growth in the number of girls at birth. But the remaining states like Meghalaya and Manipur have very less number of girls per thousand boys at birth from last two decades. Top five states where the SRB is better in 2015-16 are, Kerala (1028), Meghalaya (992), Mizoram (986), Manipur (964) and

Chhattisgarh (958) and the bottom five states where the SRB is worst in 2015-16 are Sikkim (802), Delhi (820), Punjab (845), Haryana (846) and Rajasthan (869).

Table 7 shows the trend of SRLB in all Indian states from 1992-93 to 2015-16. The top states where the SRLB is comparatively better in 2015-16 are Kerala (921), Meghalaya (918), Mizoram (916), Tamil Nadu (927), and Manipur (915) and the states at the bottom are Gujarat (660), Delhi (671), Punjab (674), Rajasthan (675) and Haryana (697). The northern states like, Himachal Pradesh (709), Uttarakhand (755) and Uttar Pradesh (755) have less number of girls at last birth in 2015-16 in comparison to many south Indian and north-eastern states. The SRLB is very low in almost all parts of the country. From 1992-93 to 2015-16, the state which has added more girls at last birth from earlier are Goa (+15) Karnataka (+20) Kerala (+38) Mizoram (+33) and Nagaland (+3), except these five states all the remaining states have less number of girls at last birth in 2015-16 in comparison to 1992-93. The sex ratio at last birth shows the level of son preference and stopping rule behaviour of couples, as the people stopping childbearing once they achieved a desired number of son.

**Table 7:** Sex Ratio at Last Birth for all states of India, 1992-93 to 2015-16

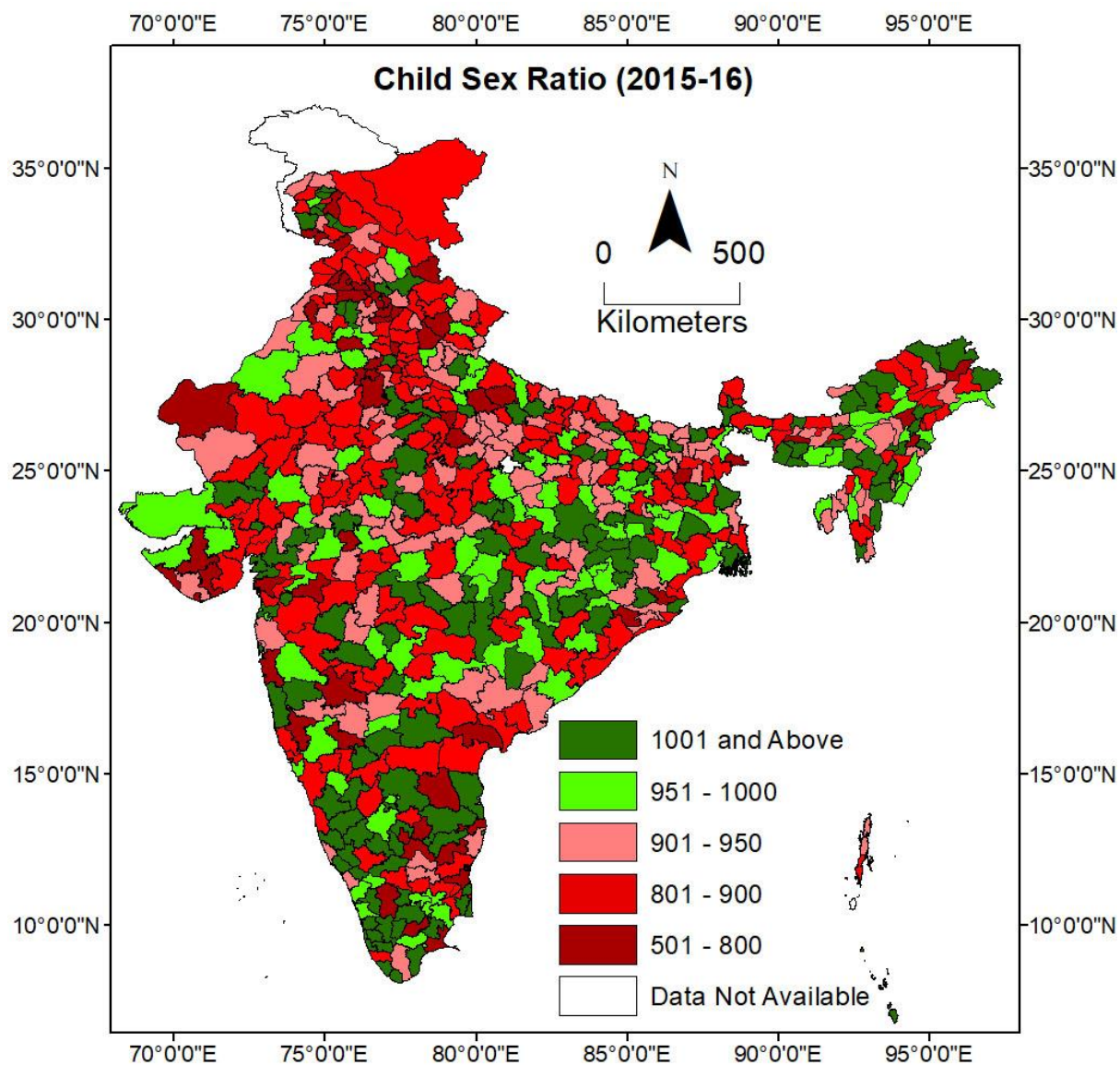
States	1992-93			1998-99			2005-06			2015-16		
	SRLB	95% CI		SRLB	95% CI		SLRB	95% CI		SRLB	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
Andhra Pradesh	969	902	1041	959	893	1030	829	759	905	841	808	875
Arunachal Pradesh	839	559	1242	777	515	1148	812	540	1201	792	596	1045
Assam	890	815	972	795	701	900	926	817	1048	853	807	902
Bihar	864	812	920	838	788	892	797	741	856	809	787	832
Goa	895	599	1326	846	564	1253	869	581	1287	910	687	1201
Gujarat	830	760	906	769	704	840	682	623	745	660	634	687
Haryana	728	641	824	707	622	801	521	456	592	697	659	737
Himachal Pradesh	770	630	937	658	529	932	586	434	774	709	624	803
Jammu and Kashmir	869	655	1146	778	637	946	775	634	942	821	751	896
Karnataka	850	778	928	853	781	932	828	758	904	870	836	905
Kerala	983	868	1112	883	780	1000	970	857	1098	1021	959	1086
Madhya Pradesh	895	841	952	847	788	910	809	741	884	786	764	808
Maharashtra	876	815	941	724	673	778	744	691	799	813	791	836
Manipur	995	669	1479	854	569	1263	855	570	1265	915	751	1113
Meghalaya	1050	707	1565	854	570	1264	799	531	1181	1018	900	1153
Mizoram	983	660	1461	899	602	1333	940	630	1395	1016	769	1343
Nagaland	896	599	1327	722	476	1066	862	575	1276	899	678	1186
Delhi	774	634	942	740	605	901	793	649	965	671	623	721
Odisha	860	787	939	839	768	916	781	714	852	822	790	855
Punjab	608	534	690	630	554	715	559	490	634	674	626	725
Rajasthan	778	712	849	773	708	844	802	734	876	675	648	702
Tamil Nadu	1005	936	1080	996	912	1087	915	838	998	927	902	953
Tripura	918	693	1212	790	525	1168	943	713	1245	907	801	1027

Uttar Pradesh	843	810	877	886	852	921	817	785	849	755	749	760
West Bengal	928	863	997	883	822	949	872	811	936	895	870	920
Sikkim	-	-	-	713	470	1053	905	605	1341	782	519	1156
Chhattisgarh	-	-	-	-	-	-	829	731	938	822	772	875
Jharkhand	-	-	-	-	-	-	976	862	1105	766	725	810
Uttarakhand	-	-	-	-	-	-	684	558	833	755	691	825
Telangana	-	-	-	-	-	-	-	-	-	868	835	903

Note: SRLB is calculated for all last births in the five complete calendar years (1987-1991, 1993-1997, 2000-2004 and 2010-2014) taken from birth history data of all round of NFHS 1, NFHS 2, NFHS 3 and NFHS 4.

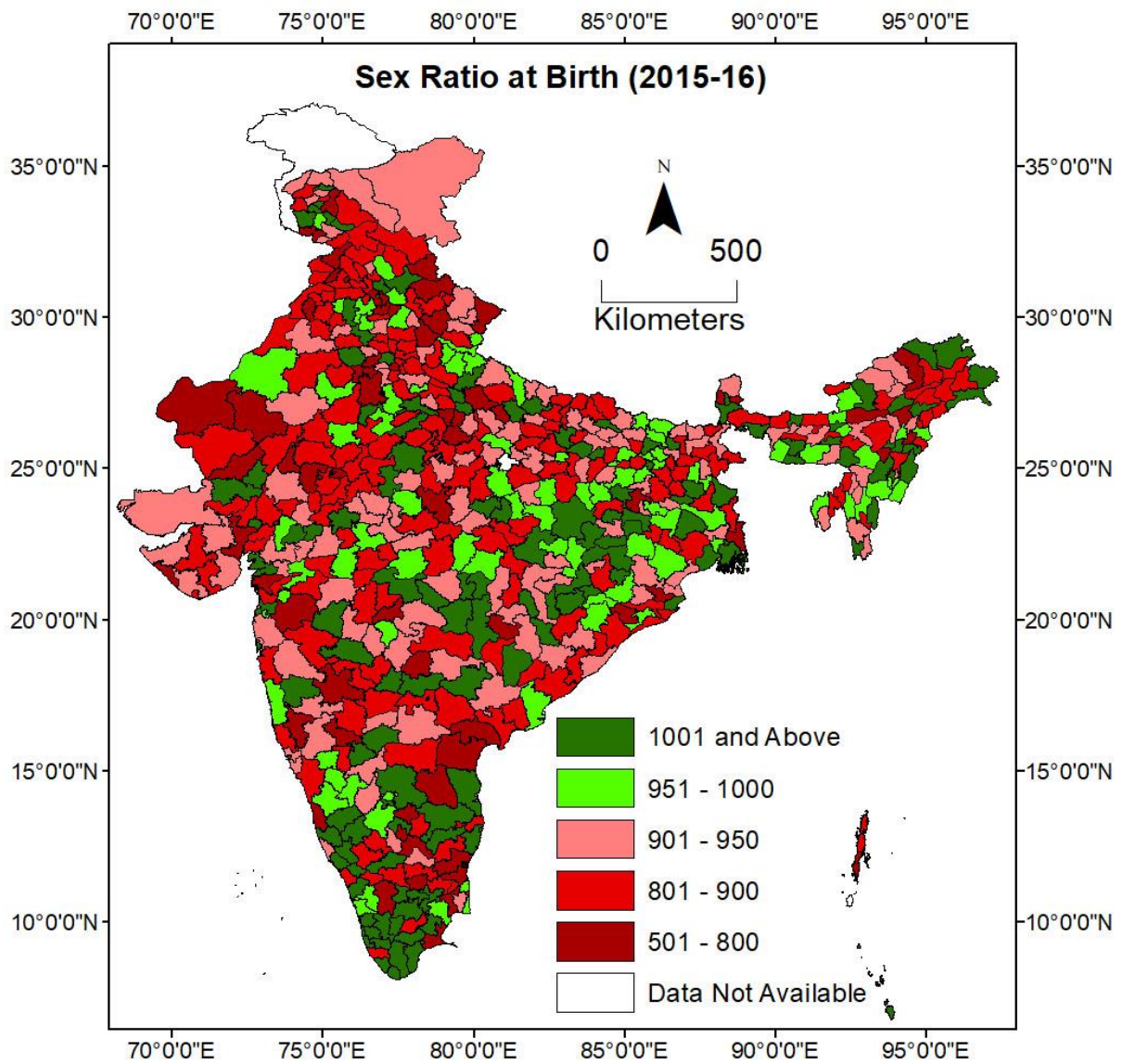
As mentioned above for the first time the design and sample size in the NFHS IV allows for estimating CSR, SRB and SRLB at district levels. District level assessment allows better regionalisation of sex ratio imbalance in the country. Also, helps to evaluate the regionalisation proposed in the previous studies. The estimates of CSR over districts show a huge variation not only across the country but within states across the districts. The states like Kerala, Meghalaya, Maharashtra, and Chhattisgarh which has comparatively better CSR figures in terms of state averages also have districts with low CSR. Most of the districts with better CSR are clustered in the southern part of the country. Map 1 is clearly showing that the districts with better CSR in any state is clustered together, while the districts with worse CSR are also sharing the geographical boundaries. Across many districts of north India, the range of CSR varies between 500-900 girls per thousand boys. The whole eastern tribal belt of Madhya Pradesh, Odisha, Chhattisgarh and north-eastern states has better CSR levels. In contrast, most of the western districts have less than 900 girls per thousand boys. In many districts of India, there are less than 800 girls per thousand boys in the 0-6 year age group. The north-eastern districts are better than western districts in terms of CSR. In Haryana, most of the districts have less than 800 girls per thousand boys in the 0-6 year age group.

Map 1: District Pattern of Child Sex Ratio in India, 2015-16



Akin to the pattern of CSR across the districts, the states having better SRB also have some parts (districts) with worse sex ratio. Thus, the map 2 shows that there is not only interstate diversity but also intrastate diversity in SRB. Although, the SRB levels are better in southern region, but there is also an emerging masculinisation process across the several districts in the region. In western India, except for few districts, most of the districts have worse SRB. The districts of east-central India also have better SRB than western India. Most of the districts of Jammu & Kashmir and Himachal Pradesh have less than 900 girls per thousand boys at birth.

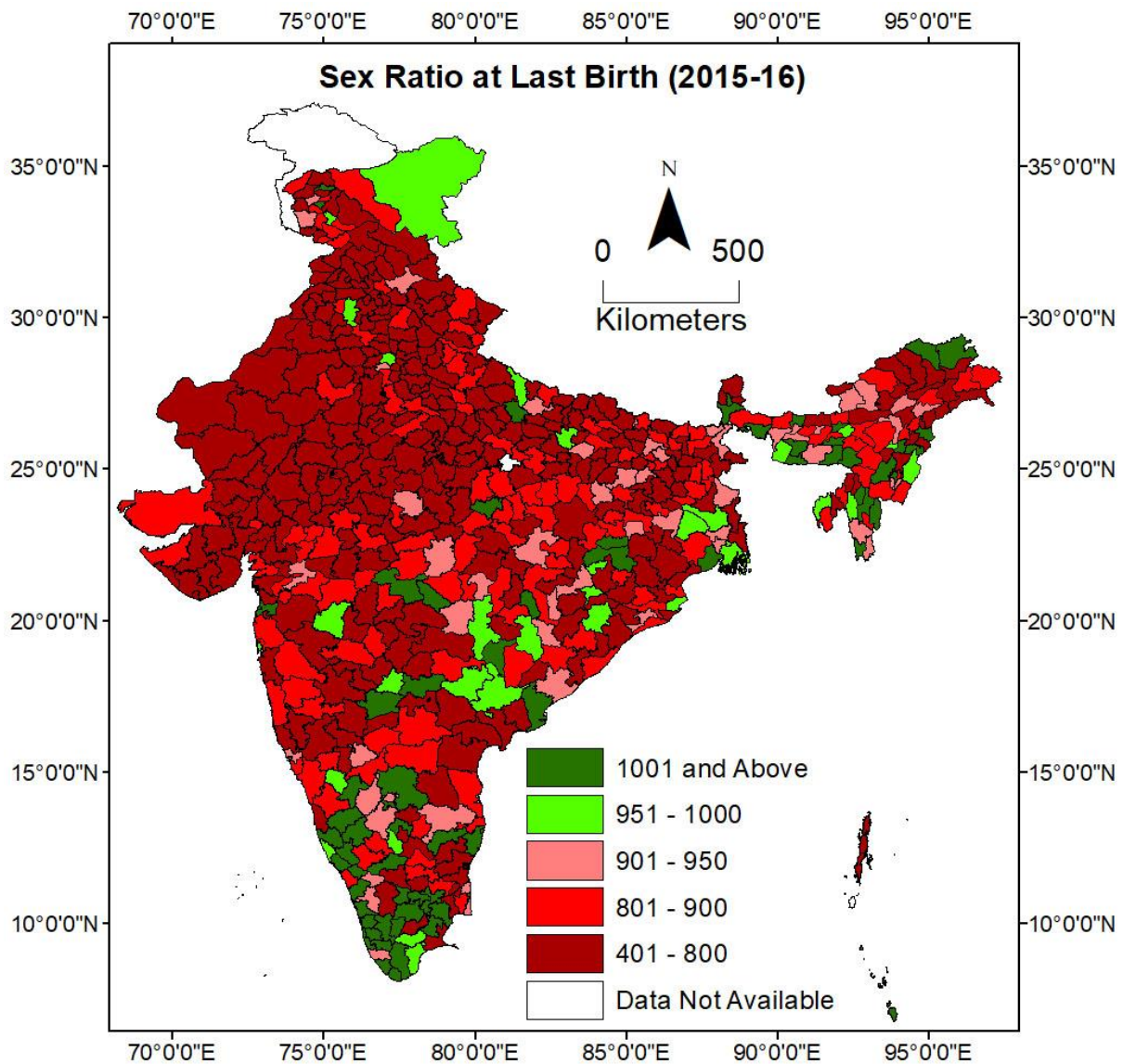
Map 2: District Pattern of Sex Ratio at Birth in India, 2015-16



As said previously, SRLB do not have any role in determining the overall sex ratio of the population in absence of sex-selective abortions, but it depicts the level of son preference existing in the society. Map 3 shows north and north western India display high meta son preference. The SRLB in western and northern India are lying between 400 to 800 girls per thousand birth. Although, southern India has more districts with better SRLB, but also have a cluster of districts with male skewed SRLB. In the north-east, we found there are only few districts with balanced SRLB. At an outset, the SRLB is overall skewed in every part of India except few geographical pockets of south and north-east.

Map 3: District Pattern of Sex Ratio at Last Birth in India, 2015-16





### Socio-economic factors of CSR, SRB and SRLB

Table 8 shows the effect of socio-economic factors on CSR, SRB, and SRLB. Model 1 represents the likelihood of having males than females in the 0-6 year age group. Results in model 1 have clearly shown that among women with son preference there is the high probability of having males than females after adjusting to all other socio-economic variables. Among social groups, the likelihood of having more male than female in 0-6 year age group is less in all other groups (SC, OBC and Others) in comparison to STs. The likelihood of having more male child among women with the primary and secondary level of education is higher than the women with no education. The probability of having males in 0-6 age is higher in the middle, rich and richest population than the poor population. North India shows the high probability of having more male child in comparison to the rest of India.

Model II presents the likelihood of having males than female at birth. The results of model II depicts that there is the higher likelihood of having males than females at birth in the presence of son preference. SCs and OBCs have less probability of having the son in comparison to STs. The probability of having more sons is high among the women with the primary and secondary level of education. The probability of having the more male child is highest among the richest women. Model III represents the likelihood of having more males than females at last birth. It is clearly shown in the result that there is the higher likelihood of having male at last birth if the last two births were female. In presence of son preference, there is the high probability of having males at last birth. Among all religion, Sikhs are more likely to have more male child at last birth. All the economic classes are more likely to have male child at last birth in comparison to poor class. The probability of having males at last birth is higher in urban areas than rural areas.

**Table 8:** Results from logistic regression models: Socio-economic Correlates of Child Sex Ratio (0-6 years), Sex Ratio at Birth and Sex ratio at Last Birth.

Factors	Exp.β (Odds Ratio)		
	Model I Likelihood of having more males than females in 0-6 age group children	Model II Likelihood of having more males than females at birth	Model III Probability of having male compare to female at last birth
<b>Sex of Previous Two Birth</b>			
Both male®	-	-	1.00
Both female	-	-	2.021*** (1.972-2.072)
One Male and One Female	-	-	1.504*** (1.473-1.536)
<b>Sex Preference</b>			
Others®	1.00	1.00	1.00
Son Preference	1.292*** (1.270-1.315)	1.283*** (1.260-1.308)	1.232*** (1.209-1.256)
<b>Caste</b>			
SC®	1.00	1.00	1.00
ST	0.955*** (0.931-0.979)	0.946*** (0.921-0.972)	0.914*** (0.888-0.942)
OBC	0.962** (0.936-0.990)	0.960** (0.932-0.989)	0.894*** (0.866-0.925)
Others	0.992 (0.972-1.014)	0.987 (0.965-1.010)	0.974* (0.950-1.000)
<b>Religion</b>			
Hindu®	1.00	1.00	1.00
Muslim	0.954*** (0.933-0.976)	0.947*** (0.924-0.971)	0.821*** (0.799-0.844)
Christian	0.954* (0.918-0.991)	0.936*** (0.898-0.974)	0.917*** (0.876-0.961)
Sikh	0.995 (0.937-1.058)	1.004 (0.940-1.072)	1.111** (1.030-1.198)
Others	0.975 (0.928-1.026)	0.964 (0.914-1.017)	0.885*** (0.835-0.940)
<b>Education</b>			
No Education®	1.00	1.00	1.00
Primary	1.048*** (1.025-1.072)	1.047*** (1.022-1.072)	1.001 (0.978-1.025)
Secondary	1.054*** (1.034-1.076)	1.054*** (1.031-1.077)	1.024** (1.000-1.049)
Higher	1.029 (0.996-1.064)	1.023 (0.987-1.061)	1.078** (1.009-1.153)
<b>Wealth Quintile*</b>			
Poorest®	1.00	1.00	1.00
Poor	1.009 (0.988-1.032)	1.001 (0.978-1.024)	1.064*** (1.038-1.091)
Middle	1.059*** (1.034-1.086)	1.048*** (1.021-1.076)	1.103*** (1.073-1.135)
Rich	1.042** (1.013-1.072)	1.031* (1.001-1.063)	1.152*** (1.116-1.190)
Richest	1.110*** (1.073-1.148)	1.115*** (1.075-1.156)	1.197*** (1.152-1.246)
<b>Place of Residence</b>			
Urban®	1.00	1.00	1.00
Rural	0.995(0.975-1.015)	1.003 (0.981-1.024)	1.080*** (1.055-1.106)
<b>Region</b>			
North®	1.00	1.00	1.00
central	0.961*** (0.940-0.984)	0.966** (0.942-0.990)	0.907*** (0.883-0.932)
East	0.948*** (0.924-0.973)	0.944*** (0.919-0.971)	0.861*** (0.835-0.888)
North-east	0.961* (0.930-0.995)	0.980 (0.945-1.016)	0.769*** (0.738-0.801)
South	0.940*** (0.913-0.969)	0.948*** (0.918-0.979)	0.747*** (0.720-0.775)

West	0.978	(0.947-1.012)	0.984	(0.949-1.019)	1.014	(0.976-1.056)
<b>Constant</b>	1.019	(0.982-1.059)	1.029	(0.989-1.072)	0.960	(0.916-1.006)

® - Reference category; Level of significance: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

**Table 9: Quantification of the impact of stopping rule on Sex Ratio of Last Births by parity, India (2015-16)**

Birth Parity	SRB of parity i				SRLB of parity i				PSR at parity i (%)			Estimation of SRLB		
	Male Birth	Female Birth	Total Birth	Actual SRB	Male Birth	Female Birth	Total Birth	Actual SRBL	PSR mi	PSR f i	PSR t i	PSR mi / PSR f i	SRB L*	SRBL **
1	292	149	441	510	290	148	438	510	99.2	99.2	99.2	1.00	952	510
2	15010	9710	24720	645	10062	6860	16923	680	67.0	70.7	68.5	0.95	1000	680
3	8866	5838	14704	658	5919	3279	9198	552	66.8	56.2	62.6	1.19	800	552
4	3607	2619	6226	725	2496	1389	3885	556	69.2	53.1	62.4	1.30	730	556
5+	2757	2182	4939	794	1851	1249	3100	676	67.1	57.2	62.8	1.17	813	676

Note: \* SRLB when the differential in stopping rule behaviour and termination of pregnancy not present or when assumed normal SRB 1050

\*\* SRLB when the differential in stopping rule behaviour and termination of pregnancy present or actual SRB

The impact of stopping rule behaviour on SRLB is assayed through human fertility model. As parents wish to have at least one boy and keep having children until they attain their wish and often stop childbearing with the attainment of the son (Keyfitz and Caswell, 2005). The SRLB is a mirror of the level of son preference in a population. The SRLB may not affect the overall sex ratio, but it can't be sidelined during the study of sex ratio especially in the background of son preference. Here in table 9, it is shown that how the SRLB is being affected by the stopping rule behaviour and termination of the pregnancy. The result shows that where there is no stopping rule behaviour, the sex ratio is ranging from 730 to 1000 over different parities. But in presence of termination of pregnancy and the stopping rule behaviour the sex ratio is highly in favour of male and it is varying between 510 girls to 680 girls per thousand boys. In the absence of differential in stopping rule behaviour and termination of pregnancy the women with parity 1 have 950 girls per thousand boys at last birth but in the presence of both there are only 510 girls per thousand boys at last birth. Same has happened in women with higher parity, i.e., in the presence of termination of pregnancy and differential in stopping rule behaviour, the women bearing very few girls at last birth in comparison to its absence.

## Discussion and Conclusion

Beside PC-PNDT act, recently India has initiated new programmes for combating the issues related to gender imbalance out of which one key programme is "Beti Bachao, Beti Padhao" (BBBP). Although, the NFHS IV data will not allow the evaluation of the impact of BBBP as the launching of survey and BBBP programme is at the same time, but allows prioritizing the key challenges in front of fulfilling BBBP targets and allows for identifying the changing

“hot spots” of the problem by analyzing the trends and patterns of the sex ratio imbalance and key factors associated with it. This study based on 2015-16 data is showing the most recent trends of masculinisation of the population by estimating the SRB, CSR, and SRLB. Given that NFHS IV factsheets wrongly representing the trends in SRB and CSR, the study for the first time present the correct estimates of SRB and CSR since the release of NFHS IV factsheets and the data. A high correlation between the NFHS and SRS based estimates intersperse faith in our estimates.

The estimation from all the rounds of NFHS data shows that there is a declining trend in CSR, SRB, and SRLB against what has been reported in the factsheets of NFHS. A more surprising fact is in spite of decline in son preference almost by half, the masculinisation of the population at early ages continues. Over the period, except slight improvement of CSR in SCs and SRB in STs, in general CSR, SRB, and SRLB worsened across all the social groups. Masculinisation continues across the population in all the religious groups, educational level, and wealth quintiles. In spite of a slight improvement in SRB and SRLB among all the religious groups, Sikhs stands at the bottom in all three indicators CSR, SRB, and SRLB. The decline is significant among females with higher education, rich wealth quintile and urban residents than their counterparts. Meta son preference is a significant factor for highly skewed SRLB. Sex of the previous births is also a critical determinant of the sex of the subsequent child. Although, states from the north and north-west India continue to show a greater masculinization of the child population, the district level assessment shows assimilation of the culture of elimination of girl child in several districts of east and south India. Therefore, the previous notion of “rice” and “wheat” belt divide or “north-west” and “south-east” divide in sex ratio imbalance (Miller, 1981; Dyson and Moore, 1983) can’t be strictly valid now as the intra-regional variation are a new emerging pattern in all three indicators of sex ratios. The culture of elimination of girl child is spreading to southern, eastern and remote areas of central India with development of increasing communication and technological access.

In a policy perspective, we put forward that the act like PC-PNDT and recent initiatives such as BBBP and other conditional cash transfers which are mainly targeting the legal surveillance of births, behaviour and attitude changes and state-specific conditional cash transfers which needs to be strictly evaluated for their impact. We especially recommend not to target only below poverty line families or marginalized communities in these programmes because the problem of skewed CSR is in the wealthiest, urban and educated families as well.

We have also doubt, how much the awareness programmes mostly driven by advertisements work as the problem lies with most educated, wealthiest and urban communities who are well aware of the legal consequences of the elimination of the girl child. The state-specific trends suggest that a strict implementation and monitoring of PC-PNDT act is having some impact regarding improving the scenario of the sex ratio in highly focused states like Punjab, Haryana, and Rajasthan where the problem continues to be severe. The problem of sex ratio imbalance roots in patriarchy and overvaluing the sons over daughters. One-side we are promoting girl child education through the programme like BBBP, but on the other side, we are reducing spending on public education and health programmes (Ministry of Finance, 2018). The catastrophic expenditures in education, health and marriages are key factors which are more affecting the girls than boys and undermine the value of daughters in the society. By providing good education, better health care and employment opportunities which will improve the value of daughters and parents trust on daughters for old age security. The continuous religious divide in the sex ratio imbalance shows that interventions in religious culture and norms are must for improving the value of daughters in the society. There is must be a change in the norm of "raising daughters is like a watering neighbour's garden". As long as patrilineal and patrilocal societies continue, the parent's insecurity of lineage and old age social security continues which will keep on undermining the value of daughters. Unless, we raise the value of daughter in the Indian society and its culture, the problem can't be eliminated through legal measures or advertisements.

## References:

- Agnihotri, S B (2000). *Sex Ratio Patterns in the Indian Population: A Fresh Exploration* (New Delhi: Sage).
- Agnihotri, S. (1996). Juvenile sex ratios in India: a disaggregated analysis. *Economic and Political Weekly*, 3369-3382.
- Agnihotri, S. B. (2003). Survival of the Girl Child: Tunnelling Out of the Chakravyuha. *Economic and Political Weekly*, 4351-4360.2
- Arnold, F., Kishor, S., & Roy, T. K. (2002). Sex-selective abortions in India. *Population and development review*, 28(4), 759-785.
- Arokiasamy, P (2004). Regional Patterns of Sex Bias and Excess Female Child Mortality in India. *Population*, Vol 59, No 6, pp 833-63.
- Arokiasamy, P and S Goli (2012). Provisional Results of the 2011 Census of India: Slowdown in Growth, Ascent in Literacy, But More Missing Girls. *International Journal of Social Economics*, Vol 39, No 10.
- Available on <file:///C:/Users/hp/Downloads/India%20Sex%20Selective%20Abortion%20FINAL.pdf>

- Bhat, P. M. (2002). On the Trail of Missing Indian Females: II: Illusion and Reality. *Economic and political weekly*, 5244-5263.
- Bhat, P. M., & Zavier, A. F. (2007). Factors influencing the use of prenatal diagnostic techniques and the sex ratio at birth in India. *Economic and Political Weekly*, 2292-2303.
- Bongaarts, J., & Guilмото, C. Z. (2015). How Many More Missing Women? Excess Female Mortality and Prenatal Sex Selection, 1970–2050. *Population and Development Review*, 41(2), 241-269.
- Cai, Y., & Lavelly, W. (2007). CSRs and their Regional Variation. In *Transition and challenge: China's population at the beginning of the 21st century*. Oxford University Press.
- Campbell, R. B. (2001). John Graunt, John Arbuthnot, and the Human Sex Ratio. *Human Biology*, 605-610.
- Chahnazarian, A. (1990). Historical Trends in the Sex Ratio at Birth. *John Hopkins Population Center*
- Das Gupta, M (1987): Selective Discrimination against Female Child in Rural Punjab. *Population and Development Review*, Vol 13, No 1, pp 77-100.
- Dyson, T and M Moore (1983): On Kinship Structure, Female Autonomy, Demographic Behavior. *Population and Development Review*, Vol 9, pp 35-60.
- Economic SRUVEY OF India 2018, Government of India, available at <http://mofapp.nic.in:8080/economicsurvey/>
- George, S. M. (2006). Millions of Missing Girls: From Fetal Sexing to High Technology Sex Selection in India. *Prenatal diagnosis*, 26(7), 604-609.
- Graunt, J. 1662. *Natural and Political Observation made upon the Bills of Mortality*. In Earliest Classics, Gregg International Publishers Limited, 1973
- Guilмото, C. Z., & Depledge, R. (2008). Economic, Social and Spatial Dimensions of India's Excess Child Masculinity. *Population*, 63(1), 91-117.
- Gupta, M. D., Chung, W., & Shuzhuo, L. (2009). Evidence for an Incipient Decline in Numbers of Missing Girls in China and India. *Population and Development Review*, 35(2), 401-416.
- India, Registrar General, 1963. *Census of India 1961, Part II-C (i) Social and Cultural Tables (C VI, pp 412-477)* Delhi: Controller of Publications.
- India, Registrar General, 1976. *Census of India 1971, Series 1 India, Part II-C(ii) Social and Cultural Tables (C IV, pp 135-196)*. New Delhi: Controller of Publications.
- India, Registrar General, 1987. *Census of India 1981, Series 1 India, Part IV A- Social and Cultural Tables (Tables C5, pp 530-686)*. New Delhi: Controller of Publications.
- India, Registrar General, 2015. *Sample Registration System Statistical Report 2015*. Delhi: Controller of Publications.
- International Institute for Population Sciences and Macro International (1994, 1999, 2007 And 2017): *National Family Health Survey (NFHS-1 NFHS-2 NFHS-3 and NFHS-4) 2005-06 India* (Mumbai: International Institute for Population Sciences).
- Jha, P., Kesler, M. A., Kumar, R., Ram, F., Ram, U., Aleksandrowicz, L., & Banthia, J. K. (2011). Trends in Selective Abortions of Girls in India: Analysis of Nationally Representative Birth Histories from 1990 to 2005 and Census Data from 1991 to 2011. *The Lancet*, 377(9781), 1921-1928.

John, M. E., Kaur, R., Palriwala, R., Raju, S., & Sagar, A. (2008). Planning Families, Planning Gender: The Adverse CSR in Selected Districts of Madhya Pradesh, Rajasthan, Himachal Pradesh, Haryana and Punjab. *ActionAid*, New Delhi, IN.

Keyfitz, N. (1977). Introduction to the mathematics of population: with revisions. *Addison-Wesley Series in Behavioural Science: Quantitative Methods*.

Keyfitz, N., & Caswell, H. (2005). *Applied mathematical demography* (Vol. 47). New York: Springer.

Kishor, S (1993). May God Give Sons to All: Gender Differences in Child Mortality in India? *American Sociological Review*, Vol 58, pp 247 -65.

Kulkarni, P. M. (2007). Estimation of missing girls at birth and juvenile ages in India. *Paper commissioned by the United Nations Population Fund, UNFP*.

Kumar, S., & Sathyanarayana, K. M. (2012). District-level Estimates of Fertility and Implied SRB in India. *Economic and Political Weekly*, 66-72.

Kundu, A., & Sahu, M. K. (1991). Variation in Sex Ratio: Development Implications. *Economic and Political Weekly*, 2341-2342.

Malhotra, S., & Kant, S. (2006). Adverse Female-to-male Sex Ratio at Birth in India: A Cause for Concern. *The National Medical Journal of India*, 19(3), 152.

Mealey, L., & Mackey, W. (1990). Variation in Offspring Sex Ratio in Women of Differing Social Status. *Evolution and Human Behaviour*, 11(2), 83-95.

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

Myers, C. (2012). Sex Selective Abortion in India. *Global Tides*, 6(1), 3.

Nair, P. M. (1996). Imbalance of Sex Ratio of Children in India. *Demography India*, 25(2), 177-87.

Planning commission of India, 2015  
([http://planningcommission.nic.in/data/datatable/data\\_2312/DatabookDec2014%202015.pdf](http://planningcommission.nic.in/data/datatable/data_2312/DatabookDec2014%202015.pdf))

Premi, M K. (2001). The Missing Girl Child. *Economic and Political Weekly*, 36: 1875-80.

Radkar, A. (2018). Is Son Preference Weakening?. *Economic & Political Weekly*, 53(12), 101.

Rajan S. Irudaya, Mishra, U.S., and Navaneetham K. (1991). Decline in Sex Ratio: An Alternative Explanation Revisited. *Economic and Political Weekly*, 26: 2963-64.

Raju, Saraswati and Premi M.K. (1992). Decline in Sex Ratio: Alternative Explanation Re-examined. *Economic and Political Weekly*, 27: 911-12

Ramachandran, K. V., & Deshpande, V. A. (1964). The Sex Ratio at Birth in India by Regions. *The Milbank Memorial Fund Quarterly*, 42(2), 84-94.

Retherford, R. D., & Choe, M. K. (2011). *Statistical Models for Causal Analysis*. John Wiley & Sons.

Sahni, M., Verma, N., Narula, D., Varghese, R. M., Sreenivas, V., & Puliyeel, J. M. (2008). Missing Girls in India: Infanticide, Feticide and Made-to-Order Pregnancies? Insights from Hospital-Based Sex-Ratio-at-Birth Over the Last Century. *PloS one*, 3(5), e2224.

Sen, A. (1990). More Than 100 Million Women Are Missing. *New York Review of Books*, Vol 37, No 20, pp 61-66.

Sen, A. (2003). Missing Women Revisited: Reduction in Female Mortality has been Counter Balanced by Sex Selective Abortions. *BMJ: British Medical Journal*, 327(7427), 1297.

Stallard, R. (2016). Sex-Selective Abortion in India. Child Reach International, United Kingdom.

Union Budget of India, Ministry of Finance available on <https://www.finmin.nic.in/#>

Visaria, L. (2005). Female Deficit in India: Role of Prevention of Sex Selective Abortion Act. In *CEPED-CICREDINED Seminar on Female Deficit in Asia: Trends and Perspectives, Singapore* (pp. 5-7).



## Appendix

**Appendix Table 1:** Sex Ratio of overall population in India, 1901-2011

States/UTs	Female per 1000 males											
	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	2011
India	972	963	955	950	945	947	941	930	934	927	933	940
A&N Island	318	352	303	495	574	625	617	644	760	818	846	878
Andhra Pradesh	985	992	993	987	980	986	981	977	975	972	978	992
Arunachal Pradesh	NA	NA	NA	NA	NA	NA	894	861	862	859	901	920
Assam	919	915	896	874	875	868	869	896	910	923	932	954
Bihar	1061	1051	1020	995	1002	1000	1005	957	948	907	921	916
Chandigarh	771	720	743	751	763	781	652	749	769	790	773	818
Chhattisgarh	1046	1039	1041	1043	1032	1024	1008	998	996	985	990	991
Dadra & Nagar Haveli	960	967	940	911	925	946	963	1007	974	952	811	775
Daman & Diu	995	1040	1143	1088	1080	1125	1169	1099	1062	969	709	618
Delhi	862	793	733	722	715	768	785	801	808	827	821	866
Goa	1091	1108	1120	1088	1084	1128	1066	981	975	967	960	968
Gujarat	954	946	944	945	941	952	940	934	942	934	921	918
Haryana	867	835	844	844	869	871	868	867	870	865	861	877
Himachal Pradesh	884	889	890	897	890	912	938	958	973	976	970	974
Jammu & Kashmir	882	876	870	865	869	873	878	878	892	896	900	883
Jharkhand	1032	1021	1002	989	978	961	960	945	940	922	941	947
Karnataka	983	981	969	965	960	966	959	957	963	960	964	968
Kerala	1004	1008	1011	1022	1027	1028	1022	1016	1032	1036	1058	1084
Lakshadweep	1063	987	1027	994	1018	1043	1020	978	975	943	947	946
Madhya Pradesh	972	967	949	947	946	945	932	920	921	912	920	930
Maharashtra	978	966	950	947	949	941	936	930	937	934	922	925
Manipur	1037	1029	1041	1065	1055	1036	1015	980	971	958	978	987
Meghalaya	1036	1013	1000	971	966	949	937	942	954	955	975	986
Mizoram	1113	1120	1109	1102	1069	1041	1009	946	919	921	938	975
Nagaland	973	993	992	997	1021	999	933	871	863	886	909	931
Orissa (Odisha)	1037	1056	1086	1067	1053	1022	1001	988	981	971	972	978
Pondicherry	NA	1058	1053	NA	NA	1030	1013	989	985	979	1001	1038
Punjab	832	780	799	815	836	844	854	865	879	882	874	893
Rajasthan	905	908	896	907	906	921	908	911	919	910	922	926
Sikkim	916	951	970	967	920	907	904	863	835	878	875	889
Tamil Nadu	1044	1042	1029	1027	1012	1007	992	978	977	974	986	995
Tripura	874	885	885	885	886	904	932	943	946	945	950	961
Uttar Pradesh	938	916	908	903	907	908	907	876	882	876	898	908
Uttarakhand	918	907	916	913	907	940	947	940	936	936	964	963
West Bengal	945	925	905	890	852	865	878	891	911	917	934	947

Source: Office of the Registrar General and Census Commissioner, India as cited in Planning Commission

([http://planningcommission.nic.in/data/datatable/data\\_2312/DatabookDec2014%20215.pdf](http://planningcommission.nic.in/data/datatable/data_2312/DatabookDec2014%20215.pdf), accessed on 19.11.2017)

**Appendix Table 2: Sex Ratio of Child Population in India, 1901-2011**

States	Female per 1000 males in 0-6 year age group					
	1961	1971	1981	1991	2001	2011
India	976	964	962	945	927	914
J&K	964	959	963	NA	941	859
Himachal Pradesh	983	980	971	951	896	906
Punjab	894	899	908	875	798	846
Chandigarh	NA	892	906	899	845	867
Uttarakhand	NA	NA	NA	948	908	886
Haryana	910	898	902	879	819	830
Delhi	923	909	926	915	868	866
Rajasthan	951	933	954	916	909	883
Uttar Pradesh	985	974	967	927	916	899
Bihar	988	964	981	953	942	933
Sikkim	1020	1086	977	965	963	944
Arunachal Pradesh	NA	967	996	982	964	960
Nagaland	1007	991	987	993	964	944
Manipur	998	986	986	974	957	934
Mizoram	NA	NA	986	969	964	971
Tripura	1003	977	972	967	966	953
Meghalaya	NA	992	991	986	973	970
Assam	1020	1001	NA	975	965	957
West Bengal	1008	1010	981	967	960	950
Jharkhand	NA	NA	NA	979	965	943
Orissa	1035	1168	995	967	953	934
Chhattisgarh	NA	NA	NA	984	975	964
Madhya Pradesh	982	976	978	941	932	912
Gujarat	955	946	947	928	883	886
Daman & Diu	NA	NA	NA	958	926	909
Dadra & Nagar Haveli	1042	1020	995	1013	979	924
Maharashtra	978	978	956	946	913	883
Andhra Pradesh	1002	990	992	975	961	943
Karnataka	987	978	975	960	946	943
Goa	NA	NA	NA	964	938	920
Lakshadweep	NA	NA	963	941	959	908
Kerala	972	976	970	958	960	959
Tamil Nadu	985	974	967	948	942	946
Pondicherry	989	977	975	963	967	965
Andaman & Nicobar Islands	996	976	977	973	957	966

Source: Calculated by using 0-6 population in single year age group by sex from Socio- economic tables (1961-1981).  
Office of the Registrar General and Census Commissioner, India.

<sup>1</sup> Although, the stopping rule behaviour may not affect sex ratio at birth, but helps in visualizing the extent of son preference in society through SRLB.

<sup>2</sup> Sex preference is measured as the difference in preference of sons minus daughters as reported by the women. The positive values are considered as son preference, while negative is considered as daughter preference, and zero is no preference.