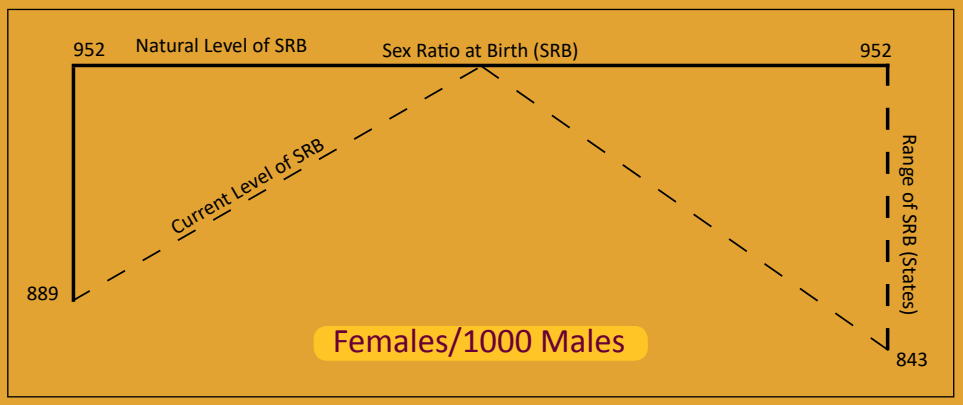
Status of
Sex Ratio at Birth in India



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Status of Sex Ratio at Birth in India

Abstract

This report has attempted to give current status of Sex Ratio at Birth (SRB) in India and all its administrative territories. There are four possible sources of data on SRB – Sample Registration System (SRS), Civil Registration System (CRS), Census and Demographic Surveys. Different studies have used these different sources of data on sex ratio at birth (SRB) and interpreted the results according to the objectives of the study. The conclusions therefore, varied depending on the source of data used for computation of SRB. This has shown different results regarding the levels of and/or trends in SRB. This study attempted to improve over this situation.

The first step in this report, therefore, was to determine the optimum source of data for computation/estimation of sex ratio at birth. After analysis of different types of errors which could affect sex ratios at birth (SRB) derived from these four different sources, it was intuitively and arguably found that Sample Registration System (SRS) is expected to provide the best estimates of sex ratio at birth. But, this source has a problem because the estimated SRB, here, is based on a sample and thus has associated standard error. In order, therefore, to improve the SRB estimate, this report attempted to assess consistency of the estimate derived from SRS against the estimates from other sources of data. It was found that Civil Registration System (CRS) should be preferred as the second source of data to be used (first being SRS data) for getting estimate of SRB as 68% of times, CRS estimate fell in the confidence interval of the estimate of SRB obtained from SRS. Such closeness was much less from other sources of data. Therefore, recommendation has been made to use the average of the estimates from SRS and CRS as the estimate of SRB; this will bring more stability in the estimate of SRB derived from SRS data.

Based on this recommendation, estimates of SRB were computed for India and different states of India for the years 2001, 2005, 2011 and 2017. The last estimate for the year 2017 was used as recent (latest available data) estimate and four-point estimates were used for analysis of trend in the SRB in the last 15 years (2001 to 2017). The results are shown in Table A-3 in Annex.

This report also made a limited attempt to assess factors/determinants which might be affecting the SRB. No relationship, correlation or regression (between SRB as dependent variable and indicators of son preference and level of fertility as independent variables from NFHS-4 data) was found to be statistically significant. Much more work is needed in this area.

As per the results, there has not been any change in the SRB in India in the last 15 years, 2001-2017. It remained about 889 females per 1000 males (or more than 109 male babies per 100 female babies). Coming to analysis at state level SRB, it was found that there were seven states out of 21[1] (other than 7 N-E states and 7 Union Territories) which had natural SRB in 2001. This number reduced to only 3 (Chhattisgarh, Goa and Kerala) in 2017, currently. It means that more and more states started practices of voluntary abortions, foeticide or infanticide (immediately after birth) in this 15-year period to get desired sex composition (preference of son) in their family.

On the other extreme in SRB, there were nine states in 2001 where level of level of SRB was less than 907 females per 1000 males[2] (or more than 109 males per 100 females) in 2001; this number came down to eight in 2017. Two states (Himachal Pradesh, and Madhya Pradesh) came out of the group of these nine states for improved SRB levels but state of Tamil Nadu got added to this category in these 15 years. Rajasthan was the only state which, instead of showing increase in SRB over the 15-year period, showed decline in the sex ratio -- increasing the imbalance in SRB. Another point which is important is that five states with lowest level of SRB is 2001 were, in increasing order, Punjab (781 females per 1000 males), Haryana (809), Gujarat (836), Bihar (837), and Uttar Pradesh (844). They improved their SRB levels in 2017 which became 881, 843, 855, 879 and 878 respectively for Punjab, Haryana, Gujarat, Bihar and Uttar Pradesh. Punjab which had the lowest SRB in 2001 among these five states, achieved maximum increase in SRB level in this period of 15 years. Currently, in 2017 five states with lowest SRB are, in increasing order, Rajasthan, Haryana, Gujarat, Uttarakhand and Tamil Nadu. It may be noted that Bihar, Punjab

1 Telangana is included in Andhra Pradesh.

2 The lower limit of the confidence interval for SRB of 907 females per 1000 males will be SRB of 881.

and Uttar Pradesh have improved their rankings; they have been replaced by Rajasthan, Tamil Nadu and Uttarakhand. The status of SRB in six N-E states and Union Territories is good except one state of Manipur in north-east and two Union Territories of Delhi and Chandigarh. To sum up, all the states are showing some changes towards reduction in the imbalance in SRB except Odisha, Rajasthan, Tamil Nadu, Uttarakhand, and Manipur. These states not only need special studies to find explanation for their unusual trend in SRB over the 15 year period but all the states should be closely monitored to accelerate the pace of reduction in the imbalance in SRB in India and its states/Union Territories.

Foreword

In one of the technical meetings with members of Technical Advisory Committee (TAC) of Indian Association of Parliamentarians on Population and Development (IAPPD), Prof. P. J. Kurien, Chairman of IAPPD raised concern on the skewed sex ratio in the India's population. He felt need for a study of this problem in greater detail so that the Indian Parliament can take actions to address this issue before it assumes a serious proportion. This was the beginning stage of this project. Later on, while discussing the annual program of action of IAPPD, three members of the TAG, with all their other commitments, accepted the challenge to undertake the study. They proposed a project on "Status of Sex Ratio at Birth in India" which affects the sex ratio in the population and started work in the month of July after all clearances at the level of IAPPD.

I wish to congratulate and thank three members of TAG, Prof. P.P. Talwar, Prof. Sudesh Nangia and Dr. Abhay Kumar who undertook the challenge and completed this study in about four months' time. They not only worked on the status of the sex ratio at birth but went on to discuss and address other matters related to the technical and substantive issues related to the problem. This report discusses the optimum source of data on sex ratio at birth, current levels of the sex ratio at birth and trend in the sex ratio in last 15 years for all the states and Union Territories of the country.

The report ends not only with the findings related to sex ratio at birth but goes on to suggest need for continuous monitoring of sex ratio at birth, not at state level but at district level so that this problem receives its appropriate attention and gets resolved before it becomes serious. In that context, findings on sex ratio at birth in this report could serve as the baseline, against which future changes can be assessed and necessary program actions are initiated to address this problem.

Once again, I wish to thank and congratulate Prof. Talwar, Prof. Nangia, Dr. Kumar and their data and analytic support member Ms. Ankita Srivastava who shouldered responsibility of completing this important and difficult

study in a short period of time. I hope that this report will be found useful by the Parliamentarians/elected representatives for advocacy, academicians, researchers and program managers; academicians and researchers will find some technical issues addressed and the other two groups will find some useful recommendations for advocacy/addressing the problem of skewed sex ratio at birth in the country.

Manmohan Sharma
Secretary, IAPPD

Acknowledgement

We wish to thank Prof. P.J. Kurien, Chairman, Indian Association of Parliamentarians on Population and Development (IAPPD) for his insightful comments and need for a study on the important social issue of skewed sex ratio in population of India. This served as point of initial thinking of the project on Sex Ratio at Birth. The second point of encouragement came when the project got approved by the IAPPD budget committee which allocated a small token money to this project. We wish to thank the Budget Committee for the encouragement. We are thankful and feel happy that we were encouraged and supported by IAPPD to look at this serious sex imbalance problem in India and make our little contribution towards this serious social issue.

We got support from Ms. Ankita Srivastava, Research Scholar at Jawaharlal Nehru University, Delhi who helped us in collection, compilation and analysis of data related to this topic with all her other academic commitments. Her compilation and analysis of data is reflected in technical and analytical thinking which comes out in this report. We express thanks to her. We also wish to express our sincere thanks to other TAG members, Drs. Jai Prakash Narain, Deepak Gupta, Dinesh Agarwal and Dr. (Ms.) Suneeta Mukherjee who were nice enough to go through this long report and made some useful and appropriate suggestions; it helped us in improvement of the report.

Mr. Manmohan Sharma, General Secretary, IAPPD was kind enough to share his ideas on the topic with us quite regularly. He spared his time for discussion on this topic with us. We thank him for his continuous support and sharing of ideas. The administrative staff of IAPPD including Mr. Harish Ajwani, Mr. U.S. Bhandari, Ms. Maya Raturi and Ms. Sangeeta Thawani were very helpful as and when we needed their help and support. We wish to express our thanks to them.

We hope that research community will find technical and analytical tools we have deployed for analysis of data for this report useful for them for their future work. In the end we request the program managers to look and consider recommendations we have made to address this social problem. If these suggestions can help alleviate this serious problem in some way, we will feel our time well-spent and work well-rewarded.

Prof. P.P. Talwar Prof. (Ms.) Sudesh Nangia Dr. Abhay Kumar

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Abbreviations

C.I.	Confidence Interval
CRS	Civil Registration System
IAPPD	Indian Association of Parliamentarians on Population and Development
N-E Region	North-Eastern Region/States
NFHS-3	National Family Health Survey-3
NFHS-4	National Family Health Survey - 4
PC-PNDT	Pre-Conception and Pre-Natal Diagnostic Technique
PNDT	Pre-Natal Diagnostic Technique
SRB	Sex Ratio at Birth
SRS	Sample Registration System
UNFPA	United Nations Population Fund

Chapter I
Introduction

1.1 **Background**

Nature creates its own laws to maintain balance and sustainability. It is so for human sapiens too. In the case of gender balance in human populations, law of nature suggests that slightly more male babies are born –[in the ratio of about 105 (104 -106) male babies for every 100 female babies – a natural/normal/biological sex ratio at birth (SRB)] (UNFPA, 2011)but they have slightly higher mortality because of genetic and biological makeup so that sex ratio in adult/young ages comes to a balance where male and female are about equal, every female in young ages has a male as her peer group. In the later life cycle, female mortality is higher in reproductive ages, particularly so in the developing countries; the case may be different in developed countries where male morality could be higher because of non-communicable diseases like heart attacks and strokes, violence and accidents. In post reproductive ages, these factors tend to increase male mortality and thus in older ages females survive longer and the sex ratio in these ages is more favourable to females. It is how the nature builds its balance in human populations in different stages of life and it becomes the norm for social life and all social interactions between males and females. This law of nature gets disturbed/ vitiated by voluntary interference by human beings; be it in the guise of planning family for its size and composition, or for any other family goals. In the case of planning family size and composition, they use contraceptives, voluntary abortions or foeticide to achieve their desired/planned family goals. In other words, the natural sex ratio at birth (SRB) gets disturbed from its normal or biological level by practices and use of technology for achieving desired family size and preferred family composition goals. Similarly, different practices adopted in other ages of the life cycle may also affect the sex ratio at other ages as well. This deviation from normal sex ratio (at birth or any other ages) has its own consequences in the social living in the society, particularly is young ages, which either has to correct itself to return to natural norms and stability or to re-invent itself and build laws or social customs to adjust to the changed situation. In the case of human life, balance in sex ratio becomes a very crucial variable for good and balanced social life where male and female are complementary and supplementary

to each other. Any disturbance in this balance has or can have serious consequences. The present trend of skewed sex ratio In India (for that matter any country) has therefore created/or should create serious concerns for necessary stability in the society. This report is addressed to this serious problem which some states in India are facing currently.

In India and many Asian countries, desire to have a planned family and a large degree of son preference has been seen to be impacting the biological/natural level of sex ratio at birth to bring about changes in them; the observed sex ratio (females per 100 males)[1]at birth and later on in other ages of the life cycle is different than the accepted norm. That is, fewer female babies are allowed to be born than what has been the "law" of nature, resulting in lower sex ratio at birth (SRB). In many cases, even under-reporting/under-registering of the female births or female population (in other ages) may also be a factor contributing to this lower sex ratio in the population. Since this sort of imbalance in sex ratio has consequences for life in the society, this issue has drawn attention of the governments and people, starting with India and China in 1980s (UNFPA, 2011). In an article, strong socio-economic factors like dowry in India and one child policy in China has been cited as responsible for unfavourable sex ratio for females (Lower sex ratio than natural level of about 952 females per 1000 males) (Amartya Sen, 1990). Initially, this phenomenon was noticed in Asian countries but now it has spread to other regions of the world as well.

India has traditionally, culturally and socially been a strong son preferring country. The need for a son to continue family line, perform rituals and financial and emotional security in old ages have been cited as reasons for this preference. Sons are looked upon as the primary providers of support in old ages (Kulkarni, 2012). On the other hand, dowry and heavy expenditure on marriages of daughters lead to avoidance/non-preference of daughters. Emerging small family norm, son preference (and to some extent daughter-avoidance) and available technology has led to this skewed sex ratio pattern in India where number of male

1 In India sex ratio is defined as females per 1000 males in contrast to international practice of defining males per 100 females. **We, in this report will use sex ratio as defined in India; that is, females per 1000 males**. So, sex ratio in this report will always imply females per 1000 males unless specifically specified otherwise. In the context of India, sex ratio of 105 male births per 100 female births in international reports will become 952 female births 1000 male births here

births are higher than females; this gap is larger than the law of nature. Several undesirable practices to achieve their preferred and desired sex composition of children have been adopted. Many couples use pre-natal pregnancy tests for determining sex of the foetus; they tend to practice voluntary abortion, foeticide or infanticide if foetus is female; poor care and neglect of the female children after birth leads to higher mortality of girls and thus widens the gap between male-female numbers in young and adult ages where a balance between male and female population is needed to have a balanced peer group.

This skewed sex ratio at birth is seen in India and in many of its states and regions. The sex ratio among births (approximated by the sex ratio of children in the ages 0-6 years) in last four censuses has shown declining trend:

Census Year	1981	1991	2001	2011
Sex Ratio (0-6) population	962	945	927	914

Such imbalances in sex ratio at birth are also evident in data from other sources like Civil Registration System (CRS), Sample Registration System (SRS) and large Demographic Sample Surveys. (Data from these sources will be shared and discussed later in this report). This sex imbalance (different from the natural/biological sex ratio) in societies has shown several negative and undesirable consequences for a happy, complete and peaceful life at family, society and country level. It is, therefore, important that sex balance is maintained in the society by eliminating the preferences for male or female children and practices which are adopted to bring about preferred sex composition of children.

The Government of India has taken note of this problem of imbalance in sex ratio of females and males seriously and has taken several measures and actions to bring about needed corrections in order to arrest its detrimental impact on family and society's life. Among others, some such steps are the following:

- PNDT (Pre-Natal Diagnostic Technique) Act was introduced in 1994 to prevent misuse of ultrasound for determining sex of the foetus and then using the information for deciding whether the pregnancy

is allowed to continue or terminated. This Act was meant against foeticide of female babies which has been prevalent in several societies and regions. This act was further made more stringent and called as Pre-Conception and Pre-Natal Diagnostic Technique Act (PC-PNDT) in 2003, mainly to make sex determination a more stringent punishment.

- Media, members of civil societies and voluntary organizations are used to spread messages of equality of male and female children in the life of parents so that tendency of son preference can be curbed.
- Female children are given all facilities and support so that they can grow to become an asset (and not liability) to the parents and family, and ultimately to the society and the country. They are being given all facilities to improve their education, chances of employment and empowerment. The idea is to nullify or at least reduce son preference so that incidence of female foeticide, female infanticide and poor female upbringing can be minimized.

All these actions are expected to raise, at least, to arrest decline in the sex ratio at birth. Perhaps, some achievements have come about but there is still a large inter-state and intra-state (and even inter-district within a state) variations in SRB. There is even evidence to suggest that this phenomenon is spreading in some states where it is new. (Tamil Nadu and Uttarakhand belong to that category of states).It may also be noted that unlike phenomenon of fertility and mortality changes, modernization or development may not bring desired changes in SRB. In contrast, there is some evidence that it may increase the problem and gender gap may increase with development of the country (UNFPA, 2011). There is, therefore definite need to keep a close watch on the trend on sex ratio at birth and monitor the impact of various efforts on the level of sex ratio at birth and even overall sex ratio in the population so that actions and measures can be fine-tuned and strengthened to bring about the desired result in shorter time period. For this purpose, the first task is to set a baseline level of sex ratio at birth (SRB) against which the progress of different measures can be assessed in future time periods. This report is an attempt to get the current status of sex ratio at birth and thus set the baseline levels of SRB at national and state levels.

1.2 Objectives of the Study

Claims are made that the measures taken by the Government of India and the states have started showing results in improving the sex ratio at birth but different studies have shown different results. If at all, achievements have been limited and slow. Even new states are getting added to the group with imbalances in sex ratio at birth. This phenomenon of declining sex ratio at birth is still in expanding stage and there is need to curb it. It is unfortunate that we are not able to measure changes therein over time since our measurement of changes is confounded and not pure and correct; it is affected by the source of data which any particular study has used. For instance, Civil Registration System (CRS) of India shows sex ratio at birth as 874, 882, 891 and 882 in the years 2001, 2005, 2011 and 2016. When one uses data from Sample Registration System (SRS), the levels of SRB for the same periods are 892, 892, 908 and 898. The estimates of levels of SRB are still different if one uses data from Census or Demographic surveys. In this context, it may be stated that Census and demographic surveys do not (generally) provide data on SRB directly but only indirectly – sex ratio in the age group (0-4)/(0-6). Either this sex ratio could be treated as proxy to the SRB or one has to reverse survive male/female population (0-4)/(0-6) to births to compute SRB. That is the reason that results of the studies on sex ratio at birth cannot be compared and interpreted in the context of trends (Kulkarni, 2012; Rajan, I.S et al 2011, 2017; Kulkarni, 1999;Kulkarni, P. 2012; Kaur Ravinder, et al 2016, Aparna, M, 2017); many times the results of these studies are even inconsistent. In other words, estimates of the levels and trends in SRB depend on the source of data used for the analysis (Sanjay, K. and K.M. Satyanarayana, 2012).It is, therefore, felt that there is need to look at different sources of data on sex ratio at birth (direct, indirect or proxy measures) to decide which source could be optimum for analysis of SRB so that results of different studies are comparable. This study should, therefore, look into different sources of data for measuring SRB to suggest if any optimum source exists and study results of only those studies (which have used the suggested source of data) may be used for comparison of SRB levels over time.

More specifically, the objectives of this study are:

- To study different sources of data on sex ratio at birth to suggest and recommend the optimum source for data for estimating level of sex ratio at birth (SRB),
- To study the current levels of sex ratio at birth for India and its various administrative entities. (It could and should be considered the baseline levels for monitoring the progress of efforts to bring favourable changes in them),
- To study the regional pattern in sex ratio at birth in the country and link them with possible associated factors,
- To study the recent trend in the sex ratio at birth, and
- To make recommendations to accelerate corrections in the imbalances of the sex ratio at birth.

Chapter II
Data and Methods

2.1 Sources of data for SRB

Sex Ratio at Birth (SRB) is computed/estimated from the number of male and female births. Accuracy in SRB therefore, is affected by sex-specific coverage of the birth events and by sex differentials in reporting or registering of male/female births. Sex Ratio at birth can also be derived from sex ratio of population in the age group (0–6)/(0–4) indirectly, by reverse surviving both male and female population in the age group (0 – 6)/ (0 – 4) to births. One will, of course, need life tables for female and male populations so that needed survival ratios can be taken from them.(Kumar, S.&K. M. Sathyanarayana,2012, Jha, P., et al., 2011)The accuracy of SRB from this indirect method will be affected by gender-specific accuracy of reporting of the population in this age group((0–4)/(0–6)) and the accuracy of survival ratios for males/females obtained from life tables. Since this report is mainly studying the SRB, the sources for data on sex specific births will come from two sources - sex specific births or sex-specific population in the ages (0-6)/(0–4) which will be reverse survived to get sex-specific births. In India, two sources which directly report male and female births are Civil Registration System (CRS) and Sample Registration System (SRS), operated by the Office of Registrar General and Census Commissioner of India. Two sources which report populations ages (0-6)/(0-4) are Census and Demographic Sample Surveys which permit computing sex ratios at birth indirectly, by reverse surviving (0 – 6)/(0 -4) population to get male and female births.

Different researchers have used these sources of data to analyze the levels and trends in SRB (Rajan Irudaya et al., 2015; Rajan Irudaya et al., 2017; Kulkarni, P.M., (1999; Kaur Ravinder et. al., 2016; Kumar, S. & Sathyanarayana, K.M., 2012). Obviously, their results, interpretation and conclusions drawn differed because the levels of SRB were estimated from four different sources of data. It is therefore, important that attempt should be made to suggest which of these four sources of data is optimum or best to use while analyzing the results on SRB. This will be helpful in making results comparable from different studies over time, the existing limitation (in comparability) of many of the existing studies on SRB. Since

this report has done a detailed analysis of SRBs, an effort has been made here, to look at all these sources of data and suggest what source is optimum in terms of its closeness to the real level of the SRBs.

2.2 Optimum source of data for analysis of SRB

As discussed earlier, data on sex ratio at birth, in India, is available from four main sources: Census, Civil Registration System, Sample Registration System and Demographic Sample Surveys—former two sources give sex ratio at birth directly and the latter two, indirectly. Each of this source has its strong and weak points. For instance, **Census**, which is decadal in its frequency, does not collect/give data on births but it gives male/female population ages (0- 6) or (0 – 4)years which, either can be used as proxy to male/female births or can be reverse survived to get male and female births and thus SRB. Many researchers have used sex ratio in the age group (0-6)/ (0-4) as proxy variable to measure sex ratio at birth (Kumar, S.& Sathyanarayana, K.M. 2012). Since population in this age group is affected by (i) (age) digit preference (Ramkumar, R. (1986); Shryock, Henry (1971), (ii)shifting in the ages while reporting, (iii) accuracy of reporting (generally done by somebody in the family)and (iv) degree of accuracy of survival ratios for males and females from the life tables, the estimate of sex ratio at birth from this source will be affected by additive effect of all these errors. Therefore, all these limitations of this source of data may be kept in mind while using this source of data for analysis of SRB.

The second source of data on SRB is **Demographic Samples Surveys**. This data has the same problems of inaccuracies as any Census data collected through the field investigators/ enumerators and more. (Its problems have been discussed above while discussing Census as a data source for SRB). In other words, this data source has errors of Census as source of data for estimating SRB **plus** additional component of sampling error because of smaller sample size of households which sample surveys cover.

The third source of data is **Civil Registration System (CRS)** which is a legal document for births and deaths. It therefore, should have all the events registered, particularly in societies where literacy and awareness of its importance is high. It should provide accurate level of sex ratio at birth if reporting is 100 per cent correct. (It may have problem of getting number of “births of usual residents population”). But in India, the situation is not

conducive for its accuracy; people still do not report births and deaths, particularly in illiterate and rural populations. Therefore, the coverage of vital events in this source of data is not complete. Though it has shown improvement over time, it still has 86% reporting for the country, as a whole, in 2016 and that too with male/female differentials in reporting (Office of Registrar General of India, Vital Statistics Based on Civil Registration System, 2016). Out of the total registered births, the share of male and female births are 50.2% and 44.0% (remaining reports on these events have no gender reporting). It may also be stated that the level of reporting greatly varies from state to state. In this way, SRB obtained from this source, in India, will be affected by its coverage as well as by the differential reporting of male and female births.

The fourth source of data for SRB is Sample Registration System (SRS) operated by the Office of the Registrar General of India. It is based on reporting from a sample of areal units probabilistically/statistically selected from each state. Male and female births for computation/ estimation of SRB in this source are obtained in a very robust fashion. Following five steps are followed to obtain them (Office of the Registrar General of India, Sample Registration System Report, 2016). (i) Baseline survey of the sample areal units is carried out to obtain demographic details of the usual resident population of the sample areas, (ii) All the vital events of the resident population are continuously enumerated by an enumerator, (iii) Independent retrospective half-yearly survey is conducted for recording births and deaths which occurred during the half year under reference, (iv) Events obtained from these two sources (continuous enumeration and half-yearly survey) are matched, and (v) Field verification is done of the unmatched and partially matched events. Obviously, this approach should be able to net all the births in the sample area. Only problem with this data source is that births are obtained from a sample of households and thus have sampling error, quantum of the error is based on the sample size of households of the usual resident population in the areal units covered in a state.

A critical and analytic look at these four sources of data for SRB (discussed in the above paragraphs) will suggest that the data source of Sample Registration System can/will provide most reliable data on male and female births, and thus on SRB because of the method of dual reporting and verification of unmatched births by field visits (Chandrasekaran

C. and Deming, W.E, 1949). Birth events are double-checked for their accuracy. But only limitation it has is its small sample size since the Office of Registrar General of India decided the sample coverage in SRS to get reliable estimate of Infant Mortality Rate at Natural Division level for the major states (population of 10 million and over) with reliability of 15 percentage relative standard error (Office of the Registrar General of India, 2016). Therefore estimate of male and female births in this source will have standard error (Statistical). In other words, estimate of SRB from this source will be most reliable but this estimate will have an element of sampling error attached to the estimate of SRB. One can, of course, use the confidence interval of the estimate of SRB developed from this data source to assure that true value of SRB lies within the computed confidence range with a pre-decided confidence level.

2.3 Consistency assessment of the four sources of data on SRB

Though our earlier discussion on the basis of intuition, arguments and reasoning on data quality of four sources of data on SRB suggested that Sample Registration System is the optimum source of data for computation of SRB, still it was felt necessary to further analyze consistency of results from this source against other sources of data, sometimes utilized by different research workers. This section has made an attempt to see how consistent the estimates of SRB from data source SRS are with other three sources of data. This exercise was done for all data sources for four years 2001, 2005, 2011 and 2015 because data on male and female population ages (0 -6)/ (0-4) was available from two censuses 2001 and 2011 and similar data was available from NFHS-3 and NFHS-4 for 2005 and 2015. These populations could be reverse survived to get SRB as life tables for the corresponding years were also available. Data for SRB for all these periods was available from CRS and SRS. For the consistency assessment of the other sources of data for computation of SRB, the following method was adopted:

- 95% confidence interval for SRB from pooled SRS data for three consecutive years was computed. (Pooling data on births for three years increased the sample size and thus reduced the standard errors in the estimates)
- SRBs were computed from other three possible sources of data (CRS for all the four periods, Census for the years 2001 and 2011, and

NFHS-3 for 2005 and NFHS-4 for 2015). In the case of CRS, moving average for three consecutive years was taken to remove effect of annual fluctuations.

- SRB levels from other three sources were plotted in and around the confidence range computed for SRB from the SRS data to see how many of them fall within the confidence range.
- It was found that 68% of the estimates obtained from CRS fell within the confidence range developed for SRB from the SRS data. It means that 68% of the CRS estimates matched with those of the SRS
- Such percentages for Census and NFHS estimates of SRB which fell in the confidence range were 54 and 39 respectively.[These percentages are obtained from the computations shown in Table A-1 (for India) and Table A-2 (for the states of India) in the Annex.]

This analysis of consistency in estimates suggests that one should use SRS data for estimating SRB as the first Choice; second, third and fourth choices of data sources should be CRS, Census and Demographic Surveys.

Since SRS estimates of SRB are prone to standard errors, there is need to have a pole to tie down the value of SRB estimated from the SRS data. The CRS estimates of SRBs are the closest to SRS estimate (68% CRS estimates fall within the confidence range of SRB computed from the SRS data), we suggest to take an average of these two estimates as the value of SRB unless CRS estimate looks to be an "outlier" in statistical sense (very far from the estimate of SRB from the SRS data). In other words, **IAPPD's recommendation** for computation of best estimate of SRB will be:

"**If data on SRB exist from all the four data sources, then the value/ estimate of SRB should be the mean value of the estimates of SRS and CRS[2] unless CRS estimate is an "outlier". The next option (in the absence of SRS data on sex ratio at birth) should be to use estimate from CRS data, followed by options of Census and Demographic Surveys".**

2 We are suggesting average of the estimates from SRS and CRS as SRS estimate has a standard error, because of the smallness of the sample of birth events on which it is computed.

2.4 Computations for SRBs for this report

The scope of this report is (i) to estimate current levels of SRB for India and all its states and Union Territories and (ii) assessment of its trends. For this purpose, SRBs were estimated for four time periods, 2001, 2005, 2011 and 2017 (SRB in the year 2017 is the current level because data from SRS and even CRS has a time lag of about 2 - 3 years and thus these are the **latest years** for which data are available from these two sources). It may be noted that first three time periods for trends analysis of SRB are the same as taken for the section on "consistency assessment of SRB from four sources of data" , but the fourth time period was the year for which most recent data on SRB was available from SRS and CRS (which is released very recently). Since data on SRB was available from both (SRS and CRS) data sources, this report used the IAPPD method of computation of SRB recommended above for all the time periods. The following points may be noted in regard to the availability and use of data for estimation of SRB for four time periods:

- Sex ratio at birth from SRS has been computed by combining births in three consecutive years to increase the sample size (and reduce the standard error). For example, data for 2017 was for 2015, 2016 and 2017. Similar is the case for other three time periods, 2001, 2005 and 2011.
- SRS gives SRB for only 21 large states, India and Delhi. It means that the data on SRB from SRS is available for only 22 Indian territories. (There are 36 administrative territories in India).
- While calculating SRBs for all the time periods (2001, 2005, 2011 and 2017), IAPPD method of computation recommended in the earlier section was used. In other words, SRB for 22 Indian Territories was computed by taking average of SRBs estimated from SRS and CRS. For other Territories, CRS data was used.
- The estimates of SRBs are given in Table A-3 in Annex.

Chapter III
Status of Sex Ratio at Birth

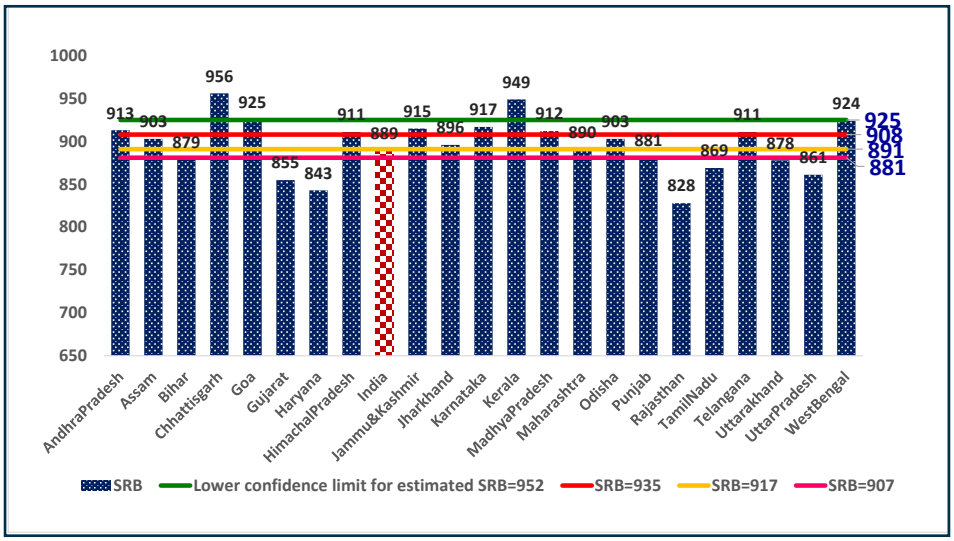
3.1 Current levels of sex ratio at birth

The data and method used for computation of SRB for four time periods has been discussed in the previous chapter and the results are shown in Annex Table A-3. The last column of the table shows the current (2017) level of SRB for India and all its states and Union Territories, divided in three separate groups –22 states (Group 1), 7 North-Eastern States (Group 2) and 7 Union Territories (Group 3).

The current level of SRBs (2017) (last column of the Table A-3)has been shown in three charts 1, 2 and 3. Since these estimates are based on a sample of births in SRS, they will have a standard error associated with them. Therefore, these charts also show four (in the case of chart I for 22 states) or three horizontal lines (for other two groups of states/Union Territories) drawn at the lower limit of 95% confidence interval if the level of natural/biological sex ratio at birth (SRB) was 952 females per 1000 males (equivalent of 105 males per 100 females), 935 (equivalent of 107 males per 100 females) , 917 (equivalent to 109 males per 100 females) and 907 females per 1000 males (equivalent of 110 males per 100 females). Only lower limits of the confidence intervals were drawn to suggest the lowest possible value of SRB (based on a sample of births used to compute SRB from SRS data)if the natural/biological SRB was at the level of 952,935, 917 or 907. The idea is that if a particular state has estimated SRB of up to 925 (lower limit of SRB if actual value is 952) , then we interpret that the state has natural SRB of 952 females per 1000 males (or 105 males per 100 females). Similarly, if any state has SRB of between 925 and 908, then we interpret that the state has natural sex ratio at birth between 935 and 952 females per 1000 males (or between 105 to 107 males per 100 females). In the extreme situation, if the state has SRB of less than 881, it will be interpreted that its SRB is less than 907 females per 1000 males (or SRB of more than 109 males per 100 females).

*Four natural/biological levels of SRB of 952, 935, 917 and 907 females per 1000 males are equivalent to SRB of 105,107,109 and 110 when SRB is measured as males per 100 females.

Chart 1
Levels of sex ratio at birth (SRB) in 2015-17 for 22 states and India, and the lower limits of the confidence interval if natural/biological SRB were to be 952,935,917,907*



The following are the important findings on the current (2015-17) levels of Sex Ratios at Birth for different states and India as a whole (Chart 1).

- The sex ratio at birth for India, currently (in 2015-2017), is 889 which falls in the natural/biological SRB of 907 females per 1000 males (This is equivalent to natural sex ratio at birth of **more than 109** males per 100 females). In other words, current **sex ratio at birth** in India is more than 109 males per 100 females which is much higher than the natural SRB of 105 males per 100 females[3].
- Only three states, Chhattisgarh, Goa, and Kerala have natural SRB of 952 females per 1000 males currently, 2015 – 2017(which is equivalent to 105 males per 100 females)
- Other seven states, Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Telangana and West Bengal

3 It may be noted that sex ratio at birth of 889 in India is based on a sample of households used by Sample Registration System and thus while interpreting this figure one has to take into consideration the standard error of the estimated level of SRB. Therefore, lower limit of the confidence interval is being used to make statement on the current level of sex ratio at birth in India.

have SRB of 935 females per 1000 males currently (Equivalent to 106-107 males per 100 females)

- Three states, Assam, Jharkhand, and Odisha have SRB of 917 females per 1000 currently (or 108-109 males per 100 females).
- Remaining nine states, Bihar, Gujarat, Haryana, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and Uttarakhand have sex ratio at birth of less than 907 females per 1000 males currently(equivalent to more than 109 males per 100 females).As stated earlier, India, as a country, belongs to this category of SRB.

Chart 2 shows current levels of SRB (2015-2017) for India and seven North-Eastern states.

The status of SRB is much better in North-Eastern states where five (out of seven) states currently have SRB of 952 females per 1000 males (or 105 males per 100 females). The state of Nagaland currently has SRB of 935 (or sex ratio of 107 males per 100 females). Only Manipur has current sex ratio at birth of less than 917 (or more than 109 males per 100 females). A further investigation is needed to understand why this state has very low SRB.

Chart 2
Levels of sex ratio at birth (SRB) in 2015-17 for 7 north-eastern states and India, and the lower limits of the confidence interval if the natural/ biological SRB were to be 952, 935, or 917

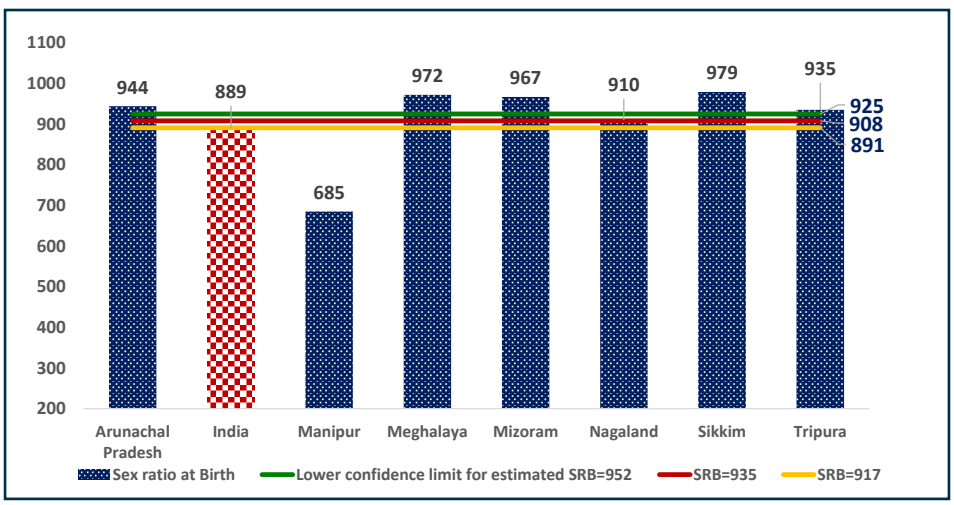
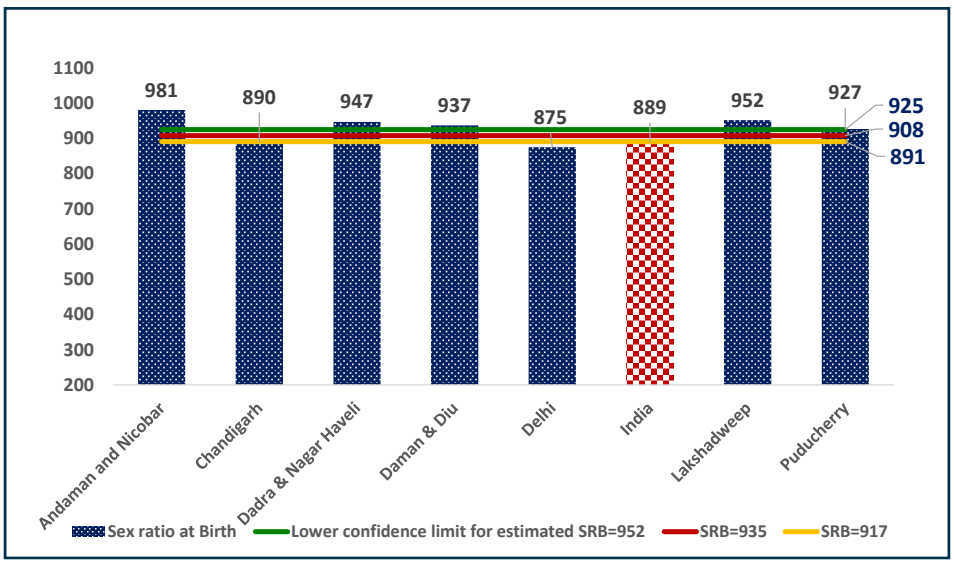


Chart 3
Levels of sex ratio at birth (SRB) in 2014-16 for Union Territories of India, and the lower limits of the confidence interval if the natural/ biological SRB were to be 952, 935, or 917 shows the current levels of SRB for seven Union Territories



The status of SRB is good (at natural level) in Union Territories exception Delhi and Chandigarh. It should be obvious as people who live in these two Territories are very similar to those living in Punjab (SRB of 881) and Haryana (SRB of 843) where SRB is quite low.

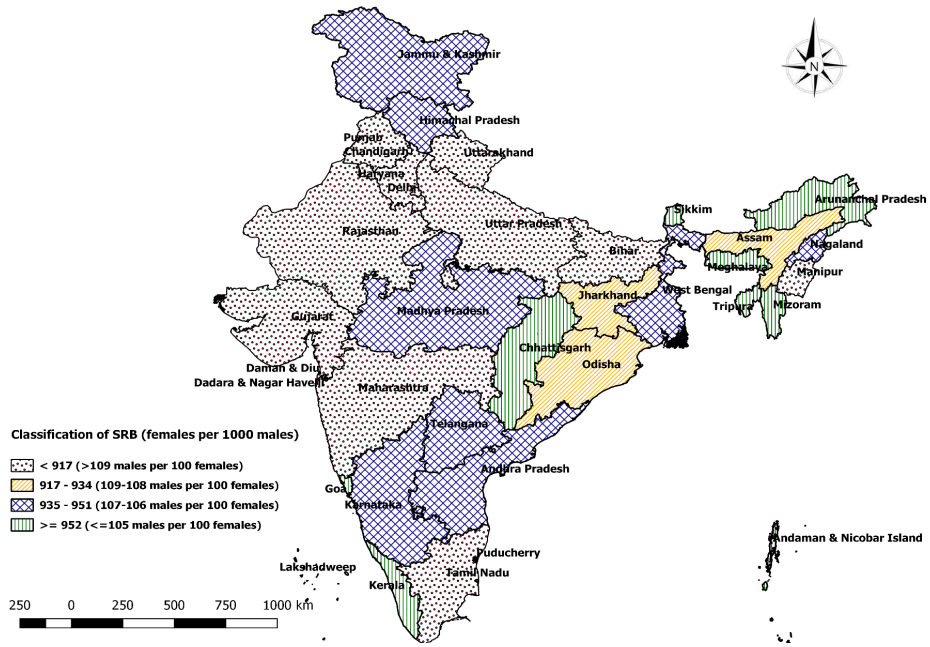
In other words, in India, three states from the first group, five North-Eastern states and five Union Territories have sex ratio at birth at natural/ biological level of 952 female per 1000 males (or, 105 males per 100 females). Other seven states of group I and one state from N-E region have SRB of 935 females per 1000 males (or 107 males per 100 females). So, it seems that there is no problem in regard to SRB for 21 of the 36 Administrative Territories in India. The real concern is for nine states in group I, one state in N-E region and two Union Territories (12 territories out of 36) where sex ratio at birth was less than 907 females per 1000 males (or more than 109 males per 100 females). These states are Bihar, Gujarat, Haryana, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttarakhand, Manipur, Delhi and Chandigarh. **India, as a whole also falls in this category.**

To sum up, the current (2015-2017) status by the level of SRB in the in India and its states and Union Territories is shown below:

Level of SRB	Name of the State and Union Territory	No.
>= 952 (or 105 males per 1000 females (Up to lower limit of SRB of 925)	Chhattisgarh, Goa, Kerala, Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, Tripura, Andaman & Nicobar, Dadra & Nagar Haveli, Daman & Diu, Lakshadweep and Puducherry	13
935-951 (or 107 -105 males per 100 females) (Up to lower limit of SRB of 908)	Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Telangana, West Bengal & Nagaland	8
917-934 (or 109-107 males per 1000 females) (Up to lower limit of SRB of 891)	Assam, Jharkhand and Odisha	3
<917 (or .>109 males per 100 females) (Up to lower limit of SRB of below 891)	Bihar, Gujarat, Haryana, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, Manipur, Chandigarh and Delhi (**India also belongs to this category)**	12
The actual values of the levels of SRB can be seen in Table A-3 in Annex.		

This classification of the states and Union Territories by their current status of SRB is shown in Indian map below (Map 1).

Map 1
Classification of states and Union Territories by their current level (2015-2017) of sex ratio at birth



3.2 Trend analysis of SRB from 2001 to 2017

As stated earlier, about 15 years period from 2001 to 2017 was selected with interval of about five years for the trend analysis of the SRB in India and the states. These four points were 2001, 2005, 2011 and 2017. Last point was indicator of the current period as it covers the period for which the latest data on births and thus on sex ratio at birth was available. (There is always a time lag of two to three years for availability of data on vital events from CRS and SRS). Table A-3 shows values of SRB at four time periods, computed on the basis of optimum choice of data source as recommended by IAPPD, in this report. This definition is repeated below:

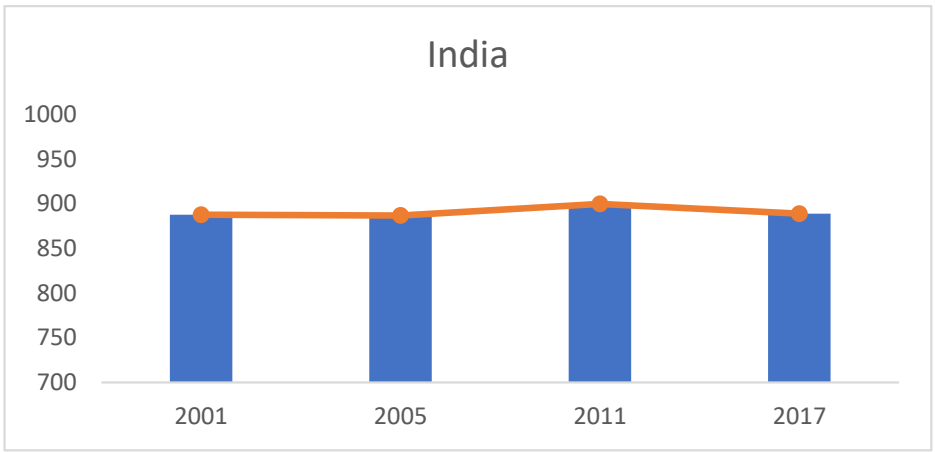
"If data on SRB exist from all the four data sources, then the value/ estimate of SRB should be the mean value of the estimates of SRS and CRS unless CRS estimate is an "outlier". The next option (in the absence

of SRS data on sex ratio at birth) should be to use estimate from CRS, followed by options of Census and Demographic Surveys".

The estimates of the SRBs at these four points are subject to the sampling errors because they are based on a sample of births in the states and the country. Therefore, the values of SRBs will be composed of the actual values of SRBs and the standard errors of the estimates. Such combination will show ups-and-downs in the values of SRB (around the actual value) at these four points. Keeping this nature of the values of the SRBs in view, one can think of two approaches to analyze the trend in the SRBs over these four points. The first is to fit a best-fitting line to the SRB values at these four points. This trend line will suggest whether the trend in SRB over these four time periods is towards "increase", "decrease" or it is "unchanged". This approach may have limitation because only four points are available for fitting a line; this will increase the role of subjectivity which goes into drawing a line or fitting a straight line. The second approach could be to compute 95% confidence band around the estimate of SRB in 2001. If the SRB levels at the next three points, 2005, 2011 and 2017 lie within the confidence band put around the level of 2001, then one can say with 95% confidence that there is no change in SRB over next three time periods. If, on the other hand, the levels for these three years (2005, 2011 and 2017), generally lie outside the confidence band, then there is a change in the levels of SRB over four time periods or there is changing trend in the SRBs. If the change is towards the lower band, then it suggests declining trend and if the change is found towards the higher end of the band, then the trend is towards increase in the SRBs. The advantage of this approach is that inference drawn by this approach has certain defined degree of confidence, 95% in this case. We propose to use this approach to assess the trend in SRB. It may, however, be added that the conclusion drawn by this approach will have higher probability of inferring "change" because the estimates of SRB on the points (2005, 2011 and 2017) also have standard errors which this approach is not considering.

The approach adopted in this report lists "increasing", "decreasing" or "unchanged" trend in the SRBs for India and the states/Union Territories in Table A-3 and Map 2. We, however show the trend in SRBs by joining the four points representing the SRB levels at four points in Chart 4 (for India) and Chart 5 (for other states/Union Territories).

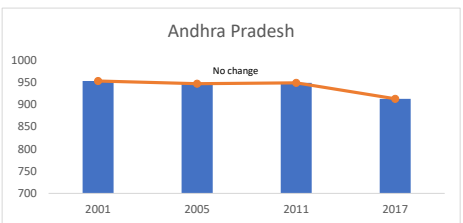
Chart 4
Trends in Sex Ratio at Birth in India during the period 2001 to 2017

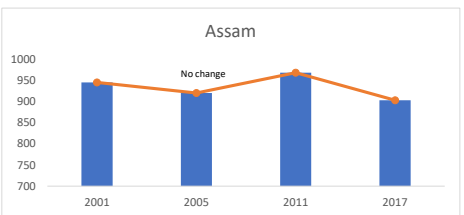


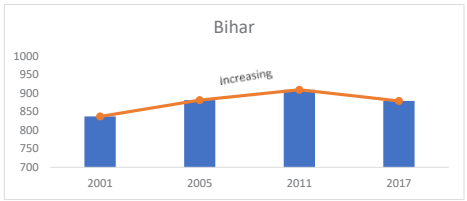
*As stated earlier, If the SRB levels at the last three points, 2005, 2011 and 2017 lie within the confidence band put around the level of 2001, then one can say with 95% confidence that there is no change in SRB over next three time periods. If, on the other hand, the levels for these three years (2005, 2011 and 2017), generally lie outside the confidence band, then there is a change in the levels of SRB.

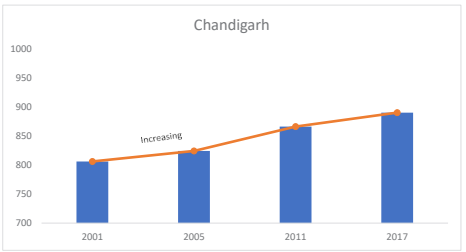
It may be seen that India, as a country, has shown "No change" in Sex Ratio at Birth (females per 1000 males) in the last 15 years. The actual values (in numbers) of SRBs for these four points may be seen in Table A-3.

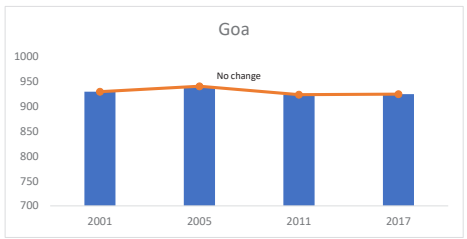
Chart 5
Trends* in sex ratio at birth in 21 states of group 1, 7 states in group 2 and 7 Union Territories in group 3

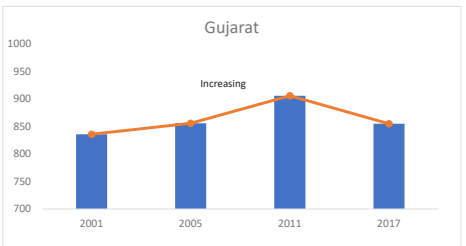


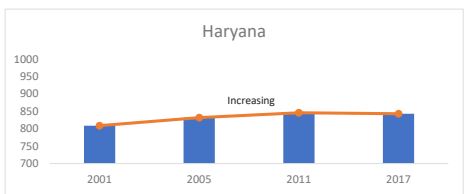


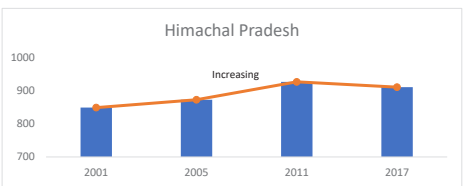

Bihar
1000
950
900
850
800
750
700
Increasing
2001
2005
2011
2017

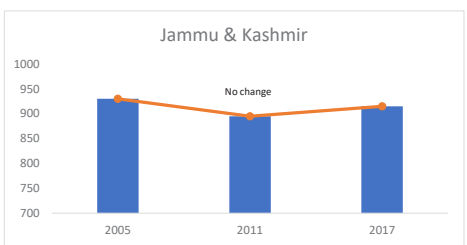

Chandigarh
1000
950
900
850
800
750
700
Increasing
2001
2005
2011
2017

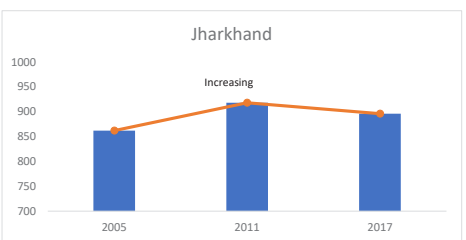

Goa
1000
950
900
850
800
750
700
No change
2001
2005
2011
2017

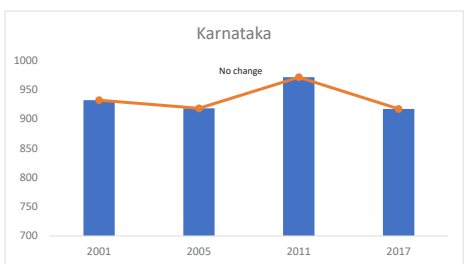

Gujarat
1000
950
900
850
800
750
700
Increasing
2001
2005
2011
2017

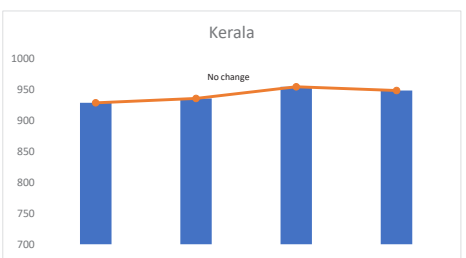

Haryana
1000
950
900
850
800
750
700
Increasing
2001
2005
2011
2017


Himachal Pradesh
1000
900
800
700
Increasing
2001
2005
2011
2017

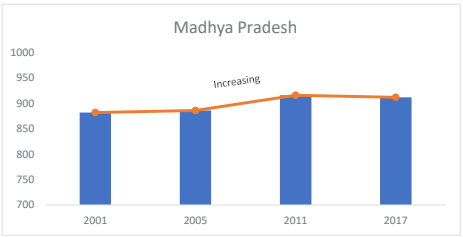

Jammu & Kashmir
1000
950
900
850
800
750
700
No change
2005
2011
2017

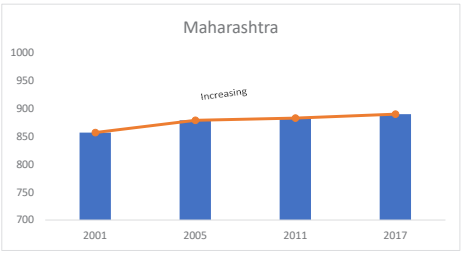

Jharkhand
1000
950
900
850
800
750
700
Increasing
2005
2011
2017

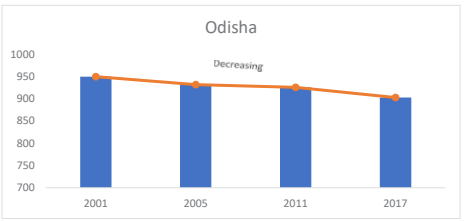

Karnataka
1000
950
900
850
800
750
700
No change
2001
2005
2011
2017

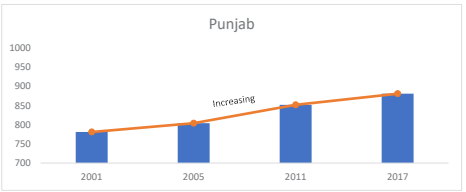

Kerala
1000
950
900
850
800
750
700
No change

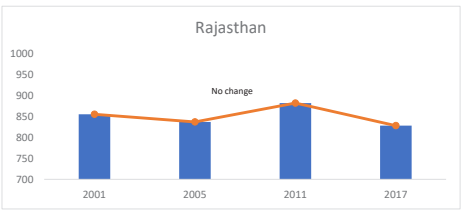
Status of Sex Ratio in India 2020

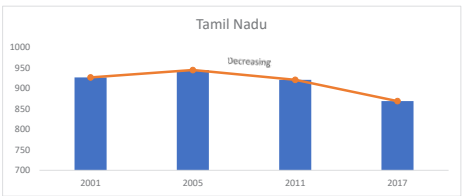


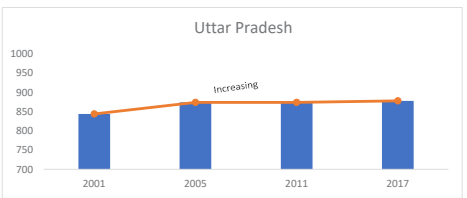


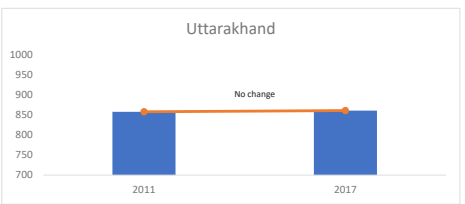


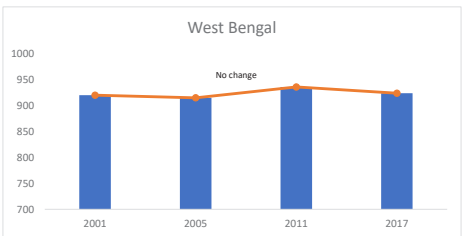




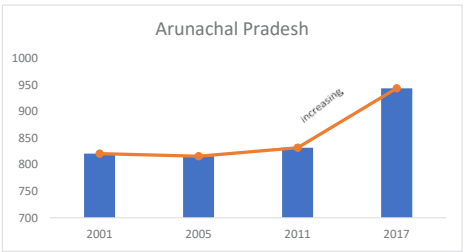


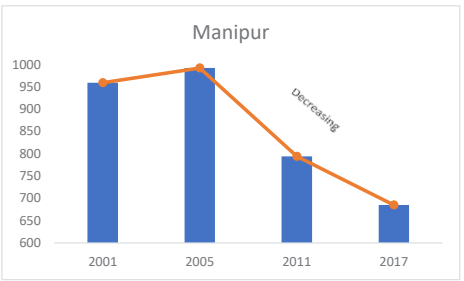


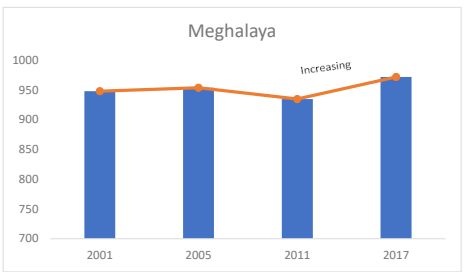


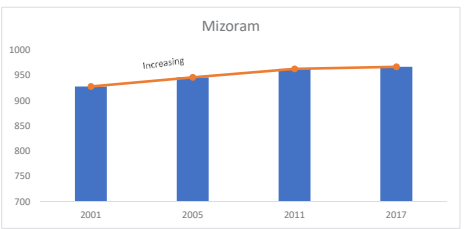


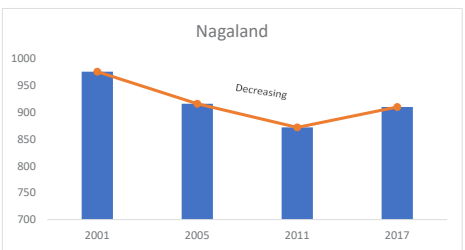
North Eastern States

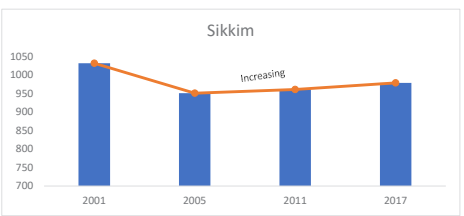


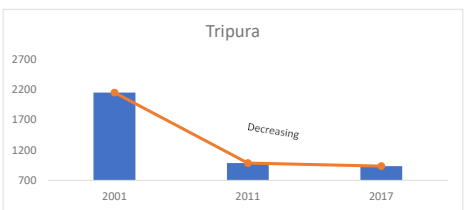




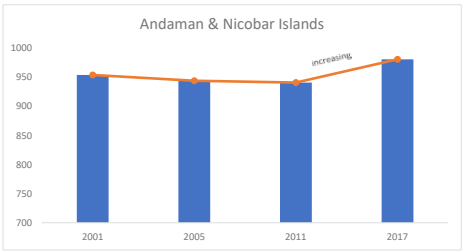


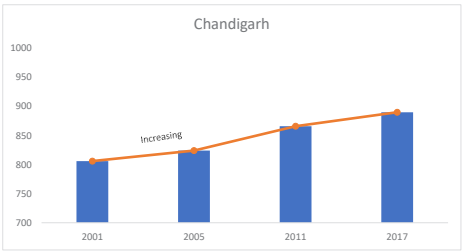


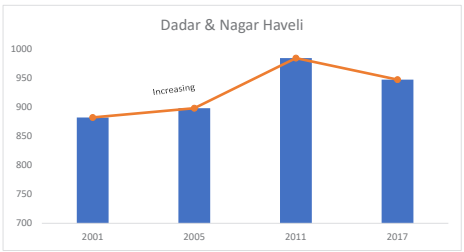


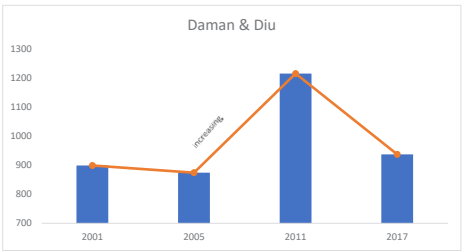


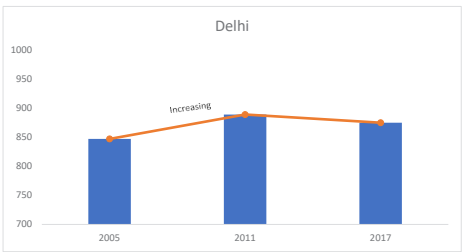
Union Territories

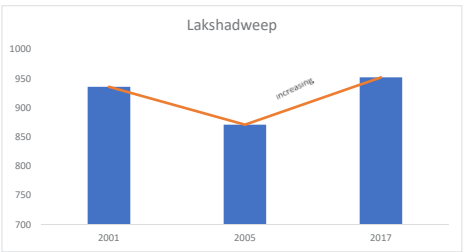


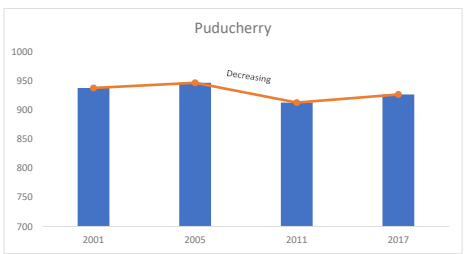












**Up and down movement of the line graph in the above charts may not indicate the actual trend in SRBs because the level at each point is based on the estimated value of SRB and its associated standard error. Therefore, this study has categorized the trend as "increasing (trend), decreasing or unchanged" by considering both the estimated value and its standard error. The summary trend of all the states is shown in tabular form at the end of write up of this section.*

Coming to trends in SRBs in 21 states[4] (Group 1), only two states have shown tendency for SRB to decline in these 15 years, rest of them have shown tendency either to increase (9 states) or "no change" (10 states). They are: Odisha and Tamil Nadu. Odisha had almost natural/biological SRB in 2001 but has started showing decline in the sex ratio at birth subsequently. This practice of sex selection in births needs to be curbed immediately after some further analysis of the region/communities where such practice is being adopted. In the case of Tamil Nadu, fall is very sharp in 2017. If this trend continues further, it will be a matter of great concern. A research study for this unusual phenomenon is needed.

Nine states where SRB has shown increasing trend are Bihar, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Punjab and Uttar Pradesh. Some of these states have been notorious for and guilty of the evil practice of sex-selective abortions or foeticide but have shown some determination to curb this practice. It seems that their determination has shown some positive results but they need to do much more, particularly in the states of Haryana and Punjab.

In the case of ten states where SRBs have shown "no change" in the last 15 years are Andhra Pradesh, Assam, Chhattisgarh, Goa, Jammu & Kashmir, Karnataka, Kerala, Rajasthan, Uttarakhand and West Bengal. These states, clearly fall into two categories; one, where sex ratio at birth was almost at natural level (952 females per 1000 males or about 105 males per 100 females) in 2001 and those where sex ratio was not at natural/ biological level in 2001. In the former category are Andhra Pradesh, Assam, Chhattisgarh, Goa, Jammu & Kashmir, Karnataka and Kerala. The other category is where SRB was poor Skewed towards males)in the initial period (2001). All efforts are needed to be made to bring about changes in the SRB in the latter category of states.

North Eastern states

In the case of North-Eastern states, four states, Arunachal Pradesh, Meghalaya, Mizoram and Sikkim have shown increasing trend in SRB; their current levels are more than 952 female births per 1000 male births (or more than 105 male births per 100 females). It is in three states, Manipur, Nagaland and Tripura where SRB has shown decreasing trend. The case of

4 Trend data for Telangana is not available as this state was formed recently.

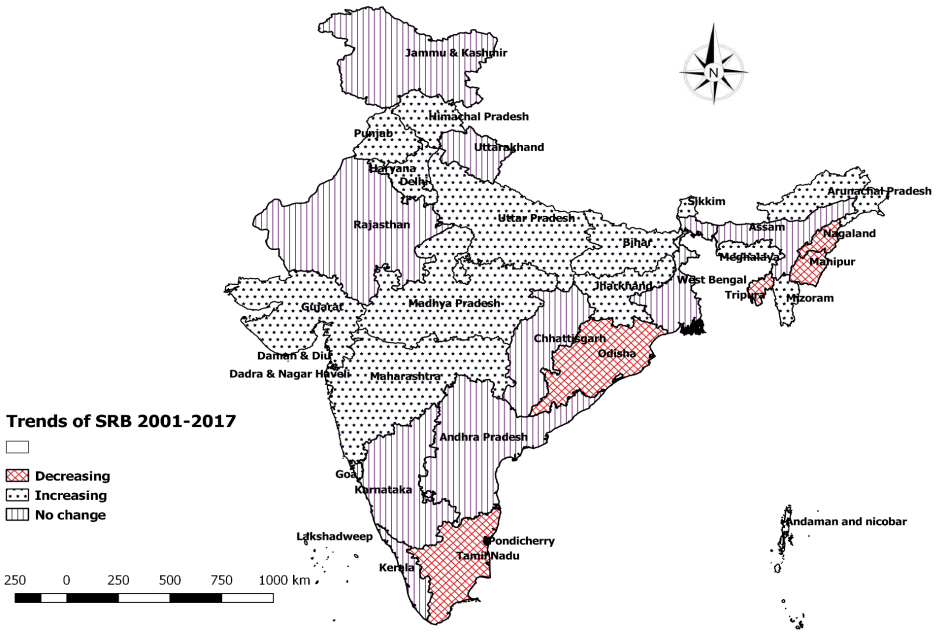
Manipur is especially worrying and needs careful investigation.

Union Territories

Six Union Territories show increasing trend in SRB; Puducherry has shown declining trend. Two Union Territories of Chandigarh and Delhi had poor SRB in 2001 and they have started showing increasing trend though the current level are still quite skewed towards male babies.
To sum up, trend in the SRB in last 15 years, 2001 to 2017 can be seen in the Table below:

Pattern of Trend in SRB	Name of the State and Union Territory	No. of states
Increasing trend in SRB	Bihar, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh, Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, Andaman & Nicobar, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Delhi, and Lakshadweep	19
"No change" in SRB	Andhra Pradesh, Assam, Chhattisgarh, Goa, Jammu & Kashmir, Karnataka, Kerala, Rajasthan, Uttarakhand, West Bengal,	10
Decreasing trend in SRB	Odisha, Tamil Nadu, Manipur, Nagaland, Tripura and Puducherry	6

Map 2
Trends in Sex Ratio at Birth in the states and Union Territories of India, 2001-2017 – Increasing, Decreasing or No Change



Chapter IV
Discussion and Recommendations

4.1 The Study

This report has attempted to give current status of Sex Ratio at Birth (SRB) in India and all its administrative territories. There are four possible sources of data on SRB – Sample Registration System (SRS), Civil Registration System (CRS), Census and Demographic Surveys. While the first two sources give information on male and female births and therefore get sex ratio at birth directly from the birth statistics. Other two sources have information of age distribution of population and therefore have information on male and female population in the age group (0 -4) or(0 -6). While using sex ratios in these age groups to draw conclusions about sex ratio at birth, researchers have, sometimes taken this sex ratio as proxy to SRB and sometimes this age group population has been reverse survived to compute male and female births and then to get sex ratio at birth. In this way, population in age groups (0 -4)/(0 -6) can indirectly give SRB.

Different studies have used these different sources of data on SRB and interpreted the results according to the objectives of the study. The results/conclusions therefore, varied depending on the source of data used for computation/estimation of SRB. This use of different sources of data related to SRB Discussion has shown different results regarding the levels of and/or trends in SRB. The first step, therefore, for this report, was to determine the optimum source of data for computation/estimation of sex ratio at birth. After analysis of different types of errors which could affect sex ratios at birth (SRB) derived from these four different sources, it was intuitively and arguably found that Sample Registration System (SRS) should provide the best estimates of sex ratio at birth or SRS is the best source of data on SRB. But estimation of sex ratio at birth from this source has a problem because estimated SRB from this source is based on a sample of births and thus has associated standard error. In order, therefore, to improve the SRB estimate, this report attempted to assess consistency of this estimate against the estimates from other three sources of data. It was found that choice of the estimate of SRB derived from Civil Registration System (CRS) should be the second best source of data for estimating SRB—68% of times, CRS estimate fell in the confidence interval band obtained for the estimate of SRB from SRS data source. Therefore,

recommendation has been made to use average of the estimates from SRS and CRS as the estimate of SRB; this will bring more stability to the estimate of SRB derived from SRS data.

Based on the recommendation for developing an estimate of SRB, estimates of SRB were computed for India and different states of India for the years 2001, 2005, 2011 and 2017. The last estimate for the year 2017 was used as current (latest available data) estimate of SRB and estimates of SRB on four points were used for analysis of trend in the SRB in the last 15 years. In this connection it may be pointed out that data for three consecutive years was utilized for the reference year for which SRB was computed. Three consecutive years, in the case of SRS increased the sample size of births on which the estimates were based and moving average of three years for CRS estimates helped in reducing yearly fluctuations in the estimate. The results are shown in Table A-3 in Annex.

This report has also made a limited attempt to assess factors/determinants which might be affecting the SRB. The literature has pointed out the following three factors as explanatory framework affecting the SRB (UNFPA, 2011) though several other studies have gone further in analysis of its other correlates as well (Kaur, R. (2016):

- Son Preference
- Small or declining Family Size, and
- Availability of technology for determining the sex of foetus for achieving desired family composition and size[5].

There is also general agreement that "son preference" is the root cause. While dependent variable was SRB computed in this study, two independent variables were taken from NFHS-4. Indicator taken for son preference was indicator of sex preference from NFHS-4 which collected data from women on the ideal number of sons and daughters they will like to have. Besides, two indicators of family size were tried: (i) Wanted total fertility rate, and (ii) Total fertility rate. No relationship, correlation

5 No effort was made to include indicator on "available technology" because a couple could go anywhere (district or even state) to use ultra sound to determine sex of the foetus. As a matter of fact, the couple is more likely to go to other places/districts/blocks etc. to keep the visit to ultra sound clinic a secret.

or regression (between SRB as dependent variable and indicators of sex preference and fertility as independent variables) was found to be statistically significant. Regression equation explained only 7 to 8 percent of the total variation in the value of SRBs at state level by use of these two independent variables. Obviously, other important factors like personal psychology, friends' or relatives' experiences in this respect, family's/ parents'/ in-laws' pressure etc. become more important in prediction of sex ratio at birth. We recommend and the international experience suggests need to further refine this framework by including other psychological variables and refinement of the concept of 'Son Preference'. (This work itself is an important research requiring separate and full-fledged independent study).

4.2 Discussion on Results

SRB in India

There has not been any change in the SRB in India in last 15 years, 2001-2017. It remained about 889 females per 1000 males (or more than 109 male babies per 100 female babies).

Results and Discussion in 21 states – States other than North-East and Union Territories

Assuming natural SRB as 952 females per 1000 males (or 105 boys per 100 girls) and the average sample size taken by SRS per state, the confidence interval for natural SRB will be (925, 981). It means that a state will have a natural level of SRB even if SRS gives estimate of up to 925 females per 1000 males. Keeping this possibility in mind, seven states out of 21[6] (other than 7 N-E states and 7 Union Territories) had natural SRB in 2001. This number reduced to only 3 in 2017, currently (Chhattisgarh, Goa and Kerala). In other words, only three Indian states of Chhattisgarh, Goa and Kerala have natural level of SRB in 2017. Reduction from seven states with natural level of SRB in 2001 to only three in 2017 (currently) means that more and more states started practices of voluntary abortion, foeticide or infanticide (immediately after birth) in this 15 year period to get desired sex composition (preference for sons) in their family.

6 Telangana is included in Andhra Pradesh.

On the other extreme in SRB, there were nine states in 2001 where level of level of SRB was less than 907 females per 1000 males[7] (or more than 109 males per 100 females) in 2001; this number came down to eight in 2017. Though the number remained almost the same, but two states (Himachal Pradesh, and Madhya Pradesh) out of nine states improved their SRB level (came out of poor SRB tab of 907 female babies per 1000 male babies to between SRB of 907 and 917) but one state (Tamil Nadu) got added to this category in these 15 years. Remaining seven states (out of 9) continued to remain in poor SRB tag of less than 907 level of SRB . Though these seven states had continued to remain in the same category of SRB but their level of SRB did improve (but remained in SRB of <907 category) except Rajasthan where it deteriorated. There is need to study, therefore, why Rajasthan did not improve (even got further reduced) its level of SRB like other states in its category in 2001.

Another point which is important is that five states with lowest level of SRB is 2001 were, in increasing order, Punjab (781 females per 1000 males), Haryana (809), Gujarat (836), Bihar (837), and Uttar Pradesh (844). They improved their SRB levels in 2017 which became 881, 843, 855, 879 and 878 for Punjab, Haryana, Gujarat, Bihar and Uttar Pradesh respectively. Punjab which had the lowest SRB in 2001 among these five states, achieved maximum increase in SRB level in this period of 15 years. Currently, in 2017 five states with lowest SRB are, in increasing order, Rajasthan, Haryana, Gujarat, Uttarakhand and Tamil Nadu. It may be noted that Bihar, Punjab and Uttar Pradesh have improved their rankings; they have been replaced by Rajasthan, Tamil Nadu and Uttarakhand.
The changing status of SRB in these 21 states can also be analyzed in another way – by looking at the trend during this 15 year period. This trend is indicated in the table A-3 in annex.

Pattern of Trend in SRB	Name of the state	No. of states
Increasing trend	Bihar, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharash-tra, Punjab, Uttar Pradesh,	9

7 The lower limit of the confidence interval for SRB of 907 females per 1000 males will be SRB of 881.

Pattern of Trend in SRB	Name of the state	No. of states
"No change"	Andhra Pradesh, Assam, Chhattisgarh, Goa, Jammu & Kashmir, Karnataka, Kerala, Rajasthan, Uttarakhand, West Bengal,	10
Decreasing	Odisha and Tamil Nadu,	2

Distribution of the 21 states in three categories, "Increasing trend", "No change" and "Decreasing trend" shown in the above table indicates that most of the states (nine in number) where SRB was low in the beginning of the study period (2001) have started showing increasing trend, a welcome sign. There is, though, need to accelerate their pace of increase. Ten states (second category) are such that SRB has not shown any significant change in the level of SRB in the 15 years of study period. This is because of the fact that the level of SRB in most of these states were high (more than 935 females per 1000 males (or 105-107 males per 100 females) in the initial period except Rajasthan and Uttarakhand. In other words, two states, Rajasthan and Uttarakhand in this category had low SRB (109 males per 100 females) in the initial stages but still did now show increase in the level of SRB. Definitely, much more effort is needed in these two states after studying the reasons for this unusual behaviour.

The situation is grave in two states in the third category in the above table. These two states, Odisha and Tamil Nadu have shown sharp declines in the levels of SRB –Odisha from natural level in 2001 to 903 in 2017 (from about 105 male babies per 100 female babies to about 108 male babies to 100 female babies) and Tamil Nadu from 927 to 869, a sharp decline in sex ratio at birth. These two states, particularly Tamil Nadu needs to take fast and strong actions to curb this increasing imbalance in sex ratio at birth because its SRB is declining fast, perhaps, more female foetuses are getting lost because of voluntary abortions and/or foeticides. There is need to undertake research studies in these states to understand this phenomenon.

Results and Discussion in North-Eastern states and Union Territories

The status of SRB in six N-E states and Union Territories is good except one state of Manipur in north-east and two Union Territories of Delhi

and Chandigarh. Manipur had started with natural level of SRB in the initial period (2001) but saw a sharp decline in its value in 15 year period, the gender imbalance has come about very fast. It needs to analyze its major reasons/causes and address them with strong actions. Two Union Territories of Delhi and Chandigarh are, probably getting influenced by neighbouring states of Haryana and Punjab. It is expected that their fate is tied up with those of Punjab and Haryana. Upward movement in SRB is these four territories will move parallel. Steps need to be taken to reduce the sex imbalance at faster pace in these four territories.

Monitoring the Imbalances in Sex Ratio at Birth

It seems that steps initiated to reduce son preference, improve the usefulness of girls in the family and reduce the incidence of voluntary abortions/foeticide through pre-natal testing are working towards attaining its goals of reducing imbalance in sex ratio at birth but the process is so slow that overall impact at country level has been nil in last 15 years. Perhaps improvement in SRB in some states is getting offset by such new or increased such practices in other states. There is need, therefore, to accelerate media activities against son preference and increased importance of girls in the family by their better education and improved chances of employment. The implementation of the PC-PNDT Act has also needs to be strengthened so that sex determination of foetus becomes impossible. These activities need to be monitored to make sure that they are working at their optimum levels. In addition, five states, Rajasthan, Uttarakhand, Odisha , Tamil Nadu and Manipur require special studies to understand their unique behavior in regard to their SRB. Rajasthan and Uttarakhand had low SRB (more than 109 males per 100 females) in the initial stages but did not change in 15 years of study period. Odisha and Tamil Nadu have shown sharp declines in the levels of SRB –Odisha from natural level in 2001 to 903 (from about 105 male babies per 100 female babies to about 108 male babies to 100 female babies) and Tamil Nadu from 927 to 869, a sharp decline in sex ratio at birth. Manipur had started with natural level of SRB in the initial period (2001) but saw a sharp decline in its value in 15 year period, the gender imbalance has increased very fast. After analysis of their causes, suitable actions need to be taken and their trends need to be monitored to fine-tune the programs/activities and strengthen them to increase their impact.

4.3 Recommendations

We make the following recommendations in order to reduce imbalances in SRB:

1. The imbalance in female and male sex ratio at birth and in overall population is a much more serious social issue than many people of the country realize. It is therefore the first task that a strong realization of its seriousness should be given to people of the country; more importantly to the elite society including civil society members, NGOs and elected representatives at all levels, Parliament to the Panchayats, so that the message can go all over the country. A strong advocacy of this issue should be one of the first tasks of the Government, more particularly of the Ministry of Health and Family Welfare and the Ministry of Women and Child Development. Involvement of elected representatives has been found to be very important to bring about social changes, particularly the issues like sex imbalances. It is therefore, recommended that this group should receive special emphasis to harness their full potential for this social cause.

2. There is a need to start monitoring the progress of the activities and their impact of SRB in the states/UTs and the country immediately towards achieving the sex balance so that country does not face the related problems. For this purpose, the present report could be taken as a baseline status of the SRB in India and the states and this parameter may be monitored to make sure that the country is moving in the right direction of reducing and even nullifying the imbalance in sex ratio at birth. In this task, the first act is a decision on the source of data to be used for computation of SRB as this source has to be kept common to make SRB comparable and get true assessment of the progress.(As stated earlier in the report, different researchers have used different sources of data and arrived at different results, creating some confusion on the level of the problem and the states where this problem is serious). We recommend using the IAPPD indicator developed for this report as the baseline and the source of data it has utilized. (Justification has been given for the choice of the source of data recommended in this report).

3. Many studies have pointed out that there exists large inter-state and intra-state (district level) variations in the levels of SRB (Kumar, S. and K. S. Sathyanarayana (2012)). There is need , therefore, to ultimately work at district level. For this purpose, robust estimates of SRBs at district level need to be developed and monitored. It requires more reliable and continuous data on SRB at district level. Data should cover both components-- supply (regulation of technology) and demand (reduction in son preference). The former takes the form of regulating access to technology and various levels of enforcement of this regulation. Measures to reduce demand include both short- and long- term measures, such as conditional cash transfers for parents of daughters or advocacy campaigns, but also long term efforts, such a policies to increase empowerment of women and bring more gender equality (UNFPA, 2011),

4. An exercise in identification of the districts with low sex ratio at birth may be undertaken. A further effort needs to be made to determine its determinants and correlates so as to focus media campaign and advocacy among those groups (Kaur, R. et al. 2016). This exercise will permit district-wise monitoring and taking quick measures to bring about changes in the poor SRB districts. Here, at this stage, it is necessary to determine methodology as how to estimate SRB at district level. This task may be given to IAPPD or any other agency like NIPCCD of the Ministry of Women and Child Development, IIPS or NIHFW of the Ministry of Health & Family Welfare. This agency may be asked to elaborate and expand indicators of “Supply” and “Demand” .Once this task is completed, the monitoring needs to be done at district level For this purpose, even Population Research Centres at state level can be involved.

5. A small unit may be given responsibility in one of the Ministries (Health & Family Welfare or Women and Child Development) to compile SRB data, compute SRBs regularly; initially, at state level by using source of data recommended in this report and then moving to district level monitoring. Analysis of the trend and regular feedback need be given to all the states, more particularly to the states where imbalance is high like Bihar, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar

Pradesh, Uttrakhand, Manipur, Chandigarh and Delhi so that they can take quick actions to help the state to move in the direction of natural SRB. If necessary, effort should be made, by regular workshops or some other modes of interactions for sharing the experiences so that states can learn from each other's experiences on this issue.

Annexures

Chart 1
Trends in Sex-Ratio at Birth based on CRS, SRS and IAPPD estimates in India during 2001-2017

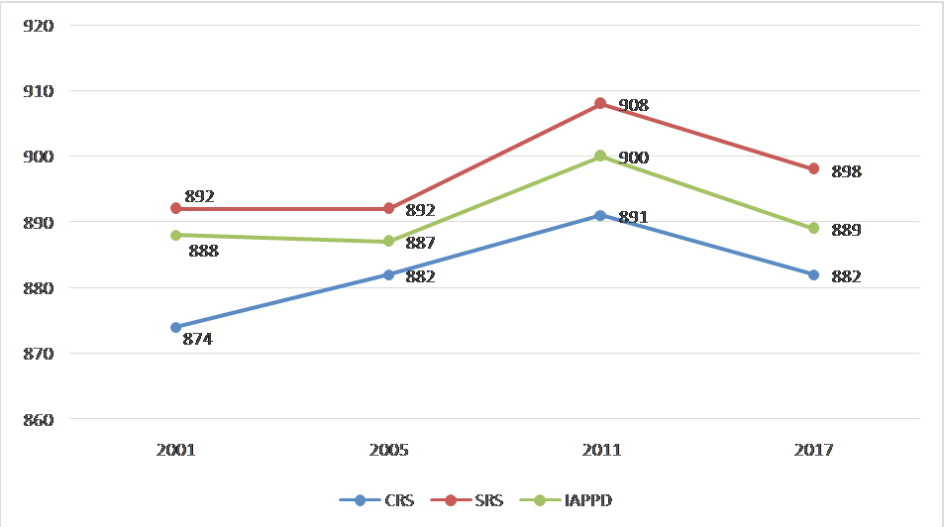


Table A-1
Direct* and Indirect* Estimates of Sex Ratio at Birth for India from Four Data Sources: Civil Registration System (CRS), Sample Registration System (SRS), National Family Health Survey (NFHS) for 2005 and 2015 and Census for 2001 and 2011

India/Data Sources	Direct and Indirect Estimates of SRB for four periods			
	2001	2005	2011	2015
Direct Estimates				
CRS	874	882	891	882
SRS -Estimate	892	892	908	898
SRS (C. I.)**	(887, 897)	(887, 897)	(903, 913)	(893, 903)
NFHS (if survey gives estimate of SRB directly)	NA	928	NA	922

India/Data Sources	Direct and Indirect Estimates of SRB for four periods			
	2001	2005	2011	2015
Indirect Estimates				
SRS				
NFHS	NA	928	NA	916
Census	934	NA	923	NA

Note: *Direct Estimates of SRB are those obtained directly from male and female births. Indirect Estimates are those derived from sex ratio at ages (0 – 4)/(0 – 6) by use of survival ratios of male and female populations to age 0 from Life Tables and then computation of sex ratio at birth.

** C.I. stand for Confidence Interval of the estimate

Table A-2

Direct* and Indirect* Estimates of Sex Ratio at Birth for the States of India from Four Data Sources: Civil Registration System (CRS), Sample Registration System (SRS), National Family Health Survey (NFHS) and Census for the states

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	2005	2011	2015
Andhra Pradesh				
Direct Estimates				
CRS	960	977	984	909
SRS -Estimate	945	917	914	913
SRS (C. I.)**	(919, 972)	(893, 942)	(8 9 0 , 939)	(885, 942)
NFHS	NA	881	NA	902
Indirect Estimates				
NFHS	NA	888	NA	896
Census	959	NA	941	NA

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	**2005**	**2011**	**2015**
Assam				
Direct Estimates				
CRS	NA	NA	1013	891
SRS -Estimate	945	920	922	896
SRS (C. I.)	(919, 972)	(892, 949)	(8 9 3 , 952)	(867, 926)
NFHS	NA	1015	NA	933
Indirect Estimates				
NFHS	NA	992	NA	951
Census	972	NA	968	NA
Bihar				
Direct Estimates				
CRS	803	NA	NA	858
SRS -Estimate	870	881	909	908
SRS (C. I.)	(853, 887)	(863, 900)	(8 8 9 , 929)	(887, 929)
NFHS	NA	917	NA	906
Indirect Estimates				
NFHS	NA	900	NA	941
Census	952	NA	939	NA
Gujarat				
Direct Estimates				
CRS	828	847	902	NA
SRS -Estimate	844	865	909	848
SRS (C. I.)	(821, 867)	(843, 887)	(8 8 6 , 932)	(827, 869)
NFHS	NA	927	NA	885
Indirect Estimates				
NFHS	NA	895	NA	908
Census	889	NA	894	NA

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	2005	2011	2015
Haryana				
Direct Estimates				
CRS	813	827	834	853
SRS -Estimate	804	837	857	832
SRS (C. I.)	(780, 829)	(811, 864)	(829, 886)	(805, 860)
NFHS	NA	795	NA	840
Indirect Estimates				
NFHS	NA	825	NA	837
Census	839	NA	840	NA
Himachal Pradesh				
Direct Estimates				
CRS	872	875	915	903
SRS -Estimate	826	872	939	917
SRS (C. I.)	(780, 865)	(828, 918)	(888, 993)	(870, 967)
NFHS	NA	922	NA	922
Indirect Estimates				
NFHS	NA	930	NA	926
Census	887	NA	916	NA
Jammu & Kashmir				
Direct Estimates				
CRS	927	921	NA	913
SRS -Estimate	NA	838	895	906
SRS (C. I.)	NA	(807, 870)	(864, 927)	(874, 940)
NFHS	NA	913	NA	931
Indirect Estimates				
NFHS	NA	924	NA	930

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	2005	2011	2015
Census	932	NA	864	NA
Karnataka				
Direct Estimates				
CRS	912	918	992	905
SRS -Estimate	952	917	950	935
SRS (C. I.)	(925, 980)	(895, 940)	(9 2 7 , 974)	(912, 958)
NFHS	NA	913	NA	922
Indirect Estimates				
NFHS	NA	936	NA	933
Census	942	NA	951	NA
Kerala				
Direct Estimates				
CRS	947	950	944	950
SRS -Estimate	911	922	966	959
SRS (C. I.)	(880, 943)	(893, 953)	(9 3 6 . 997)	(929, 990)
NFHS	NA	925	NA	1069
Indirect Estimates				
NFHS	NA	951	NA	1001
Census	960	NA	966	NA
Madhya Pradesh				
Direct Estimates				
CRS	844	858	910	907
SRS -Estimate	920	913	921	922
SRS (C. I.)	(899, 941)	(891, 935)	(8 9 9 , 943)	(901, 943)
NFHS	NA	968	NA	906
Indirect Estimates				
NFHS	NA	997	NA	923

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	**2005**	**2011**	**2015**
Census	947	NA	924	NA
Maharashtra				
Direct Estimates				
CRS	815	NA	870	899
SRS -Estimate	899	879	896	876
SRS (C. I.)	(8 7 5 , 934)	(856, 903)	(8 7 2 , 921)	(854, 899)
NFHS	NA	881	NA	964
Indirect Estimates				
NFHS	NA	919	NA	923
Census	919	NA	896	NA
Odisha				
Direct Estimates				
CRS	955	930	903	868
SRS -Estimate	944	934	948	948
SRS (C. I.)	(919, 969)	(909, 959)	(9 2 3 , 974)	(922, 975)
NFHS	NA	981	NA	927
Indirect Estimates				
NFHS	NA	940	NA	944
Census	949	NA	942	NA
Punjab				
Direct Estimates				
CRS	787	799	840	876
SRS -Estimate	775	808	863	893
SRS (C. I.)	(750, 801)	(780, 837)	(8 3 3 , 894)	(833, 894)
NFHS	NA	753	NA	873

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	2005	2011	2015
Indirect Estimates				
NFHS	NA	747	NA	854
Census	816	NA	851	NA
Rajasthan				
Direct Estimates				
CRS	819	818	870	800
SRS -Estimate	890	855	893	857
SRS (C. I.)	(870, 910)	(835, 875)	(872, 915)	(835, 880)
NFHS	NA	888	NA	894
Indirect Estimates				
NFHS	NA	897	NA	905
Census	921	NA	901	NA
Tamil Nadu				
Direct Estimates				
CRS	927	934	914	830
SRS -Estimate	926	955	928	915
SRS (C. I.)	(898, 954)	(930, 981)	(904, 953)	(891, 939)
NFHS	NA	893	NA	984
Indirect Estimates				
NFHS	NA	917	NA	944
Census	944	NA	945	NA
Uttar Pradesh				
Direct Estimates				
CRS	NA	NA	NA	877
SRS -Estimate	864	874	874	882
SRS (C. I.)	(849, 879)	(859, 889)	(859, 890)	(867, 936)
NFHS	NA	922	NA	909

State/Data Sources Direct and Indirect Estimates of SRB for four periods				
	2001	**2005**	**2011**	**2015**
Indirect Estimates				
NFHS	NA	935	NA	906
Census	930	NA	911	NA
West Bengal				
Direct Estimate				
CRS	891	899	927	909
SRS -Estimate	949	931	944	937
SRS (C. I.)**	(927, 972)	(910, 952)	(9 2 3 , 966)	(914, 961)
NFHS	NA	969	NA	971
Indirect Estimates				
NFHS	NA	969	NA	953
Census	954	NA	956	NA

Note: *Direct Estimates of SRB are those obtained directly from male and female births. Indirect Estimates are those derived from sex ratio at ages (0 – 4)/(0 – 6) by use of survival ratios of males and females to age 0 from Life Tables and then computation of sex ratio at birth.

** C.I. stands for Confidence Interval for SRB derived from data source SRS

Table A-3
Levels of Sex Ratio at Birth in three State Groups for four time periods 2001, 2005, 2011 and 2017

India/States	Time periods				Pattern of change in trend analysis
	2001	2005	2011	2017	
India	**888**	**887**	**900**	**889**	**No change**
Group 1: 22 states (Other than N-E states and Union Territories states					
Andhra Pradesh	953	947	949	913	No change
Assam	945	920	968	903	No change
Bihar	837	881	909	879	Increasing
Chhattisgarh	NA	944	942	956	No change
Goa	930	941	924	1925[9]	No change
Gujarat	836	856	906	855	Increasing
Haryana	809	832	846	843	Increasing
Himachal Pradesh	849	873	927	911	Increasing
Jammu & Kashmir	NA	930	895	915	No change
Jharkhand	NA	862	918	896	Increasing
Karnataka	932	918	971	917	No change
Kerala	929	936	955	949	No change
Madhya Pradesh	882	886	916	912	Increasing
Maharashtra	857	879	883	890	Increasing
Odisha	950	932	926	903	Decreasing
Punjab	781	804	852	881	Increasing
Rajasthan	855	837	882	828	No change
Tamil Nadu	927	945	921	869	Decreasing
Telangana	NA	NA	NA	911	
Uttar Pradesh	844	874	874	878	Increasing
Uttarakhand	NA	NA	858	861	No change
West Bengal	920	915	936	924	No change

Group 2: North- Eastern states					
Arunachal Pradesh	821	816	832	944	Increasing
Manipur	959	992	794	685	Decreasing
Meghalaya	948	954	935	972	Increasing
Mizoram	928	946	963	967	Increasing
Nagaland	976	916	872	910	Decreasing
Sikkim	1032	951	961	979	Increasing
Tripura	2151	NA	986	935	Decreasing
Group 3: Union Territories					
Andaman & Nicobar	954	944	941	981	Increasing
Chandigarh	806	824	866	890	Increasing
Dadra & Nagar Haveli	882	898	984	947	Increasing
Daman & Diu	899	874	1215	937	Increasing
Delhi	NA	847	889	875	Increasing
Lakshadweep	936	871	NA	952	Increasing
Puducherry	938	947	913	927	Decreasing

*Pattern of change was determined by computing confidence interval (CI) for the SRB level in the period 2001. If the succeeding at least two values of SRB fell in the computed confidence interval, then it was interpreted that trend has shown “no change”. If SRB values for the other time points fell beyond the Confidence interval, then interpretation was that trend is towards “decreasing” in SRB or “increasing”, depending on whether the values of SRB for other points fell on the lower side or upper side of the CI.

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(Footnotes)

1 Latest data available is from CRS is for the year 2016.

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