Infant and under-five mortality among Dalits in India: Evidences from 2011 Census

J, Retnakumar and C.S., Krishnakumar

Research Fellow, Speaker's Research Initiative Cell (SRIC), Lok Sabha Secretariate, New Delhi , Director, Institute of Development Studies, Thiruvananthapuram

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INFANT AND UNDER-FIVE MORTALITY AMONG DALITS IN INDIA: EVIDENCES FROM 2011 CENSUS

Retnakumar J. Ph.D

(Research Fellow, Speaker's Research Initiative Cell (SRIC), Lok Sabha Secretariate, New Delhi) retnakumar2005@gmail.com (Author for correspondence)

and

Krishnakumar C.S. Ph.D

(Director, Institute of Development Studies, Thiruvananthapuram) www.idr.org.in, e-mail: krishnaidr@gmail.com.

Abstract

Hardly any attempts have been made to understand the dynamics of dalit mortality as it is highly relevant for addressing India's health, mortality transition and human development. The National Family Health Survey, the only nation-wide sample survey believed to collect and divulge the most reliable estimates of health and mortality indicators for dalit population. However, many of their estimates in the latest round of the survey (NFHS-4) have been vehemently criticized as it failed in ensuring the quality of data on account of multiplicity of issues. In this context, we made an attempt to indirectly estimate the infant and under-five mortality rates using Brass and Coale method for dalits from the 2011 Census data. The Infant mortality rates of SC and ST population are estimated to be 59.7 and 67.7 (per 1000 live births) respectively. The under-five mortality rates are estimated to be 85.8 for the SC population and 97.0 for the ST population. As in case of general population, most of the northern states are in a disadvantageous position compared to the southern states in terms of these mortality indicators. The gender-specific mortality pattern highlights that mostly the male children stood behind their female counterparts in their first year of life as they are biologically stronger. As they move to higher ages, although mortality rates increases, the gender gap narrows down remarkably and female children have started experiencing higher under-five mortality rates in few states. These results unhitch the gray area of literature on the pattern of dalit mortality and evoke urgent policy interventions for gauging their mortality rates.

Keywords: *Infant Mortality Rate, Under-Five Mortality Rate, Dalits, Children Ever Born, Children Surviving, Schedule Castes, Scheduled Tribes, Census, Brass and Coale Method and India*

1.1 Introduction

Available evidences highlights that, despite large budgetary allocations are being spent for the upliftment of the Scheduled Caste and Scheduled Tribes, it is yet to mark a great leap forward in terms of their health and mortality indicators. The levels of mortality have been considered to be the most ideal indicator for assessing the health of the population and the advancement of health systems in a given geographical area. Although there are different measures of mortality, the estimates of Infant Mortality Rate (IMR) and Under Five Mortality Rates (UFMR)[1] occupies a prominent position not only in mortality analysis but also closely associated with many other socio-economic variables of development, standard of living, well-being, morbidity, nutrition, quality of care etc. With the advent of health indicators such as the Disability Adjusted Life Expectancies (DALE), capable of measuring the overall health of the population, globally the relevance of IMR and UFMR have slightly fade away as it categorically measures the mortality pattern of population only in younger age-groups.

However, in countries such as India, these mortality indicators are still been used as important barometers for indirectly assessing the health of the population and the nutritional status. IMR and CMR have traditionally been used as the most significant indicator for assessing the social and economic well-being of a region (Chandrasekhar 1972; Saha and Roy 2002). The trends in IMR and UFMR have closely been observed as measures to weigh up the effectiveness of various health intervention programmes. Even though these estimates are available for general population at national or state level, reliable mortality estimates are not readily available for dalits, a common term used to denote the Schedule Caste and Schedule Tribe population in India. They constitute sizable proportion of India's population (one out of every four person is categorised as dalit as per the estimates of 2011 census) and any health policy initiatives remains inconclusive without addressing the levels and variations in their mortality. Given this context, this paper estimates the IMR and UFMR for dalits, one of the most secluded, backward and marginalised segment of our population.

[1] IMR and UFMR are the probabilities of dying between birth and exact one-year and the birth and exact five years of age respectively expressed per 1,000 live births. Social scientists, especially non-demographers, often confuse between the terms UFMR and Child Mortality Rate (CMR). CMR is nothing but the probability of dying between the first and fifth birthdays per 1,000 live births.

1.2 Methodological issues in mortality estimation

There are ample evidences in the social science literature highlighting the backwardness of dalit population and the basis of such inferences were mostly drawn either from sample surveys or through qualitative assessment. Our understanding is very limited with respect to their morality pattern at the national or state level. The nation-wide large scale sample surveys such as National Family Health Survey (NFHS) and the National Sample Survey Organisation (NSSO) collects and publishes information categorically for different segments of our population such as SC, ST, Other Backward Caste (OBC) and Forward Communities (FC) etc. at the national and state level. One of the issues we confront with these classification is that the sample size of the population representing each of these categories are insufficient for estimating the mortality rates. In addition, the survey does not consider the proportion of caste groups for estimating appropriate weights. As a result, the estimates generated from the data sets do not truly portray either the macro or micro level scenario. Even though NSSO has made certain attempts to assess the demographics of India[2], the mortality pattern of dalits remained an unnoticed area of their investigation till now.

The National Family Health Surveys, an important nation-wide sample survey supposed to collect information on mortality indicators for different segment our population is too not free from limitations[3]. Compared to their earlier rounds, researchers have expressed serious concerns over the quality of information collected in the latest round of the survey (NFHS-4) held during 2015-16. For instance, the survey put 5.6 and 7.1 as the IMR and UFMR (per 1000 live births) respectively for Kerala. Similar rates are 6 and 7 for the United States as per the estimates of World Bank for the year 2018. Apparently, the heath of the population and the performance of the health systems in these two entirely different geographical and cultural settings are incomparable by using any of the standardized yardsticks.

Concerns were raised with the design as well as the implementation of the survey. The major issues highlighted includes large number of categories and questions, use of biometric test, the time spent on each questionnaire, sensitivity of the questions especially on gender, sexual behaviour and reproductive health etc. (Srinivasan and Rakesh 2020). The huge size of the samples, failures of the nodal agencies in properly monitoring the survey by and large might

[2] For example, the fourteenth round (report numbers 48 and 76), fifteenth round (report no. 110) and the eighteenth round (report no. 121) provides the estimates of various population parameters.
[3] For a critical evaluation of the quality of data collected in the first three rounds of NFHS See Rajan and James (2004; 2008).

have impeded the overall data quality and specifically the mortality estimates. Due to sampling issues, no mortality estimates were made available for dalits in few states[4]. In rest of the states, the figures could be either under-estimated or over-estimated[5]. Providing reliable and up-to-date mortality estimates of dalit population from a comprehensive data such as census should stand out in the entire social welfare programmes aims at enriching their standard of living.

1.3 Objectives

The main objective of this paper is to estimate the rates of infant and under-five mortality among dalits at the national and state level. It also explores the gender dimensions of mortality pattern among the children with less than one and five years of age.

1.4 Data and methods

This paper supply estimates only for those states with more than 0.50 million dalit population. As a result, most of the smaller states and union territories have been automatically excluded from the mortality estimation. It is assumed that estimates for the regions with smaller population size may result in inflated figures. The study fundamentally uses 2011 census, published by Registrar General of India (RGI), New Delhi for the estimation purpose. The estimates provided by demographers, NFHS and Sample Registration Systems (SRS) have also been used for assessing a comparative snapshot of the mortality pattern of dalits viz-a-viz non-dalits (general population). District-wise census estimates were clubbed to derive separate estimates for the newly created state of Telangana and erstwhile Andhra Pradesh. The data on Children Ever Born (CEB) and Children Surviving (CS) were obtained from F series of the Census to assess the mortality rates. The Census of India collects data on number of children born alive to each woman (CEB) and the number of children surviving (CS) out of them in different age groups. The present estimates are based on cohort measure whereas the estimates based on sample surveys are period measure of mortality.

[4] Among the major states, no IMR estimates are available for Kerala and NCT Delhi with 9.1 percent and 16.8 percent of SC population respectively. Similarly, no mortality estimates are available for Scheduled Tribe population in the states of Andhra Pradesh, Uttrakhand, Telangana, Tamil Nadu and Kerala.

[5] Despite these limitations, the estimates based on NFHS have been extensively used by the social scientists and research organizations all over the world to assess the performance and linkages of various demographic, health and mortality outcomes.

Thus, the CEB is a measure of her lifetime fertility experience till the date of data collection by the census officials. The data on CEB and CS has been segregated in 7 categories of five-year age intervals (15-19, 20-24.....45-49) of the women in the reproductive ages of 15-49. Fertility tables F1 and F5 deals with CEB and CS of the general population and dalit population respectively.

Several methods are available in the literature for indirectly estimating the levels of IMR and UFMR in a given population. The methods could vary depending upon the type of data (Census or sample survey) and the purpose for which the data is been used. Here, the method developed by Brass and Coale (1968), one of the most conventional and popular method has been used for the estimation of mortality levels from the CEB and CS data.

To simplify the computation procedures, the formula has been simultaneously applied in the data on SC population and the step-wise descriptions are given below. The first step is the calculation of Average Children Ever Born (ACEB) and Average Children Surviving (ACS) by dividing these figures with the total women in respective reproductive age groups without considering their marital or childbearing status. The next step is the computation of the proportion of dalit children dead $({}_5d_x)$ tabulated using the following formula.

$$ {}_5d_x = 1 - \frac{{}_5CS_x}{{}_5CEB_x} $$

Where; ${}_5d_x$ is the proportion of dead children in ages x to $x+5$. The notations ${}_5CS_x$ and ${}_5CEB_x$ is the children surviving and the children ever born to the women in ages x to $x+5$ respectively. The parity ratios (PR) of the women in ages 15-19 and 20-24 are essential for the computation of ${}_nq_0$ and the estimation of time reference t_x. The parity ratios for women in ages 15-19 and 20-24 have been computed using the procedure given below.

$$ PR_{15-19} = \frac{{}_5P_{15}}{{}_5P_{20}} = \frac{0.1046}{0.8715} = 0.1200 \text{ and} $$

$$ PR_{20-24} = \frac{{}_5P_{20}}{{}_5P_{25}} = \frac{0.8715}{1.8833} = 0.4628 $$

The numerator and the denominator of these equations indicate the ACEB in different age groups. For instance, ${}_5P_{15}$ represents the mean number of children born to women in ages 15-19. Table 1 gives the detailed procedures of these computations.

---Insert Table: 1------

The data on proportion of children dead by the age of the mother essentially fails in producing any age patterns of mortality. To overcome this riddle, the model life tables were used to describe the mortality pattern. As conventionally the South Asian model life table is used in the Indian context as to a great extent it explains the child mortality pattern existing in our country. The same procedure has been adopted here as well. Each values of ${}_5d_x$ have been converted into ${}_nq_0$ (probabilities of dying at exact age n) using the regression co-efficients obtained from the Princeton South Asian model life table. Thus, for an age group of 30-34, ${}_nq_0$ has been estimated as:

$$ {}_5q_0 = {}_5d_{30} * (a_{i+}(b_i * PR_{15-19}) + (c_{i*}PR_{20-24}) $$

Where, ${}_5d_{30}$ is the proportion dead among the CEB in ages 30-34 and a (i), b (i) and c (i) are the regression co-efficients. Applying the formula in case of SC women in the age group of 30-34, the ${}_nq_0$ can be derived in the following manner.

$$ {}_5q_0 = 0.0844 * \left(1.1905 + (0.2361 * 0.1200) + (-0.4487 * 0.468)\right) = 0.856 $$

The time reference (t_x) before the census has been estimated using the regression co-efficients from the model life table. Thus, the time reference for the age group 30-34 is expressed using the equation given below.

$$ t_x = e_1 + (f_i) * (PR_{15-19}) + (g_i * PR_{20-24}) $$

$$ t_{30-34} = 1.9399 + (-2.2739) * (0.1200) + (10.3876 * 0.4628) = 6.47 $$

The 2011 census was carried out in two phases. The first phase covers house listing covered a span of six months from April 2010 to September 2010. The second phase of population enumeration was held during 9th February 2011 to 28th February 2011. The provisional population figures were estimated for 31st March 2011. So the estimated time reference can

be computed by deducting t from 2011.247, which indicates the decimal representation of 31st March 2011 (Table 2).

------Insert Table: 2-------

The final step in the computation of mortality estimates is the conversion of each $_nq_0$ values into the estimated values of IMR ($\widehat{_1q_0}$) and UFMR ($\widehat{_5q_0}$). Each value of the $_nq_0$ has been converted to a logit form Y_n using the equation given below.

$$Y_n = 0.5\left(\ln\left(\frac{_nq_0}{1-_nq_0}\right)\right) - Y^s(n)$$

Where, $Y^s(n)$ is the standard logit transformation values obtained from the model life tables. Deducting the logit Y_n from the standard logit $Y^s(n)$ provides a series of a values corresponding to the $_nq_0$ for women in the reproductive ages. Each values of a are then utilized with the standard $Y^s(n)$ to get the estimates of $\widehat{_1q_0}$ and $\widehat{_5q_0}$. Thus, $\widehat{_1q_0}$ can be obtained as:

$$\widehat{_1q_0} = \frac{e^{2(a+{_1Y_0}^s)}}{1+e^{2(a+{_1Y_0}^s)}}$$

Where, $_1Y_0$ is the standard logit transformation value for age one. Thus, the Infant mortality for SC women in the age group of 25-29 can be computed as:

$$Y_3 = 0.5\left(\ln\left(\frac{0.0804}{0.9196}\right)\right) - (-0.98051) = -0.23795$$

$$\widehat{_1q_0} = \frac{e^{2(-0.238+(-1.13932))}}{1+e^{2(-0.238+(-1.13932))}} = 59.8$$

In estimating rest of the $\widehat{_1q_0}$, we keep the value of ${_1Y_0}^s$ (the standard logit values for women in ages 15-19) as constant. Here, the value of ${_1Y_0}^s$ is estimated to be -1.3932. On the other hand, the value of a changes with the change in the age group of women. Similar procedures have been adopted for the estimation of $\widehat{_5q_0}$ where the value of ${_1Y_0}^s$ remains as -0.94337 (women in ages 30-34) with varying values of a for the women in different age groups (Table 3).

------Insert Table: 3--------

Demographers by and large believes that the estimates of $\widehat{{}_1q_0}$ derived from the respondents of women in ages 15-19 (q1) are affected by serious biasness and should be excluded from the computations. Being young mothers, their children are likely to experience higher rates of mortality. It is evident from the above table (Table: 3) that both the vales of $\widehat{{}_1q_0}$ and $\widehat{{}_5q_0}$ at q_1 and q_2 are tend to be higher compared to the women in rest of the age groups. It is assumed that rather than considering the women in younger age groups, the mortality experience of women in ages q_3 and q_5 contains only minor errors. Thus, the mean values of q_3 and q_5 have been used to estimate the values of $\widehat{{}_1q_0}$ and $\widehat{{}_5q_0}$. The average of these values provide an estimate of 59.7 ($\widehat{{}_1q_0}$) and 85.8 ($\widehat{{}_5q_0}$) for SC population based on 2011 Census figures. Further, these estimates are somewhat close with the interpolated values of $\widehat{{}_1q_0}$ for the year 2011.

1.5. Estimates of IMR and UFMR among Scheduled Caste population

Table 4 exhibits the estimated IMR and UFMR for SC population in India by the states and gender. These rates are estimated to be 59.7 and 85.8 respectively per 1000 live births in the country. The level of UFMR is estimated to be 40 percent higher than IMR levels. The IMR at the national level is found to be higher among males (62.5) compared to females (56.9). Similar pattern can be observed at the state level as well with significant inter-state variations.

------Insert Table: 4--------

The IMR was found to be highest in Uttar Pradesh (78.8) followed by Madhya Pradesh (72.9) Odisha (68.0) Rajasthan (66.0), Bihar (65.6) and Jharkhand (64.5). The levels of IMR in these states are found to be much higher than the national level estimates of mortality. In rest of the states, the level of IMR is lower than the national figures. The lowest level of IMR was found in Kerala (26.1) followed by West Bengal (38.8) Jammu and Kashmir (41.9), Maharashtra (42.2), Tamil Nadu (45.9) and Himachal Pradesh (46.9). Gender specific infant mortality rates at the state level also follows more or less similar pattern.

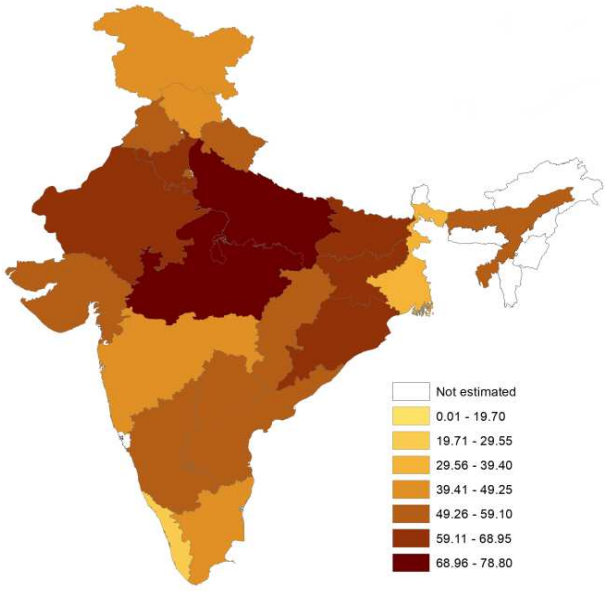
Similar to infant mortality, the state of Uttar Pradesh (112.2) and Madhya Pradesh (104.2) occupies the top position whereas Kerala (38) stood at the bottom of the ladder with respect

to the under-five mortality rates of SC population. Broadly speaking, the relative position of states remains more or less same in terms of both IMR and UFMR though the rates vary significantly across the states. The variations in these mortality rates are significant in those states with higher levels of mortality. For instance, the deviations between IMR and UFMR is estimated to be 33.4 (112.2-78.8) for Uttar Pradesh whereas it is only 11.9 (38-26.1) for Kerala.

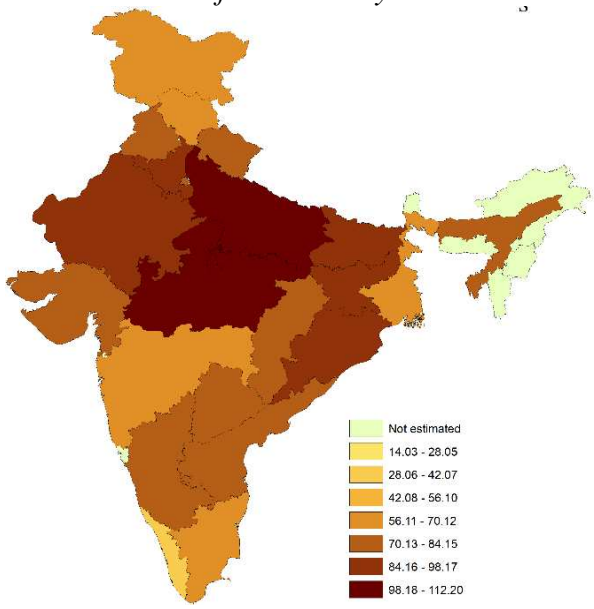
We have graphically plotted both IMR and UFMR at the state level to understand the regional variations in mortality pattern existing among the SC population (Map: 1). The map clearly highlights that both IMR and UFMR are found to be the highest in two aforementioned northern states. In contrast, the rates are found to be relatively lower in the southern parts of the country. Interestingly, the states with the higher rates of infant mortality tend to follow higher under-five mortality rates as well.

Map 1: IMR and UFMR of Schedule Caste Population across Indian states, 2011

Infant mortality rate



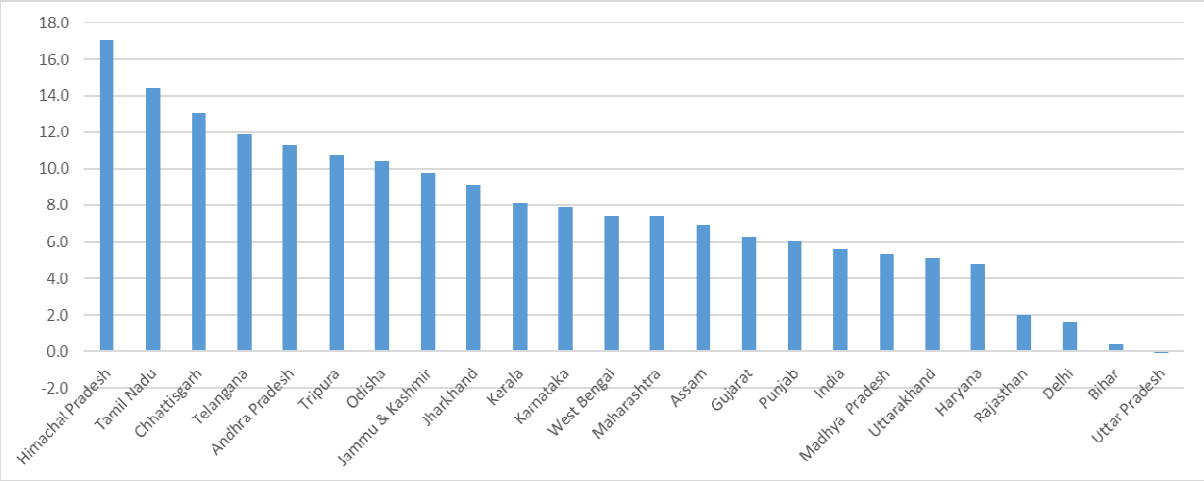
Under-five mortality rate



The Gender dimensions of IMR and UFMR pattern has been explained in Figure 1 and Figure 2 respectively. The bars behind the base-line (X axis) indicate the variations and the higher mortality rates of female children. In Uttar Pradesh and Bihar, the gender differentials in IMR seem to be insignificant. In rest of the states, male children experiences higher levels of IMR than female children on account of their biological disadvantages associated with their childbirth. Surprisingly, Himachal Pradesh and Tamil Nadu, two states with relatively

better literacy rate and human development indices have the largest gender differentials in infant deaths. At the same time, the all India gender differences in IMR are found to be very little compared to many of the major states (Figure: 1). Besides Uttar Pradesh and Bihar, the states such as Rajasthan, NCT Delhi and Haryana[6] too have the lowest gender differentials with respect to the IMR of SC population. It seems that the biological advantage of female children at the time of their birth cannot be clearly observed in these states.

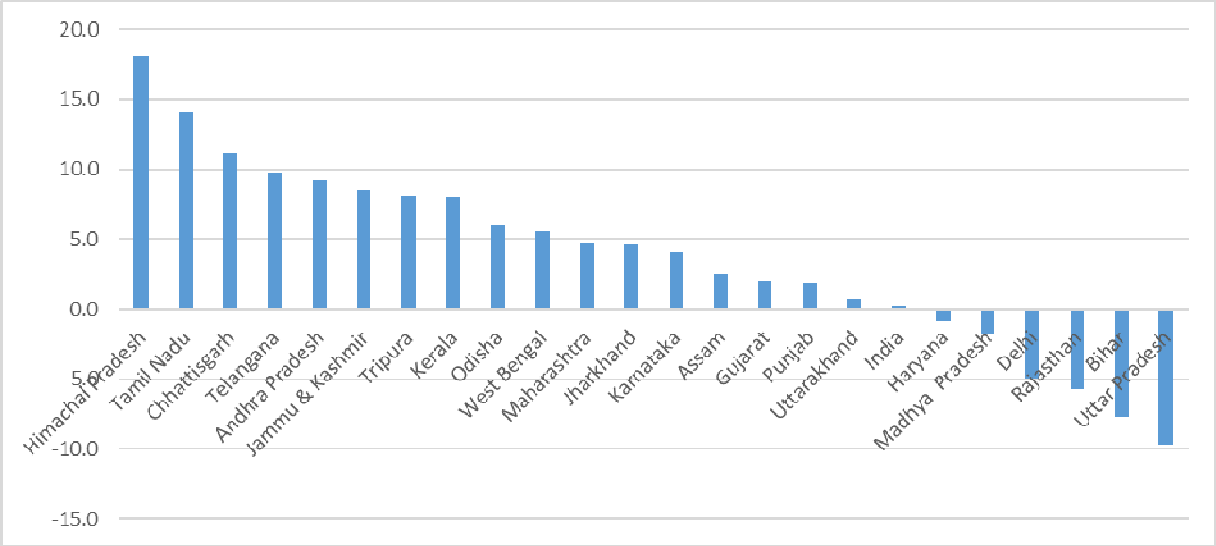
Figure 1: Gender differentials in Infant Mortality Rates of SC population, 2011



As stated above, the gender differentials highlight that male children tends to experience higher mortality rates than female children with respect to IMR. Even though the relative position of the states remains more or less similar, the gender differentials in UFMR narrows down significantly compared to IMR. In fact, the advantage of female children with respect to IMR dissipates in case of UFMR. As a result, the states such as Uttar Pradesh, Bihar, Rajasthan, NCT Delhi, Madhya Pradesh and Haryana had higher UFMR among female children than their male counterparts (Figure: 2). Uttar Pradesh and Bihar are the two states in the country, with the largest gender differentials in UFMR that are unfavourable to female children. The little gender differentials exist in IMR at the national level almost disappears when it comes to UFMR scenario.

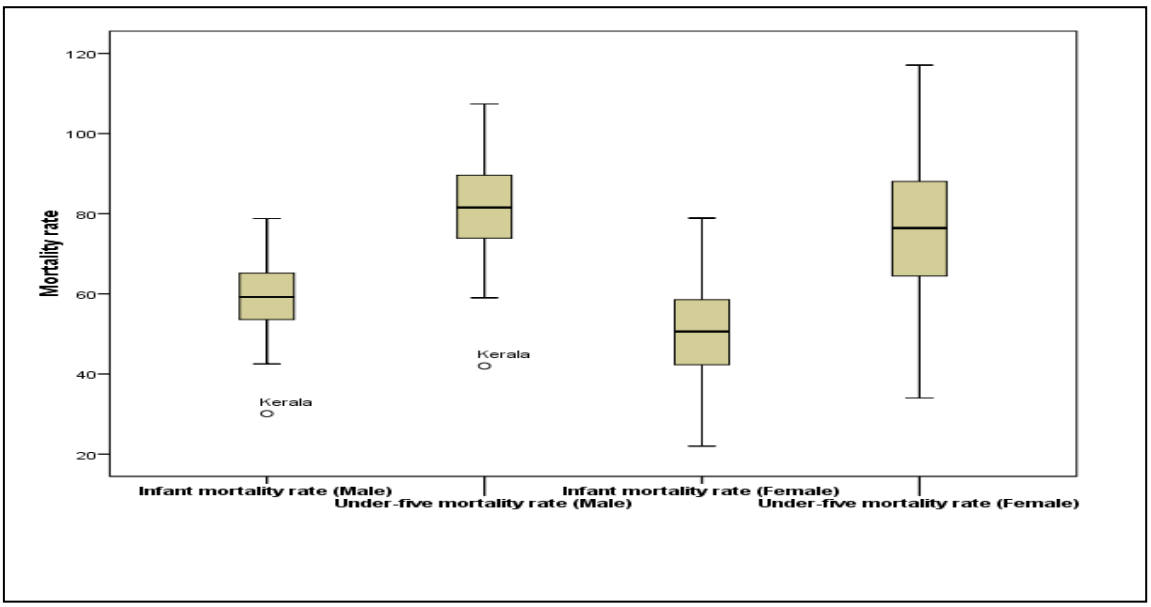
[6] Haryana is one of the DMARU states, an acronym used by Ashish Bose to denote the states with the highest rates of female feticide.

Figure 2: Gender differentials in Under-Five Mortality Rates of SC population, 2011



A whiskers plot (box plot) has been drawn to understand the variability in infant and under-five mortality rates in India (Figure 3). The plot clearly portrays to what extent the mortality rates varies among children across the states in India. The gender specific analysis highlights that the variability is found to be higher among female children than male children in mortality rates. The UFMR among female children had the highest variability compared to either the IMR (both the sexes) or the UFMR of males.

Figure 3: Variability in IMR and UFMR among SC population across states, 2011



Notes: Kerala stands as an outlier in both IMR and UFMR of males

1.6 Estimates of IMR and UFMR among Scheduled Tribe population

The IMR of Schedule Tribe population in India is estimated to be 67.7 per 1000 live births. The UFMR among them are calculated to be 97, which was reported to be 40 percent higher than their IMR levels. The highest level of IMR was found in Madhya Pradesh (83.4), followed by Odisha (81.8) and Chhattisgarh (78.1). In states such as Meghalaya, Rajasthan, Uttar Pradesh, Arunachal Pradesh and Jharkhand the levels of IMR is estimated to be more than 70. On the other hand, among the Schedule Tribes, the lowest levels of IMR was reported in Manipur (41.7), followed by West Bengal (46.5). The IMR was found to be close to 50 in states such as Mizoram, Maharashtra and Tamil Nadu (Table: 5).

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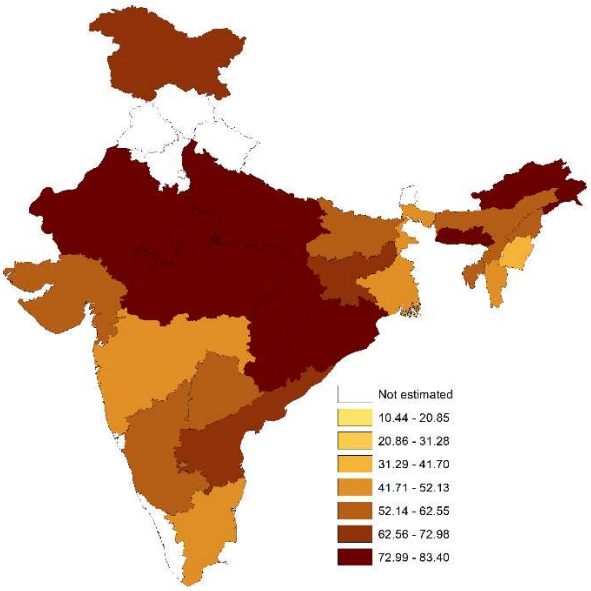
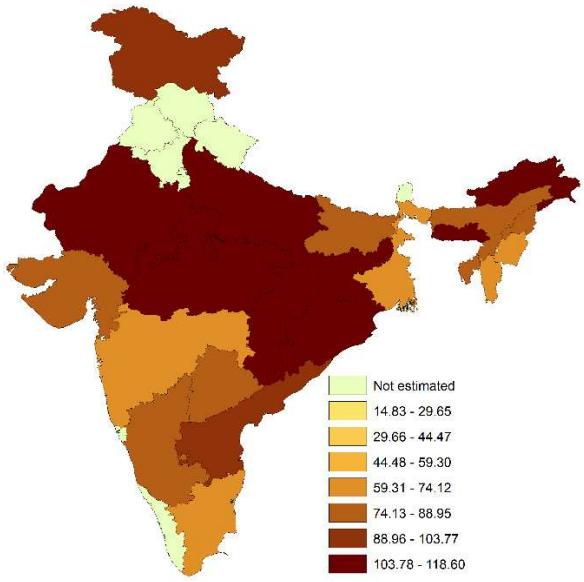
Similar to SC population, male children in ST population experience relatively higher rates of mortality compared to female children. At the national level, the infant mortality rates of males are estimated to be 72.1 for male children and 63.5 for female children.

Map 2: IMR and UFMR of Schedule Tribe Population across Indian states, 2011

Infant mortality rate



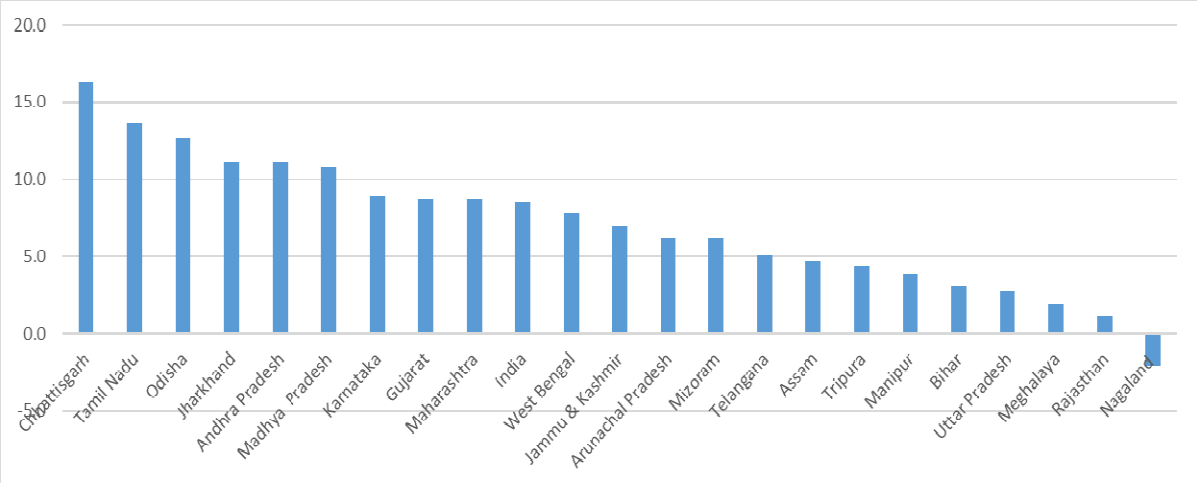
Under-five mortality rate



Map 2 demonstrates the geographical variations in estimated mortality rates among ST population across the states in the country. The map clearly illustrates that, like SC population, the states with highest prevalence of mortality rates are found in the central-eastern-northern parts of the country. Significant inter-state variations and gender

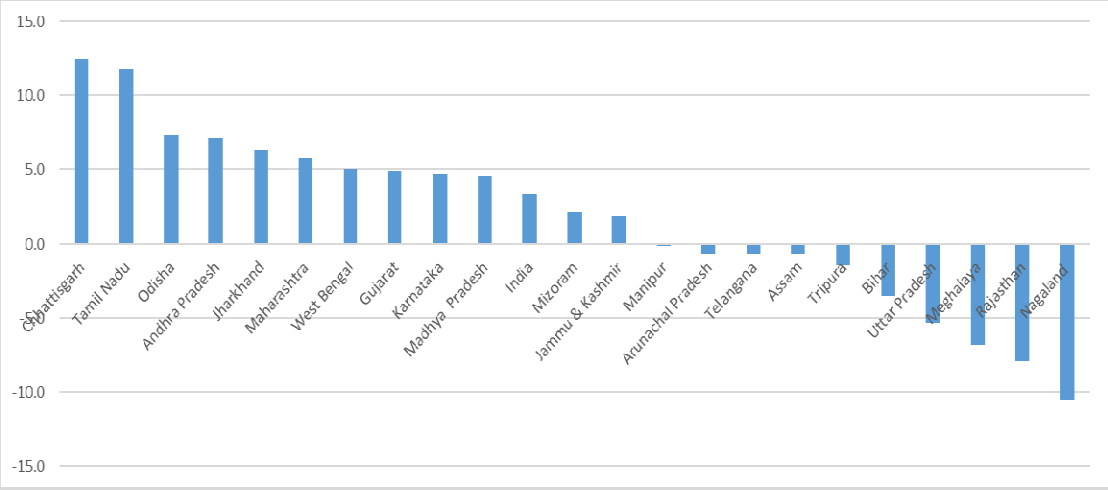
differentials in IMR levels can be observed in ST population. It is clear from the figure that only Nagaland had a higher rate of IMR for female children than male children (Figure 4).

Figure 4: Gender differentials in IMR of ST population, 2011



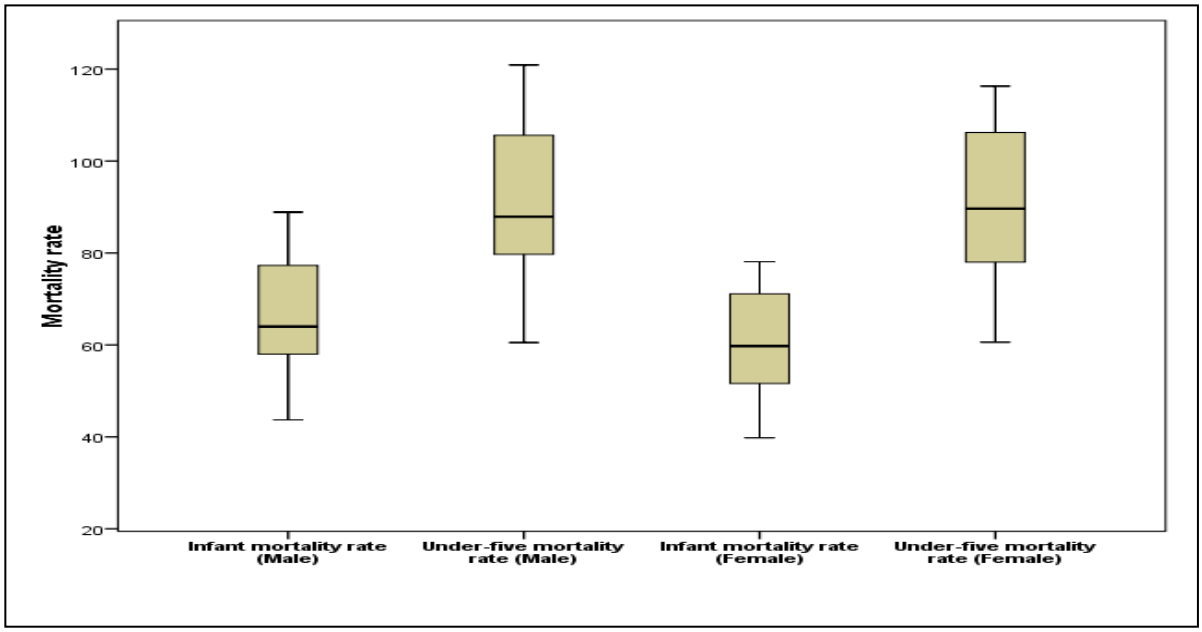
A close observation of the mortality estimates underlines that both mortality rates are found to be higher among males than females. However, similar to SC population, the existing gender differentials in IMR gauge down significantly when it comes to UFMR. As a result, the UFMR of female children tends to be higher in the states of Nagaland, Rajasthan, Meghalaya, Uttar Pradesh, Bihar etc. (Figure: 5). Among those states with higher UFMR among male children, Chhattisgarh and Tamil Nadu tops in the list with more than 10 point difference. Only Nagaland had more than 10 point differentials in UFMR among those states with higher female child mortalities. Such higher rates of UFMR among female children can be observed in ten states with ST population and six states with SC population.

Figure 5: Gender differentials in UFMR of ST population, 2011



Unlike children in the Scheduled Caste population, children in Scheduled Tribe population experience more or less similar pattern of variability with respect to their mortality pattern.

Figure 6: Variability in IMR and UFMR among ST population across states, 2011



However, figure 6 accentuate that among ST population, the levels of UFMR has higher variability than the levels of IMR.

1.6 Factors influencing mortality among dalit children

Many national and international policy documents highlight the exigency for improving the mortality rates and overall well-being of the children in India. In fact, most often we fall short of the specified targets. For instance, the targets set by the Millennium Development Goals and the National Population Policy documents[7] for the year 2015 and 2010 has not been accomplished even in 2017.

Few attempts have been made to understand the association of child mortality with different set of variables among different caste groups in India (Dommaraju et. al 2008; Archana Singh-Manoux et.al 2008). Moreover, the incidence of mortality among children in the lower

[7] The Millennium Development Goals set by the United Nations (2000) aims at reducing the levels of IMR to 29 (per 1000 live births) by the year 2015. The objective of the National Population Policy (2000) was to bring down this rate to less than 30 by the year 2010. Currently, the IMR and UFMR are estimated to be 33 and 37 respectively per 1000 live births (Registrar General and Census Commissioner 2017).

castes is found to be relatively higher in some of the most backward and the poorest districts in the country (Dommaraju et. al 2008). Our estimates also accentuate the fact that both infant mortality and under-five mortality rates are relatively higher among dalits than that of non-dalits (Table 6 and Table 7).

------Insert Table: 6 & Table: 7--------

Given this context, this section examines the causative factors behind the higher prevalence of IMR and UFMR among dalits compared to general population. The aforementioned tables clearly highlights deplorable condition of dalits in terms of their alarmingly higher mortality rates in their population at the younger age groups. The existing evidences corroborate the fact that children born to women in dalit families have higher probabilities of mortality than children born to women in rest of the categories (Das et.al 2010, Ranjan et.al 2018). Numerous factors have been cited as the reasons for higher mortality prevalence among dalit children compared to non-dalits. The differentials in socio-economic status, cultural practices, poverty, utilization of maternal and child health care services, quality of water, poor sanitation, lack of institutional deliveries etc. are often cited as the reasons for their higher mortality rates (Baqui et. al 2007, World Bank 2007, Das et. al 2010, Ranjan et.al 2018).

Besides the factors quoted above, higher levels of mortality rates among dalit children could be attributed mainly on account of the disparities in literacy and educational attainment of their parents. Studies have proven that the adult education had a protective association with the infant and child mortality rates in India (Guio et. al 1996; Murthi et.al 1996). Among dalits, the children in Scheduled Tribe population tend to experience higher mortality in terms of both IMR and UFMR. Due to the same reasons, the children in SC population category enjoy relatively lower mortality rates than children in ST category.

A further vetting has been attempted here to strengthen our earlier arguments that mortality rates among children are closely linked with numerous socio-economic variables. As mentioned above, the results strongly advocate that dalit children experience higher levels of mortality than children in general population. The socio-economic milieu of the children belongs to the general population explains their better survival rates than their dalit counterparts For instance, the literacy level of general population is 74 percent whereas it is 66 percent for SC population and only 59 percent for ST population as per 2011 Census

estimates. Comparing with much better indices, around 20 percentage of the general population are in the lowest wealth quintiles compared to 29.7 percent among SC population and 49.9 percent among ST population. In contrast, for higher quintiles the percentages were 20, 10.2 and 5.2 respectively during 2005-06 (IIPS and Macro International 2007: 44-45). Even after a decade, there has been no dramatic drift in the proportion of people in each of these wealth quintiles as per the estimates of NFHS-4. Thus, it is obvious that socio-economic factors of the population could have profound impacts on the mortality pattern of their children.

UNICEF has recently come out with their least estimates of on the position of under-five mortality rates for different countries on the planet. It was estimated that over 8.82 lakh Indian children departed from their life in 2018 and there by the country stands top in the list in terms of total under-five deaths (Unicef 2019: 190). The report further designate that, among under-five children around 38 per cent are stunted; this is almost half in the worst-affected state compared with a fifth in the least-affected state (ibid 38). Some of the studies evaluating the effectiveness of health expenditure on health outcomes establish the fact that such initiatives largely failed in achieving coveted results in terms of reduction in child mortality rates (Bhalotra 2017).

1.7 Concluding observations

This paper has been devoted for estimating the state level and gender specific infant and under-five mortality rates based on the birth and survival history of children born to all dalit the women in the reproductive age groups. The results point towards an appalling condition of dalits in terms of their child mortality indictors compared to rest of the segment of our population. It accentuate that UFMR tends to be higher than IMR among dalits with significant inter-state variations. The dalit children in southern states are better placed in terms of these mortality indicators and the highest prevalence was mostly found in the central and the northern parts of the country. The children in SC category have relatively lower levels of mortality than children among ST population on account of their relatively better socio-economic profile. The IMR was found to be higher among male children due to their biological disadvantages in childbirth and the existing gender gap narrows down as they move to higher ages and starts experiencing under-five mortalities. In few states, especially among children in ST category, the UFMR tend to be higher among females than males.

The estimations were attempted at the backdrop of paucity of reliable estimates on the pattern of infant and child mortality existing among dalits, an important segment of our population that needs special attention due to their historical and cultural seclusion. Systematic understandings of these vital mortality rates of dalits are very crucial in addressing the pattern and pace of their health and mortality transition. A close scrutiny of the existing information discloses that most of the estimates suffer either under-estimation or over-estimation. Plethora of issues likely to influence the quality of data in large-scale sample surveys and there by the results, interpretations and conclusions arrived on the basis of such sample survey estimates.

As a result, there are inconsistencies in the estimates of IMR provided by individual demographers/organizations for dalits and non-dalit population. A cursory glance suggests that, at the state level, there has been a relatively higher level of consistency between the estimates based on Census and the interpolated estimates of NFHS-4. However, in certain states there are glaring differences of more than 10 points in states such as Telangana, Haryana, Odisha, Tamil Nadu and Karnataka. Such differences, as stated earlier, could be largely attributed by sampling or response errors occurred in the NFHS survey. Though there are limitations of non-response errors, our estimates based on census information are supposed to be more comprehensive, reliable and accurate on account of its better coverage of dalit population.

The major finding of this paper should closely be read with some of the latest estimates of UNICEF on the position of under-five mortality in India. The alarming number of UFMR raises questions about the quality of mortality data collected in SRS for the general population. The multitude of UFMR forces us to ascertain that the existing mortality rates in India, especially the rates related to children could highly be underrated. The stunted rates among children are closely associated with the malnutrition and eventually lead to higher probability of mortalities among children. There have been copious health policy initiatives for the betterment of health and nutritional status of dalits in our country since we became independent. It raises serious questions about the outcomes of various flagship programmes aims at strengthening their nutritional, maternal and child health status. The initiatives for strengthening our mortality statistics related to dalit children should be the first stepping stone towards reducing their morality rates.

The relatively higher mortality rates prevailing among dalit children should be canvassed in a wider perspective than what is believed to be. Our policy initiatives aim at grooming a healthy population and the concept of inclusive development remains inconclusive if we fail to address the challenges of mortality and under-nourishment issues of children belong to dalit categories.

The disturbing figures of mortality rates among dalit children should be perceived as an indication that the authorities might not have paid proper consideration in assessing the health status of dalit children. The substantial improvements in the morality pattern of dalit children can only be achieved through comprehensive policy measures covering health, nutrition, employment and education as the mortality rates are closely linked correlated with numerous socio-economic variables. We have to carry out further investigations in this area to identify the loopholes and the factors blocking us from attaining the desired targets in the areas of mortality and health.

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Tables

Table 1: Estimates of proportion of SC children dead ($_5d_x$) based on 2011 Census

Age Group	Total women	Total Children Ever Born	Total Children Surviving	Mean Children Ever Born	Mean Children Surviving	Proportion of children dead ($_5d_x$)
15-19	9737869	1018886	923627	0.1046	0.0948	0.0935
20-24	9108461	7937972	7269595	0.8715	0.7981	0.0842
25-29	8261748	15559243	14326896	1.8833	1.7341	0.0792
30-34	7040941	18596956	17028223	2.6413	2.4185	0.0844
35-39	6836291	21032508	19051942	3.0766	2.7869	0.0942
40-44	5500274	18581405	16629551	3.3783	3.0234	0.1050
45-49	4701492	16816735	14853112	3.5769	3.1592	0.1168

Source: The first five columns are from Census 2011 (F series data)

Table 2: Various life table regression co-effients and estimation of time reference in years before Census 2011

			Regression co-efficients for (nq0)				Regression co-efficient for time ago			Time ago t	Reference date (2011.247-t)
Age Group	n	$_5d_x$	a(i)	b(i)	c(i)	$_nq_0$	e(i)	f(i)	g(i)		
15-19	1	0.0935	1.0819	-3.0005	0.8689	0.1051	1.0900	5.4443	-1.9721	0.83	2010.42
20-24	2	0.0842	1.2846	-0.6181	-0.3024	0.0901	1.3079	5.5568	0.2021	2.07	2009.18
25-29	3	0.0792	1.2223	0.0851	-0.4704	0.0804	1.5173	2.6755	4.7471	4.04	2007.21
30-34	5	0.0844	1.1905	0.2631	-0.4487	0.0856	1.9399	-2.2739	10.3876	6.47	2004.77
35-39	10	0.0942	1.1911	0.3152	-0.4291	0.0970	2.6157	-8.4819	16.5153	9.24	2002.01
40-44	15	0.1050	1.1564	0.3017	-0.3958	0.1060	4.0794	-13.8308	21.1866	12.22	1999.02
45-49	20	0.1168	1.1307	0.2596	-0.3538	0.1165	7.1796	-15.3880	21.7892	15.42	1995.83

Notes: Regression co-efficients are obtained from Princeton South Asaian model life table

Table 3: Estimated values of $_1\widehat{q_0}$ and $_5\widehat{q_0}$ for SC population in India, 2011

Age Group	n	$_nq_0$	1-$_nq_0$	logit Y_n	Standard logit $Y^s(n)$	Value a	$_1\widehat{q_0}$	$_5\widehat{q_0}$
							(Per 1000 live births)	
15-19	1	0.1051	0.8949	-1.07090	-1.13932	0.06842	105.1	148.0
20-24	2	0.0901	0.9099	-1.15621	-1.02707	-0.12913	73.3	104.8
25-29	3	0.0804	0.9196	-1.21846	-0.98051	-0.23795	59.8	86.0
30-34	5	0.0856	0.9144	-1.18429	-0.94337	-0.24092	59.5	85.6
35-39	10	0.0970	0.903	-1.11551	-0.91098	-0.20453	63.7	91.5
40-44	15	0.1060	0.894	-1.06613	-0.88990	-0.17623	67.2	96.3
45-49	20	0.1165	0.8835	-1.01300	-0.85999	-0.15301	70.2	100.4

Notes: Standard logit values are obtained from the Princeton South Asian model life table

Table 4: Estimated IMR and UFMR of SC population by State and Gender, 2011

States	Infant mortality			Under five mortality		
	Persons	**Male**	**Female**	**Persons**	**Male**	**Female**
Bigger states						
Andhra Pradesh	51.5	57.2	45.9	74.3	78.8	69.6
Assam	56.3	59.8	52.9	81.0	82.3	79.8
Bihar	65.6	65.8	65.4	94.1	90.3	98.0
Chhattisgarh	57.9	64.5	51.5	83.4	88.9	77.8
Gujarat	52.9	56.1	49.8	76.2	77.2	75.2
Haryana	59.4	61.9	57.1	85.5	85.0	85.9
Jammu & Kashmir	41.9	46.9	37.1	60.8	64.8	56.3
Jharkhand	64.5	69.1	60.0	92.6	94.8	90.2
Karnataka	55.3	59.3	51.4	79.7	81.7	77.6
Kerala	26.1	30.1	22.0	38.0	42.0	34.0
Madhya Pradesh	72.9	75.6	70.3	104.2	103.3	105.0
Maharashtra	42.2	45.9	38.5	61.0	63.4	58.6
NCT Delhi	56.3	57.1	55.5	81.0	78.6	83.5
Odisha	68.0	73.2	62.8	97.4	100.3	94.3
Punjab	51.0	54.1	48.0	73.6	74.5	72.6
Rajasthan	66.0	67.0	65.0	94.6	91.8	97.5
Tamil Nadu	45.9	53.1	38.7	66.3	73.3	59.3
Telangana	55.5	61.5	49.6	79.9	84.7	74.9
Uttar Pradesh	78.8	78.8	78.9	112.2	107.4	117.1
West Bengal	38.8	42.5	35.1	56.3	59.0	53.5
Smaller states						
Himachal Pradesh	46.9	55.6	38.6	67.9	76.9	58.8
Tripura	53.7	59.1	48.4	77.5	81.4	73.3
Uttarakhand	50.2	52.8	47.7	72.4	72.8	72.1
India	**59.7**	**62.5**	**56.9**	**85.8**	**85.9**	**85.6**

Source: Estimated by the authors

Table 5: Estimated IMR and UFMR of ST population by State and Gender, 2011

States	Infant mortality			Under five mortality		
	Persons	**Male**	**Female**	**Persons**	**Male**	**Female**
Major States						
Andhra Pradesh	66.1	71.8	60.7	94.8	98.3	91.2
Assam	55.6	58.0	53.3	80.1	79.8	80.4
Bihar	61.5	63.0	59.9	88.3	86.6	90.1
Chhattisgarh	78.1	86.4	70.1	111.6	117.8	105.3
Gujarat	55.9	60.3	51.6	80.5	82.9	78.0
Jammu & Kashmir	63.0	66.6	59.6	90.1	91.1	89.2
Jharkhand	72.9	78.5	67.4	104.0	107.1	100.8
Karnataka	60.4	65.0	56.1	86.9	89.2	84.5
Madhya Pradesh	83.4	88.9	78.1	118.6	120.9	116.3
Maharashtra	50.0	54.4	45.7	72.2	75.1	69.3
Odisha	81.8	88.3	75.6	116.4	120.0	112.6
Rajasthan	76.3	76.9	75.8	109	105.1	113.0
Tamil Nadu	50.6	57.5	43.8	73.2	79.1	67.3
Telangana	59.5	62.1	57.0	85.6	85.3	85.9
Uttar Pradesh	75.3	76.7	73.9	107.5	104.9	110.2
West Bengal	46.5	50.5	42.7	67.3	69.8	64.8
Smaller States						
Arunachal Pradesh	74.1	77.3	71.1	105.9	105.6	106.2
Manipur	41.7	43.7	39.8	60.6	60.5	60.6
Meghalaya	77.5	78.5	76.6	110.5	107.2	114.0
Mizoram	49.1	52.2	46.0	70.9	72.0	69.8
Nagaland	59.0	58.0	60.1	84.9	79.7	90.2
Tripura	59.6	61.8	57.4	85.7	85.0	86.4
India	**67.7**	**72.1**	**63.5**	**97.0**	**98.7**	**95.3**

Source: Estimated by the authors

Table 6: Trends in IMR and UFMR for total and SC population (per 1000 live births) by various estimates, 2011

States	IMR (persons) (General population)			IMR (SC)		UFMR (SC)	
Bigger states	**SRS (2011)**	**Rajan et.al (2018)****	**NFHS (2011)**	**New Estimates (2011)**	**NFHS (2011)**	**New Estimates (2011)**	**NFHS (2011)**
Andhra Pradesh	43	24	42.3	51.5	55.1	74.3	49.8
Assam	55	43	55	56.3	57.5	81.0	67.9
Bihar	44	51	53.5	65.6	64.5	94.1	68.8
Chhattisgarh	48	56	60.7	57.9	50.3	83.4	74.7
Gujarat	41	31	40.4	52.9	52.5	76.2	50.5
Haryana	44	35	36.4	59.4	40.1	85.5	45.6
Jammu & Kashmir	41	32	37.3	41.9	44.1	60.8	43.0
Jharkhand	39	44	53.8	64.5	60.9	92.6	69.8
Karnataka	35	23	33.4	55.3	42.7	79.7	40.8
Kerala	12	16	9.5	26.1	-	38.0	10.8
Madhya Pradesh	59	64	58.5	72.9	65.3	104.2	76.4
Maharashtra	25	26	29.2	42.2	37.1	61.0	35.9
NCT Delhi	28	28	34.6	56.3	-	81.0	44.0
Odisha	57	44	49.6	68.0	50.9	97.4	65.1
Punjab	30	26	34.2	51.0	42.2	73.6	40.7
Rajasthan	52	63	50.9	66.0	68.7	94.6	64.6
Tamil Nadu	22	22	24.3	45.9	29.1	66.3	30.3
Telangana	-	24	27.7*	55.5	32.8*	79.9	19*
Uttar Pradesh	57	60	67.2	78.8	76.9	112.2	85.4
West Bengal	32	34	35.7	38.8	32.3	56.3	42.9
Smaller states							
Himachal Pradesh	38	30	35	46.9	48.9	67.9	39.2
Tripura	29	29	36.6	53.7	-	77.5	43.3
Uttarakhand	36	42	40.6	50.2	51.4	72.4	50.6
India	**44**	**40**	**47.2**	**59.7**	**53.7**	**85.8**	**59.5**

*Notes: *Figures are for the year 2015-16 (NFHS-4). Rest of the NFHS figures are obtained by linearly interpolating the values for the periods 2005-06 (NFHS-3) and 2015-16 (NFHS-4) for standardised comparisons. Figures for Andhra Pradesh and Telangana have been obtained by segregating the CEB and CS data cumulating their district level population. All the states and Union Territories with less than 0.5 lakhs SC population (0.50 million) were excluded from the analysis. ** based on Census of India 2011*

Source: Registrar General (2011), Iruadaya Rajan et.al (2018), Various National Family Health Survey Reports.

Table 7: Trends in IMR and UFMR for total and ST population (per 1000 live births) by various estimates, 2011

States	IMR (overall) (General population)			IMR (ST)		UFMR (ST)	
Bigger states	**SRS (2011)**	**Rajan et.al (2018)**	**NFHS (2011)**	**New Estimates (2011)**	**NFHS (2011)**	**New Estimates (2011)**	**NFHS (2011)**
Andhra Pradesh	43	24	42.3	66.1	-	94.8	49.8
Assam	55	43	55.0	55.6	48.6	80.1	67.9
Bihar	44	51	53.5	61.5	47.1*	88.3	68.8
Chhattisgarh	48	56	60.7	78.1	75.7	111.6	74.7
Gujarat	41	31	40.4	55.9	52.0	80.5	50.5
Jammu & Kashmir	41	32	37.3	63.0	36.2	90.1	43.0
Jharkhand	39	44	53.8	72.9	65.3	104.0	69.8
Karnataka	35	23	33.4	60.4	38.5	86.9	40.8
Madhya Pradesh	59	64	58.5	83.4	73.6	118.6	76.4
Maharashtra	25	26	29.2	50.0	40.2	72.2	35.9
Odisha	57	44	49.6	81.8	62.6	116.4	65.1
Rajasthan	52	63	50.9	76.3	53.0	109.0	64.6
Tamil Nadu	19	22	24.3	50.6	-	73.2	30.3
Telangana	-	24	27.7*	59.5	32.8*	85.6	19.0
Uttar Pradesh	41	60	67.2	75.3	40.8*	107.5	85.4
West Bengal	32	34	35.7	46.5	-	67.3	42.9
Smaller states							
Arunachal Pradesh	32	45	38.0	74.1	39.6	105.9	54.8
Manipur	11	25	24.9	41.7	-	60.6	32.3
Meghalaya	52	45	35.8	77.5	-	110.5	52.0
Mizoram	34	31	37.7	49.1	-	70.9	-
Nagaland	21	29	33.0	59.0	-	84.9	48.3
Tripura	29	29	36.6	59.6	27.5*	85.7	43.3
India	**44**	**40**	**47.2**	**67.7**	**51.5**	**97.0**	**59.5**

*Notes: *Figures are for the year 2015-16 (NFHS-4). Rest of the NFHS figures are obtained by linearly interpolating the values for the periods 2005-06 (NFHS-3) and 2015-16 (NFHS-4). Figures for AP and Telangana are obtained by segregating the CEB and CS data of SC population at the district level. All the UT's and States with less than 5 lakhs (0.50 million) SC population has been excluded from the analyses.*

Source: Same as Table: 6