

## **Have State-level Inequalities including Gender Gaps in Completeness of Death Registration in India Narrowed in Last Two Decades of Civil Registration System Strengthening?**

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### **Background**

Since 2000, there has been a significant increase in not only the absolute numbers of deaths registered by the Indian CRVS system, but also the completeness when measured as a proportion of estimated total deaths. In 2000, 3.8 million deaths were registered in India, which increased to almost 8 million deaths in 2020. This increase in registered deaths is substantial in the context of the 56.5 million annual global deaths. With rising levels of completeness of registration, there is an increased potential for death registration data to be used as a source of routine mortality estimates, with appropriate adjustments for estimates of incompleteness. **The increase in death registration completeness in India since 2000 raises the question about whether state-level inequalities in completeness including gender gaps in registration have really reduced over the period? If the level of improvement is not as per expectation, then what should be the course correction?** The relative level of completeness of death registration between states is important because it demonstrates the utility of the death registration system to be a source of routine subnational mortality data, particularly given the population size of some states, and also shows the extent to which the benefits of death registration are available to the population, particularly to the marginalized populations and the women.

**This paper aims to critically analyze whether inequalities in death registration completeness including the gender gaps in death registration in the states of India have really reduced since 2000? If yes, to what extent and what should be the course corrections measures to be undertaken for continued improvement?** It does this by using the empirical completeness method to measure annual state-level completeness from 2000 -2020, and then assessing trends in the correlation of completeness with the two socio-economic indicators: the Socio-Demographic Index (SDI) and Multi-dimensional Poverty Indicator (MPI) of each state. I also assessed these trends by sex-specific completeness, and examine the availability of age and sex data by state. These results are expected to highlight how investments in the CRVS system have been distributed across states, and where further investment is needed.

### **Methods**

Death registration data used in this study are registered deaths presented in the Reports on Civil Registration System in India published by the Office of Registrar General of India. I

obtained data from the 2009-2020 Reports, which show numbers of deaths registered in each year from 2000-2020 by state/territory and, where available, age group and sex (sex is only reported for 2009-2020). Completeness of death registration (i.e. the percentage of actual deaths that are registered) is calculated using the empirical completeness (Adair-Lopez) method. This method is a statistical model that estimates completeness based on data inputs that reflect the determinants of the crude death rate; mortality level (represented by the under-five mortality rate) and population age structure (reflected by the percentage population of the aged 65 years and above). I assessed state-level inequalities in completeness of death registration according to two indicators: the SDI and MPI. The SDI is a composite indicator of development that is the geometric mean of average income per person, educational attainment, and total fertility rate; it ranges from 0 to 1. The SDI has previously been used for analyses of subnational Indian epidemiological transition and under-five mortality. It is available for Indian states and territories from 2000-2016 and I projected for 2017 to 2020 based on the annual rate of change from 2015-2020. The MPI is a measure of the proportion of a state's population in poverty and is based on different variables of Standard of Living, Health and Education. In general, the SDI is a superior measure of the development status of all of a state's population, whereas the MPI better reflects the proportion of the population experiencing poverty. I included both measures to provide a holistic assessment of inequalities of completeness. Other indicators such as literacy and malnutrition among children were also investigated as indicators of inequalities but did not show as strong an association as SDI or MPI.

Inequalities were measured using a linear regression of state-level completeness with a covariate of either SDI or MPI. For each year, the regression coefficient of either SDI or MPI was used as the indicator of the extent of state-level inequalities in completeness. For SDI, which is expected to have a positive relationship with completeness, narrowing of inequalities would be demonstrated by the coefficient falling over time. For MPI, which is expected to have a negative relationship with completeness, narrowing of inequalities would occur if the coefficient rose (i.e. became closer to zero). Given the large variation in the size of the populations of Indian states, I also conducted the regressions for SDI and completeness for both sexes weighted by population, to assess if it had any impact on trends. I also used a state's average MPI from 2000 to 2020 in the regressions, rather than each individual year's MPI, because the standard deviation of MPIs fell sharply from 0.12 to 0.06 because there was a universal decline in poverty over the period; the smaller variation in MPI in recent years could result in a larger negative coefficient when predicting completeness and hence incorrectly show widening inequalities. The standard deviation of SDI, in contrast, remained at 0.07 in both 2000 and 2020.

## Results and Discussions

The additional 3.2 million annual registered deaths between 2000 and 2018, an increase in estimated completeness from 58% to 81%, is a substantial achievement and dramatically increases the potential of the death registration system to be used as a routine source of mortality data. These changes have occurred with a narrowing of state-level inequalities by SDI, whether it was measured weighted by population size or not, and to a lesser extent MPI. Both male and female completeness increased from 2009-2020, but with SDI for females remaining steady, for males narrowing. The largest increases in completeness were found in Rajasthan, Gujarat, Madhya Pradesh, Arunachal Pradesh and Sikkim, and the largest state, Uttar Pradesh, where completeness increased from 18% in 2002 to 54% in 2020. The trend in completeness is characterized by an initial increase to 2007, followed by a dip and then increase in recent years.

The narrowing of inequalities in completeness demonstrates that the benefits of higher levels of death registration, including for mortality statistics and individuals, have spread to relatively poorer states of India in recent years. However, the continued low completeness in some states, such as the poorest state Bihar, as well as in Nagaland where there was a substantial decline in completeness over the period, are concerning. Low female compared with male registration in many states is also an area where much improvement in the system is needed, including in Rajasthan and Arunachal Pradesh. The Indian death registration system also needs to increase the number of deaths with age reported to improve their usability for mortality statistics. In 2020, seven states with comprising 41% of India's population didn't report deaths by age. Even where deaths are reported they are in 10-year age groups, whereas calculation of life expectancy and many mortality indicators require deaths reported in five-year age groups. Although not a focus of this study, child death registration is very low in India, with another study estimating that less than one-third of deaths under five years are registered.

The extent of variation in the death registration in India across the states, and importantly the varied progress made by the individual states over the decade, reinforces that the steps to improve death registration will have to be addressed at the state level, as generic recommendations to improve completeness may not be applicable across all states. Lessons could be learnt from the states which have made progress in completeness for the states which are lagging behind. In general, some facilitators for death registration such as access to the insurance funds and succession of property owned by the deceased, barriers to death registration such as discontinuation of the government pension post death of a retired public sector employee or poor inclination to register death of a child are acknowledged in India. Death registration was documented as being higher for males than females. This relative under-

registration of female deaths is likely because India is a patriarchal society with the succession rights linked to males.

There are some limitations with this study. Deaths are published according to year of registration, so are subject to annual fluctuations caused by both delayed registrations and also collation of registered deaths. Hence, annual levels of completeness may be affected by reporting efficiencies completeness by year of registration may differ from that reported by year of occurrence. However, the longer-term trend in increased completeness is clear, irrespective of how whether year of registration of occurrence is used. Also, even though this study found that many states do not report detailed age data for registered deaths, does not mean they are not available in the data for the policymakers. However, good practice is for these to be published, to enable external analysts to use the data. The measures of completeness used in the study are estimates; however, the estimate of completeness in 2020 of 81% was only slightly higher than that calculated according the GBD estimated deaths of 75%. Finally, the summary socio-economic measures only show state-level and not individual socio-economic differences in death registration; it is likely that differences by individual socio-economic and also by smaller area of enumeration, as shown in Chinese counties, would be larger than according to state.

Concentrated effort is needed in the assessment of strengths and weaknesses at the subnational level of not only CRVS processes in India but the data it produces is essential to ensure that improvements in completeness are continued. Given that India accounts for one-in-six of the world's deaths, increased routine reporting of these deaths will help with understanding of global health trends. Furthermore, improved cause of death data through both Medical Certification of Causes of Death (MCCD) for facility deaths and routine verbal autopsy for community deaths will help improve understanding of national and subnational cause of death patterns and enable more reliable computation of health indicators such as the Sustainable Development Goals (SDGs) by local analysts.

## **Conclusions**

The narrowing of inequalities in completeness according to the SDI demonstrates that the benefits of higher levels of death registration have spread to relatively poorer states of India in recent years. However, the continued low completeness in some states, such as the poorest state Bihar, as well as in Nagaland where there was a substantial decline in completeness over the period, are concerning. Low female compared with male registration in many states is also an area where much improvement in the system is needed, including in Rajasthan and Arunachal Pradesh. The Indian death registration system also needs to increase the number of deaths with age reported to improve their usability for mortality statistics.