

India: notes on estimates of crude death rate and registration coverage¹

The [2019 CRS report](#) provides both national and subnational data on registered deaths, along with estimates of registration coverage. Estimated deaths are calculated using the Sample Registration Survey (SRS) which gives national and subnational (i.e., state- or Union Territory-) estimates of crude death rates (CDRs). The 2018 SRS annual statistical report (henceforth "the 2018 SRS report") is [available here](#).

A national or subnational CDR from the SRS can be multiplied by a national or subnational population estimate for the year, [based on population projections](#), to estimate total expected deaths. The level of death registration nationally or subnationally is then estimated by comparing registered deaths and estimated total deaths.

However, a number of different calculations (below) suggest that SRS estimates of mortality from recent years may underestimate the CDR in India at national level.

The national 2019 SRS-CRS estimates of CDR (6.2) and registration coverage (92%)

According to the 2019 CRS report, 7,641,076 deaths were registered nationally in 2019. The 2018 SRS report estimates India's CDR as **6.2** per 1K population, while the estimated 2019 national population was 1,332,900K. Assuming no change in the CDR between 2018 and 2019 we would expect around $6.2 \times 1,332,900 = 8,263,980$ deaths during 2019. This estimate would, indeed, imply registration coverage during 2019 to be **92%** (to the nearest full percent), as given in the 2019 CRS report. We will refer to these estimates as the "2019 national SRS-CRS" estimates.

The United Nations' estimates

The [United Nations estimated CDR](#) in India to be **7.2** per 1K for the period 2015-20 ([link to excel file](#)). This is considerably higher than the 2018 SRS estimate. At a CDR of 7.2, based on the population projections, we would expect 9.6 million deaths nationally in 2019, giving estimated registration completion of **80%**.

Estimates from subnational data

Registration estimates for each state and Union Territory (UT) are also given in the 2019 CRS report, based on 2018 SRS estimates of crude death rates along with registered deaths in that state or UT in 2019. These subnational estimates are capped at 100%, i.e., if more deaths were registered than expected from the estimated CDR, then registration coverage is assumed to be 100%. For example, Andhra Pradesh had an estimated CDR of 6.7 in the 2018 CRS report, and an estimated 2019 population of 52,221K, giving expected deaths in 2019 at around 350K. However, 401,472 deaths were actually registered in the state in 2019, 15% more than expected. Formally speaking, this gives registration coverage in the state of 115% during 2019.

One interpretation, perhaps unlikely, is that around 50K of the deaths registered in Andhra Pradesh during 2019 were actually of residents of other states. The most probable explanation is that the SRS underestimated true mortality in the state, and that Andhra Pradesh's CDR in 2019 was actually higher than 6.7 deaths per 1,000, perhaps closer to $401,472/52,221 = 7.7$ deaths per 1,000.

¹ Updated on 24th September 2021, by Murad Banaji and Aashish Gupta.

The example of Andhra Pradesh highlights why, if we use subnational estimates, we might arrive at different estimates of national CDR and registration coverage. For each state or UT, we simply divide the total registered deaths by the estimated registration coverage as a fraction, to get an estimate of total deaths in that location. Summing these up across all states and UTs, we obtain an estimated total of 8,837,847 deaths nationally in 2019. The discrepancy of over 500,000 between this number and the 2019 national SRS-CRS-based estimate of total deaths (around 8.3 million) arises, at least partly, because several states saw considerably more death registrations in 2019 than estimated from 2018 SRS-based CDR estimates, as noted for Andhra Pradesh above.

Thus, using subnational SRS-CRS data we find an estimated national CDR in 2019 of $8,837,847/1,332,900 = 6.6$ per 1K, somewhat higher than the 2018 SRS-based estimate of 6.2. This higher CDR estimate gives estimated national registration coverage of $7,641,076/8,837,847$, namely around **86%**, rather than 92%.

Estimates using SRS age-wise death rates

The 2018 SRS report gives estimated percentages of the population in different age brackets (Table 1 in the report) and also estimated death rates in different age brackets (Table 8 in the report). This data can also be used to estimate the national CDR.

The report gives estimated percentages of the population in different age brackets to only one decimal place. This level of precision, especially in the older age groups where the percentages are small, is very unsatisfactory for the purposes of estimating population and mortality in different age-brackets. Nevertheless, we can use these estimates along with the projected 2019 population to estimate total 2019 populations in each age-bracket. We can then use age-wise death rates to estimate deaths in each age group, and hence total deaths in 2019. This process gives an estimate of 8.38 million deaths in 2019, quite close to the estimate of 8.26 million from the 2018 SRS-based national CDR.

In fact, this probably should not count as a separate estimate of 2019 mortality since it is likely that the national estimate of CDR at 6.2 may have been calculated using the estimated 2018 age-pyramid given in the 2018 SRS report, which presumably reflects the sampled population.

If we dig a little deeper, however, we find that the 2018 SRS estimated population fractions in the older age-groups could be too low. According to Table 1 in the 2018 SRS report, about 5.2% of the population was 65 or above. But already by 2011 census, 5.5% of the population was 65 or above and, according to the population projections, this should have risen to 6.2% by 2016 and 6.9% by 2021. We would thus expect around 6.4%-6.5% of the population to be over 65 during 2018, considerably higher than the 5.2% estimated in the 2018 SRS. This discrepancy makes a fairly major difference to estimated CDR.

The population projections give projected population pyramids for 2016 and 2021, but not intervening years. We can use either estimated 2016 or 2021 population pyramids to estimate 2019 CDR. Estimates depend on the fraction of the over-80s who are assumed to be over 85, which is not given in the projected population pyramids, so we set this to be the fraction estimated in the 2018 SRS, namely, 0.375.

Using the 2018 SRS age-wise death rates and the projected 2016 age pyramid. We expect 8.78 million deaths in 2016 which, over an estimated population of 1,290 million gives a CDR of **6.8** per 1K. This CDR estimate, applied to the estimated 2019 population of 1,333 million gives 9.1 million deaths in 2019, corresponding to registration coverage in 2019 of **84%**.

Using the 2018 SRS age-wise death rates and the projected 2021 age pyramid. We expect 10.23 million deaths in 2021 which, over an estimated population of 1361 million gives a CDR of 7.5 per 1K. This CDR estimate, applied to the estimated 2019 population of 1,333 million gives 10.0 million deaths in 2019, corresponding to registration coverage in 2019 of 76%.

We may assume that if a 2019 projected population pyramid were available, we would arrive at an estimate of CDR between 6.8 and 7.5 per 1K, corresponding to registration completion of between 76% and 84%.

Estimates based on the NFHS-5

Recently released [NFHS summary reports](#) also suggest that official death registration levels in the CRS reports, including the subnational estimates, may be overestimated. The NFHS asks respondents about deaths of any usual family member in the last three years, and whether the death was registered. NFHS surveys were conducted between mid-2019 and early 2020 in 22 states and UTs, comprising around 50% of the national population.

Using estimated 2018 populations, we can compute a weighted average registration level in these states and territories of 75.4%. We can try to estimate registration levels from the SRS and CRS for a comparable period as the NFHS-5 estimate, using annual estimates. On the other hand, the SRS-CRS-based estimated registration level in these 22 states and UTs for an equivalent period three years before the average NFHS interview in NFHS-5 first phase states was 81.7%.

Thus, NFHS-5 data suggests that total deaths over the period covered in the states and UTs in question - and hence the CDR - were about 8% greater than SRS-CRS based estimates. If we assume a similar underestimation of the CDR nationally, and scale up the estimated national CDR of 6.6 in 2019 based on the subnational estimates, we get an estimated CDR of 7.0. If this was, indeed, the CDR in 2019, this would imply that registration coverage was around 80%, rather than 92%.

Summary of estimates

In the table below are a summary of estimates of the 2019 crude death rate and, consequently, registration coverage that year.

	2019 CRS and 2018 SRS (national data)	2019 CRS and 2018 SRS (subnational data)	United Nations estimate	2018 SRS age-wise death rates using projected 2016 age pyramid	2018 SRS age-wise death rates using projected 2021 age pyramid	NFHS-5 based estimate
CDR	6.2	6.6	7.2	6.8	7.5	7.0
registration coverage	92%	86%	80%	84%	76%	80%

We see that SRS-CRS national estimate gives the lowest estimate of CDR, and is, indeed an outlier. The median estimate of CDR is, in fact 6.9, and the median estimate of registration coverage in

2019 is 82%. This is somewhat lower than the national estimate based on the 2019 SRS-CRS subnational estimates, suggesting that even these might be overestimates.

Conclusions

Overestimating registration coverage is equivalent to underestimating mortality. Since excess mortality calculations rely on estimates of baseline mortality, we also risk underestimating excess mortality during the pandemic period and other derived estimates, such as of COVID-19 infection fatality rate. The data available from a number of sources suggests that taking the estimated national registration completion of 92% at face value is problematic. Several other calculations and sources of data suggest that the true value likely lies between 80% and 86%, corresponding to values of CDR between 6.6 and 7.2.