

# Sample Registration System in India: Coverage and data availability

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# Background

- Births and deaths registration system (Civil Registration System) existed even before independence, however, coverage and quality have been a major concern
- In 1981, ~8.5M births/2.7M deaths annually captured in CRS
  - Increased to 22M births/6.3M deaths In 2016
- Additionally, data was fragmented across smaller presidencies during pre-independence period; Consolidated information lacked
- Post independence, India launched five-year plans for the development of various sectors
- Need for demographic parameters related to fertility and mortality felt for evidence based planning of programs and services

# Emergence of Sample Registration System SRS

- To fill the data gap then, in 1964-65 SRS was launched as a pilot in a few states
- Became fully operational in 1969-70 as an interim measure to generate vital statistics
  - until the Civil Registration System developed fully

# SRS: Objectives and Coverage

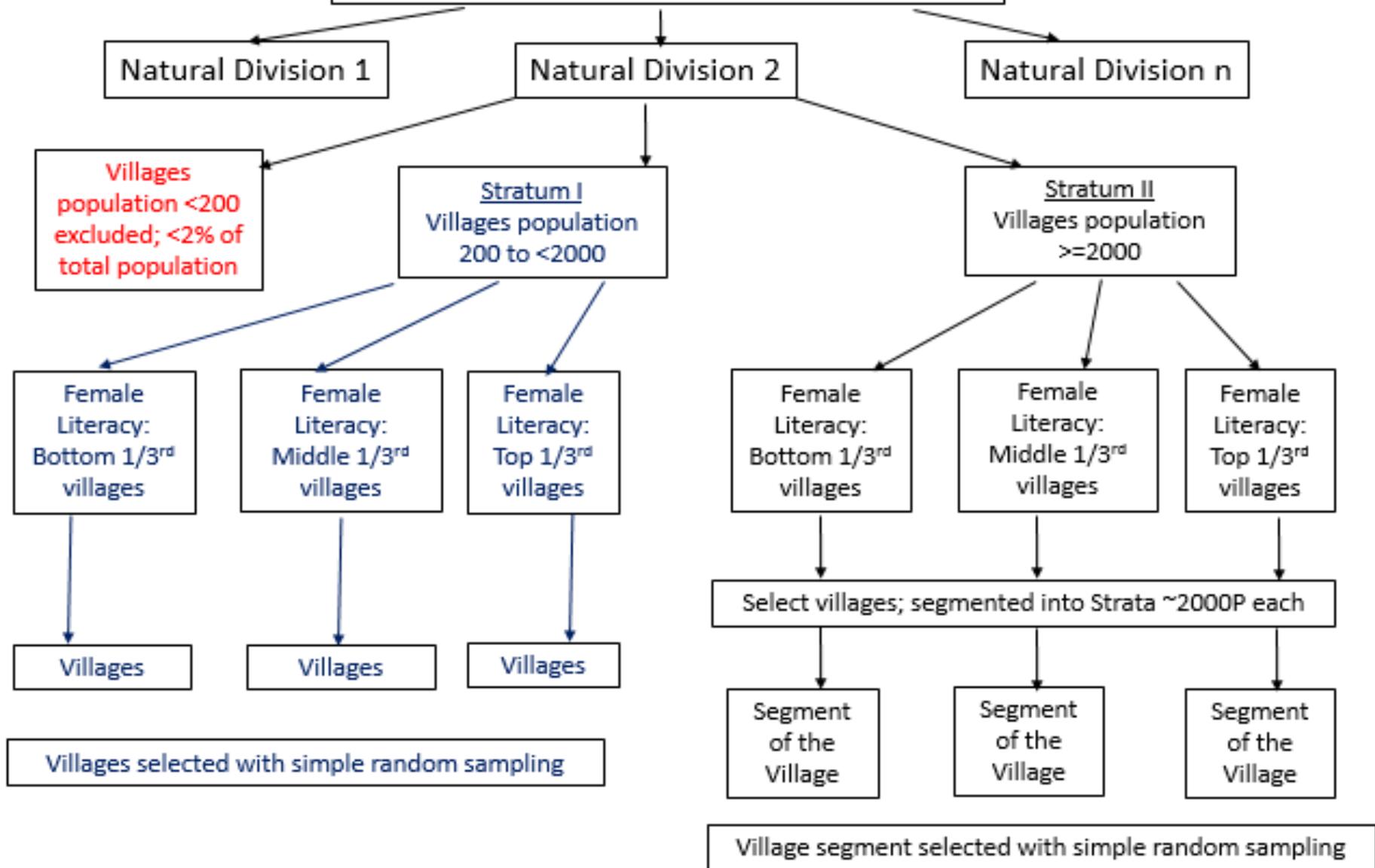
- To provide reliable annual estimates of vital rates for India and states
- To specifically give annual
  - Fertility indicators
  - Mortality indicators (incl. Maternal Mortality Ratio)
  - Medical attention at the time births and deaths

Coverage: All states and the Union Territories of India

# Rural Sampling Design

- Except stratum II, a uni-stage stratified simple random sample; No replacement;
- In stratum II, 2–stage stratification applied
  - Villages ordered by female literacy rate (2011)
  - 3–equal size substrata created
  - Each village, subdivided into 2 or more segments ensuring
    - No segments cut across Census Enumeration Blocks
    - Population of each segment formed by grouping contiguous CEBs approximately equals 2000
- Bigger States (Population 2011  $\geq 10M$ )
  - NSS natural division: First level of geographical stratification

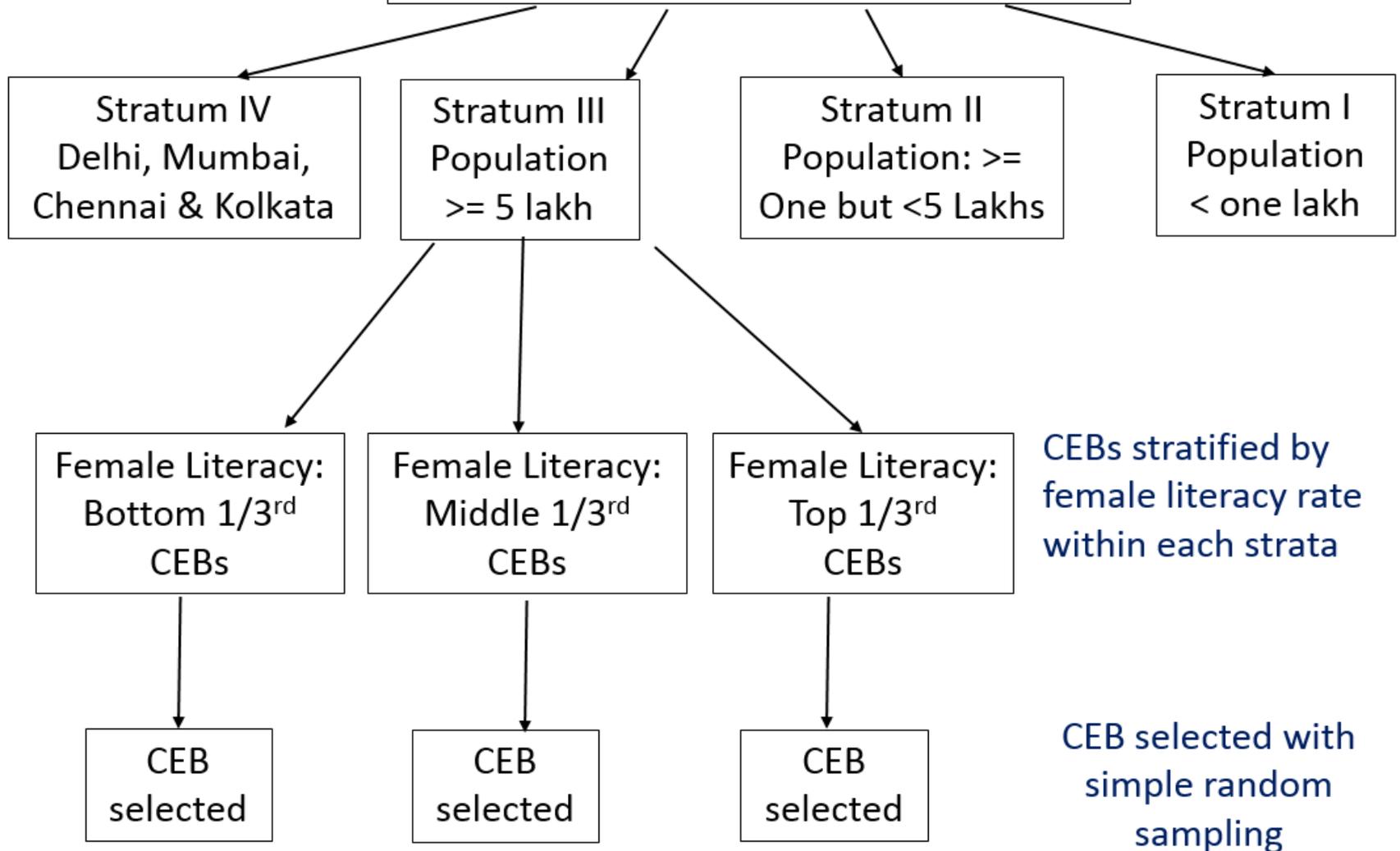
# Sampling design: Rural areas



# Urban Sampling Design

- The towns/cities divided into four strata based on size classes (six strata before 2014)
- Towns with population
  - Stratum I = < one lakh
  - Stratum II =  $\geq$  one lakh but <5 lakhs,
  - Stratum III =  $\geq$  5 lakh
  - Stratum IV = Four metro cities of Delhi, Mumbai, Chennai and Kolkata
- Urban sampling unit = Census Enumeration Block (CEB)

# Sampling design: Urban areas



# SRS Sample size

- Until 2004, CBR used to determine sample size
- Since 2004, IMR is used
- Permissible level of error
  - Rural areas: 10 percentage relative standard error at natural division level
  - Urban areas:
    - 10% relative standard error at state level for states having population >10M
    - 15% relative standard error at state level for remaining smaller States/UTs

# Number of PSUs covered under SRS post censuses, 1969-70 to 2014

Area	Sample units at different replacement period					
	1969-70	1977-78	1983-85	1993-95	2004	2014
Rural	2432	3684	4176	4436	4433	4961
Urban	1290	1738	1846	2235	3164	3892
Combined	3722	5422	6022	6671	7597	8853

1. 2004 & 2014: Replacement in one go; completed over 2-3 years <2004
2. 2015 & 2016: 74 fewer PSUs (rural 52; urban 22) due to non-conduct of survey in Jhelum Valley (natural division of Jammu and Kashmir)

States / UTs	Total	Rural	Urban
<b>India</b>	<b>8853</b>	<b>4961</b>	<b>3892</b>
Andhra Pradesh	327	199	128
Assam	300	90	210
Bihar	330	200	130
Chhattisgarh	158	73	85
Delhi	200	10	190
Gujarat	478	231	247
Haryana	256	144	112
Himachal Pradesh	210	155	55
Jammu & Kashmir	351	226	125
Jharkhand	212	91	121
Karnataka	511	361	150
Kerala	280	175	105
Madhya Pradesh	449	285	164
Maharashtra	662	306	356
Odisha	405	290	115
Punjab	250	130	120
Rajasthan	350	236	114
Tamil Nadu	545	235	310
Telangana	224	121	103
Uttar Pradesh	500	328	172
Uttarakhand	375	195	180
West Bengal	555	304	251

## 2014: State-wise number of PSUs

States	Total	Rural	Urban
<b>Arunachal Pradesh</b>	<b>65</b>	<b>50</b>	<b>15</b>
<b>Goa</b>	<b>95</b>	<b>45</b>	<b>50</b>
<b>Manipur</b>	<b>165</b>	<b>120</b>	<b>45</b>
<b>Meghalaya</b>	<b>130</b>	<b>95</b>	<b>35</b>
<b>Mizoram</b>	<b>45</b>	<b>25</b>	<b>20</b>
<b>Nagaland</b>	<b>50</b>	<b>35</b>	<b>15</b>
<b>Sikkim</b>	<b>65</b>	<b>50</b>	<b>15</b>
<b>Tripura</b>	<b>90</b>	<b>65</b>	<b>25</b>
<b>A &amp; N Islands</b>	<b>55</b>	<b>37</b>	<b>18</b>
<b>Chandigarh</b>	<b>40</b>	<b>5</b>	<b>35</b>
<b>Dadra, Nagar Haveli</b>	<b>35</b>	<b>15</b>	<b>20</b>
<b>Daman &amp; Diu</b>	<b>25</b>	<b>15</b>	<b>10</b>
<b>Lakshadweep</b>	<b>15</b>	<b>3</b>	<b>12</b>
<b>Puducherry</b>	<b>55</b>	<b>18</b>	<b>37</b>

**Source: Statistical report 2016**

## Population (in '000) covered by SRS, India

Year	Area		
	Rural	Urban	Combined
1970	2633	1030	3663
1989	4624	1319	5944
2004	4936	1798	6734
2016	5674	2033	7708

**Source: Statistical reports of various years**

States / UTs 534	Total	Rural	Urban
Andhra Pradesh	321	260	61
Assam	215	106	109
Bihar	360	283	76
Chhattisgarh	114	70	44
Delhi	128	15	114
Gujarat	416	289	127
Haryana	235	182	53
Himachal Pradesh	116	91	25
Jammu & Kashmir	225	182	44
Jharkhand	150	90	60
Karnataka	491	411	80
Kerala	359	307	51
Madhya Pradesh	399	303	96
Maharashtra	501	340	161
Odisha	347	288	59
Punjab	202	142	60
Rajasthan	314	259	55
Tamil Nadu	504	277	177
Telangana	206	153	53
Uttar Pradesh	505	406	99
Uttarakhand	285	181	104
West Bengal	534	408	126

## 2016: State-wise population ('000) surveyed

States	Total	Rural	Urban
<b>Arunachal Pradesh</b>	<b>40</b>	<b>30</b>	<b>10</b>
<b>Goa</b>	<b>85</b>	<b>63</b>	<b>22</b>
<b>Manipur</b>	<b>146</b>	<b>120</b>	<b>26</b>
<b>Meghalaya</b>	<b>79</b>	<b>60</b>	<b>19</b>
<b>Mizoram</b>	<b>35</b>	<b>24</b>	<b>11</b>
<b>Nagaland</b>	<b>30</b>	<b>23</b>	<b>6</b>
<b>Sikkim</b>	<b>60</b>	<b>49</b>	<b>11</b>
<b>Tripura</b>	<b>105</b>	<b>90</b>	<b>14</b>
<b>A &amp; N Islands</b>	<b>45</b>	<b>36</b>	<b>9</b>
<b>Chandigarh</b>	<b>30</b>	<b>10</b>	<b>21</b>
<b>Dadra, Nagar Haveli</b>	<b>40</b>	<b>27</b>	<b>13</b>
<b>Daman &amp; Diu</b>	<b>27</b>	<b>21</b>	<b>6</b>
<b>Lakshadweep</b>	<b>12</b>	<b>3</b>	<b>9</b>
<b>Puducherry</b>	<b>48</b>	<b>26</b>	<b>21</b>

**Source: Statistical report 2016**

Note:

1. Total may not add up to Rural & Urban due to rounding
2. Estimate of Jammu & Kashmir excludes Ladakh Valley Natural Division

# SRS Process: Flow Chart

F=Form

Baseline Survey: By Supervisor assisted by enumerator

House list (F1)

Household schedule (F2)

Pregnant woman list (F3)

Continuous enumeration by part time enumerator (PTE)

Retrospective half yearly survey (HYS) by supervisor

Births

Netting of Births = F4  
Monthly report = F6

Deaths

Netting of Deaths = F5  
Monthly report = F7

Updating  
F1, F2, F3

Netting of Births: F9

Netting of Deaths: F10

Matching

Births: F4 with F9  
Deaths: F5 with F10

Partial match/Unmatched

Fully matched

Re-Verification

Independently by another supervisor

Correct Birth & Death

Transmission of F11 to F17 to the ORGI

F11: Finalized list of births  
F12: Finalized list of deaths  
F13: Results of HYS of birth  
F14: Results of HYS of deaths

**F8: Consolidated monthly report of Births/Deaths; F15: Usual residents by age/marital status; F16: Female Population by age & education; F17: Females married during HYS by age at effective marriage**

# Method/Process under SRS

- Dual recording system
  - continuous recording of events (births and deaths) by resident enumerators
  - six monthly follow-up survey by independent team of regular supervisors
- Matching of events – continuous enumeration versus listed in half-yearly survey
  - Discrepancies reconciled by half yearly field visits
  - Reconciliation of unmatched and partially matched events helps in netting of most vital events and minimises errors
- Usual resident population: Base-line survey of sample units

# SRS Publications

## **Annual publications:**

1. SRS Bulletin
2. SRS Annual Statistical Report
3. Abridged life tables
  - Indicators mostly for bigger states by residence, sex, age
  - CBR/CDR/IMR available for natural division for bigger state
  - Life tables constructed by combining 5-years death; separately for rural-urban areas and male-female

## **Special publications:**

1. Bulletin on maternal mortality
2. Causes of death

# Periodicity, content, type of indicators and disaggregation level in SRS

Title and location	Mortality Indicators/ Coverage/Level/breakdown	Periodicity/time gap
<p>A: SRS Bulletin  <a href="http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/SRS%20Bulletin%20-Sep_2017-Rate-2016.pdf">http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/SRS%20Bulletin%20-Sep_2017-Rate-2016.pdf</a> (accessed on April 6, 2019)</p>	<ol style="list-style-type: none"> <li>1. Table 1 = CDR/IMR; for all states and UT by urban-rural</li> <li>2. Table 2 = Lower/ upper estimate of CDR/IMR with 95% Confidence; Available for 21 Bigger States by urban-rural</li> <li>3. Table 3 = CDR by gender and place of residence; For all by gender and rural-urban</li> <li>4. Table 4 = IMR; For 21 bigger states by gender and rural-urban; for remaining by gender only for combined areas</li> </ol>	<ol style="list-style-type: none"> <li>1. Annual</li> <li>2. Most recent, September 2017 indicators for year 2016</li> <li>3. Time lag, more than two years</li> </ol>
<p><b>B: SRS Statistical Report 2016 (Field work period 2017)</b></p> <p><a href="http://www.censusindia.gov.in/vital_statistics/SRS_Report_2016/8.Chap%204-Mortality%20Indicators-2016.pdf">http://www.censusindia.gov.in/vital_statistics/SRS_Report_2016/8.Chap%204-Mortality%20Indicators-2016.pdf</a> (accessed on April 6, 2019)</p>	<p>A chapter on mortality estimates: Statements 40 to 57 &amp; detailed table:</p> <p>Table1: population distribution by age, sex and marital status (bigger states only)</p> <p>Table 8: Death rates by age, sex and place of residence including CDR.</p> <p>Table 9: CMR, U5MR, IMR, NNMR (early and late), PostNNMR, peri-natal MR, SBR for rural-urban residence.</p> <p>Table 10: % distribution of deaths by age, sex and rural urban residence</p> <p>Table 11: DR and IMR for NSSO natural divisions</p> <p>Share of infant deaths to total deaths (ST. 45)</p> <p>Share of NND and ENND to ID (ST. 48, 49)</p> <p>Share of 0-4, 5-14, 15-59 and 60+ deaths to all deaths (ST. 52-56) by sex and place of residence</p> <p>Percent distribution of deaths by Type of Medical Attention received before death by residence</p>	<ol style="list-style-type: none"> <li>1. Annual</li> <li>2. Latest one is published as 2016; data for the year 2016</li> <li>3. Publication gap = more than two years</li> <li>4. Year of publication not mentioned but previous reports have the date mentioned in Preface</li> </ol>

# Periodicity, content, type of indicators and disaggregation level in SRS

Title and location	Mortality Indicators/ Coverage/Level/breakdown	Periodicity/time gap
<p>C: SRS Based Abridged Life Tables, 2012-16  <a href="http://www.censusindia.gov.in/Vital_Statistics/SRS_Life_Table/SRS-12-16/3.Lftb%202012-16_85.pdf">http://www.censusindia.gov.in/Vital_Statistics/SRS_Life_Table/SRS-12-16/3.Lftb%202012-16_85.pdf</a>                      (accessed on April 6, 2019)</p>	<p><math>{}_nq_x, l_x, {}_nL_x, e_x</math> :Available for bigger states; Constructed with pooled data for 5 years; Separately for combined, rural and urban areas and by gender (person, male and female)  <b>Avg. ASDR of 5 years: MORTPAK; Open age 85+; earlier 70+</b></p>	<p>Most recent for 2012-16                      Available since 1970-75</p>
<p>D: Special Bulletin on Maternal Mortality in India  <a href="http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/MMR%20Bulletin-2014-16.pdf">http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/MMR%20Bulletin-2014-16.pdf</a> (accessed April 6)</p>	<p>Maternal Mortality ratio/rate and lifetime risk for India and 16 states                      Maternal/non-maternal deaths distribution by age for India  <i>Based on deaths combined for 3-years</i></p>	<p>Most recent for 2014-16                      Available since 1997-2003 for 20 years</p>
<p>E: Causes of Death  <a href="http://www.censusindia.gov.in/vital_statistics/causesofdeath.html">http://www.censusindia.gov.in/vital_statistics/causesofdeath.html</a></p>	<p>Distribution of deaths by broad age groups and sex                      Top 10 CoD – 0+, &lt;1, 1-4, 5-14, 15-29, 30-69, 70+, Generally available by sex, EAGA/NEAGA states and by residence for India</p>	<p>Mot recent: 2010-13                      Also available for 2001-3, 2004-6 &amp; 2007-9</p>
<p>F: Baseline report for 2014  <a href="http://www.censusindia.gov.in/vital_statistics/BASELINE%20TABLES08082016.pdf">http://www.censusindia.gov.in/vital_statistics/BASELINE%20TABLES08082016.pdf</a>                      Reference period = Jan 1 2014</p>	<p>Provide detail socio-demographic profile of the surveyed population/areas including caste, education, marital status etc.                      Prevalence of veg/non-veg among 15+ population, by sex for India and bigger states                      smoking, drinking, chewing tobacco                      Access to basic infrastructure – pucca road, bus stand, railway station, source of drinking and irrigation water, electricity, health, education, communication, type of house, sanitation, fuel type, household headship etc.</p>	<p>Once in 10 years; post replacement of the PSUs after the new census results</p>

# Omission rates per 100 births and death in SRS, 1980-81 & 1985

States / India	Births		Deaths	
	1980-81	1985	1980-81	1985
<b>India</b>	<b>3.16</b>	<b>1.82</b>	<b>3.36</b>	<b>2.54</b>
Andhra Pradesh	5.92	0.33	0.50	0.00
Assam 1971-90	9.02	3.79	4.85	3.79
Bihar	NA	0.00	NA	0.00
Gujarat	1.07	0.30	2.51	2.78
Haryana	1.24	1.12	2.35	2.20
Himanchal Pradesh	2.33	1.32	6.75	1.90
Jammu and Kashmir	NA	1.49	NA	1.02
Karnataka	11.06	2.36	6.44	4.54
Kerala	1.96	0.43	2.31	1.54
Madhya Pradesh	0.22	0.25	2.09	0.00
Maharashtra	2.51	0.00	4.65	1.19
Odisha (Orissa)	NA	0.98	NA	2.14
Punjab	1.96	NA	1.42	NA
Rajasthan	4.88	2.52	10.38	2.27
Tamil Nadu	1.98	0.81	1.38	0.00
Uttar Pradesh	2.33	2.92	5.14	5.06
West Bengal	NA	3.06	NA	3.12

- Omission rates usually higher for deaths
- ~2.5% deaths and 1.8% births omitted at national level in 1985
- Omission rates higher in Karnataka, Assam, Rajasthan
  - Lower in Tamil Nadu, Kerala, Maharashtra

Source:

1. Registrar General of India, 1983, Intensive Enquiry Conducted in a sub-sample of SRS Units, Occasional Paper No. 2, Census of India 1981
2. Registrar General of India, 1988, Intensive Enquiry Conducted in a sub-sample of SRS Units, Occasional Paper No. 2, Census of India 1991

# Omission rates per 100 births and death in SRS, 1971-80 & 1981-90

States / India	1971-80			1981-90		
	Male Deaths	Female Deaths	Births	Male Deaths	Female Deaths	Births
<b>India</b>	<b>5.9</b>	<b>8.4</b>	<b>7.5</b>	<b>5.1</b>	<b>12.0</b>	<b>6.5</b>
Andhra Pradesh	3.9	3.5	3.3	8.1	6.8	4.3
Assam (1971-90)	No census in 1981			8.4	11.8	13.9
Bihar	No SRS until 1981			10.1	20.4	8.4
Gujarat	0.0	3.8	0.2	8.6	11.0	3.2
Haryana	8.9	8.7	4.5	18.7	26.0	7.6
Himanchal Pradesh	8.7	3.1	9.7	3.5	5.8	1.7
Jammu & Kashmir	10.4	12.2	13.7	No Census in 1991		
Karnataka	10.4	15.3	16.5	9.6	17.1	7.4
Kerala	-1.0	6.6	1.9	0.0	9.0	0.5
Madhya Pradesh	2.9	-1.0	3.2	4.9	5.9	4.2
Maharashtra	5.2	5.1	12.9	4.1	13.1	8.0
Orissa/Odisha	6.3	5.4	10.4	4.9	6.5	4.0
Punjab	6.2	4.9	7.4	9.7	19.4	7.9
Rajasthan	10.9	15.0	14.0	6.2	14.7	10.0
Tamil Nadu	1.1	2.3	1.5	1.7	5.1	1.4
Uttar Pradesh	3.0	1.3	7.8	4.6	13.6	8.6
West Bengal	No SRS until 1981			7.1	8.1	10.3

- Omission rates lower for male deaths and higher for female deaths
- Patterns remains same over time
- Nationally, 6.5% births, 5% MDs and 12% FDs omitted in 1981-90
- Omission rates higher in Haryana, Bihar, Punjab, Karnataka
  - Lower in Tamil Nadu, Kerala, Himachal Pradesh

# Omission rates per 100 births and death in SRS, 1991-200 & 2001-10

States / India	1991-2000			2001-2010		
	Male Deaths	Female Deaths	Births	Male Deaths	Female Deaths	Births
<b>India</b>	<b>7.5</b>	<b>2.1</b>	<b>1.6</b>	<b>4.3</b>	<b>11.3</b>	<b>2.7</b>
Andhra Pradesh	19.8	15.1	7.2	3.1	0.6	0.7
Assam (1971-90)	17.0	10.3	5.2	4.1	8.4	2.3
Bihar	10.3	23.9	6.2	8.4	19.0	4.2
Gujarat	11.5	7.5	3.0	0.0	0.0	0.0
Haryana	4.5	3.7	0.0	9.8	18.9	4.4
Himanchal Pradesh	3.0	25.0	5.4	0.0	6.2	1.1
Jammu & Kashmir	Excluded from analysis					
Karnataka	11.8	10.4	4.0	0.0	0.0	0.0
Kerala	0.6	10.1	1.9	7.3	16.4	5.7
Madhya Pradesh	10.6	1.5	2.2	0.0	0.0	0.0
Maharashtra	0.0	0.0	0.0	0.0	0.0	0.0
Odisha (Orissa)	6.4	4.1	2.2	0.0	0.0	0.0
Punjab	2.1	0.0	1.9	0.3	0.0	0.1
Rajasthan	13.0	0.0	1.9	11.0	17.0	3.5
Tamil Nadu	24.7	20.1	10.6	0.0	0.0	0.6
Uttar Pradesh	16.0	7.0	3.8	7.8	17.6	3.7
West Bengal	14.5	0.6	2.7	2.5	7.7	1.8

- Omission rates lower for births and higher for deaths, more so females
- Nationally, 2.7% births, 4.3% MDs and 11.3% FDs omitted in 2001-10
- Coverage of birth and female deaths have deteriorated over the decade
- Coverage is almost universal in Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha and Tamil Nadu

# Key observation on data quality

- Undercount of births has reduced; still 2/3 % undercount exists
- Undercount more for deaths, specifically for female deaths
- Huge state-wise variations in coverage, specifically for deaths
  - Bhat method : on the line of balancing equation as suggested by Brass initially. Bhat used generalized population and migration
  - Ajit uses Bennet-Horiuchi Method, which is based on Generalized Population Model. He does not adjusted for migration

# Way forward

- Important to map mortality data 1970-2016 for India and states, especially ASDR (by residence and sex)
  - Bring open age of ASDR to 85+ for previous years (from 70+)
- Standardize early age death rate as 0-1, 1-4 across years
- Construct life tables using one standard method for 1970-2016
- Analyse changes in age patterns of mortality in India, states at advance stage of demographic transition vis-à-vis lagging states
- Model ASDR that can be used for projecting mortality in India
- As undercount measurement is sensitive to migration, critical analysis of migration is key before applying any indirect method to estimate incompleteness
- Some state indicate no under count of events (in relation to census quality). Theoretically it is possible, but need to be examined carefully

Thanks for your time