

Sample Design & Estimation Procedure

3.0 INTRODUCTION

The National Sample Survey, set up by the Government of India in 1950 to collect socioeconomic data employing scientific sampling methods, conducted its 80th round during the period January – December 2025 covering the subject “Household Social Consumption: Health”.

3.1 SAMPLING DESIGN

A multi-stage stratified sampling design will be used where villages/urban blocks or Sub-Units (SUs) of these are regarded as the First Stage Units (FSU) and the households as the Ultimate Stage Units (USU). Both the FSUs and USUs will be selected with Simple Random Sampling Without Replacement (SRSWOR). 8 sample households were canvassed within an FSU.

3.1.1 SAMPLING FRAME FOR FIRST STAGE UNIT

3.1.1.0 The sampling frame for urban sector is the list of Urban Frame Survey (UFS) blocks as per latest Urban Frame Survey and for rural sector, it is the list of villages as per Census 2011 updated by removing those villages which are urbanized and included in latest UFS (till the time of sample selection). Sometimes, with a view to ensuring uniformity in the size of FSUs and operational convenience, large villages/UFS blocks are notionally divided into smaller units of more or less equal size, known as sub-units depending on a pre-defined criteria based on population in the village or number of households in the UFS block. The sector-specific criteria for sub-unit formation are as below:

Rural Sector

- (i) The number of SUs to be formed in the villages (with Census 2011 population of 1000 or more and except some States/UTs) is decided based on projected present population of the village. The criteria for the formation of the SUs used is given below:

Projected Population of the village	Number of SUs to be formed
less than 1200	1
1200 to 2399	2
2400 to 3599	3
...	...

- (ii) For rural areas of Himachal Pradesh, Sikkim, Andaman & Nicobar Islands, Ladakh, parts of Uttarakhand (except four districts Dehradun, Nainital, Haridwar and Udham Singh Nagar), Jammu and Kashmir (seven districts Poonch, Rajouri, Udhampur, Reasi, Doda, Kishtwar, Ramban) and Idukki district of Kerala; SU is formed in a village if population as per Census 2011 is more than or equals to 500. The criteria followed for the number of Sus were as below:

Projected Population of the village	Number of SUs to be formed
less than 600	1
600 to 1199	2
1200 to 1799	3
...	...

Urban Sector:

Sub-units are formed in the UFS blocks with number of households 250 or more. The number of SUs formed within the UFS blocks was decided by the following criteria:

Number of Households in UFS Block	Number of SUs to be formed
less than 250	1
250 to 499	2
500 to 749	3
...	...

Thus, the list of villages / UFS blocks / SUs (for those villages or UFS blocks where sub-units are formed) together constitute the sampling frame for selection of the First Stage Units.

3.1.2 STRATIFICATION OF FSUs

3.1.2.0 The primary geographical unit, called basic stratum within a state/UT for rural and urban sectors is a district.

Rural Sector:

- (i) A Special Stratum comprising of all the uninhabited villages as per Census 2011 is formed at all-India level.
- (ii) From the remaining villages, two more strata are formed in each basic stratum. i.e., in each district:
 - (a) Stratum 1: Comprising of the villages within 5 Kms from the district headquarter or from a city/town with more than 5 lakh population. This stratum is not formed if there are less than 50 such villages in the stratum.
 - (b) Stratum 2: Rest of the villages.

Urban Sector:

Two or more strata will be formed in urban areas of each basic stratum with the following criteria:

- (i) Each million plus city as per census 2011 will be considered as a separate stratum.
- (ii) Rest of the urban areas of the district will constitute another stratum.

3.1.3 SUB-STRATIFICATION OF FSUS

3.1.3.0 In the rural sector, three groups of villages are formed within each stratum, except special rural stratum at all-India level, based on the following criteria:

Group	Population of the village (as per Census 2011)
1	all villages (Panchayat wards for Kerala) with Census 2011 population less than 250
2	all villages (Panchayat wards for Kerala) with Census 2011 population more than or equal to 250 but less than 500
3	remaining villages

3.1.3.1 Further, the sample size for a particular rural stratum is distributed among these 3 groups in proportion to population. If the number of FSUs in a particular group is very small or sufficient number of samples is not allocated, no sub-stratum will be formed. In the same line, urban sub-stratification will be formed.

3.1.4 SAMPLE SIZE

Total 17,636 FSUs have been allocated for the central sample at all-India level for the health survey. The total number of FSUs have been equally distributed among four sub-rounds, each

having a sample of 4409 FSUs. A minimum of 16 FSUs (8 each for the rural and urban sector) were allocated to each State/ UT.

3.1.5 SELECTION OF FSUS WITHIN STRATUM/SUB-STRATUM

The required number of FSUs from each of the stratum / sub-stratum is selected by SRSWOR, independently for each of the sub-rounds.

3.1.6 FORMATION OF SUB-DIVISION

3.1.6.0 It has been experienced that in some of the selected FSUs, the actual present population is significantly higher than the projected population/Census population that causes operational inconvenience for listing of all the households. In such a situation, the selected FSU is notionally sub-divided into several smaller units, called Sub-division. The criteria for determining the number of Sub-divisions to be formed in the selected rural (except areas mentioned in Point ii Section 3.1.1.0) /urban FSU is given below.

Approx. present population of the selected SU	Number of Sub-divisions to be formed
less than 1500	1
1500 to 2399	2
2400 to 3599	3
3600 to 4799	4
...	...

3.1.6.1 The criteria for determining the number of Sub-divisions in rural areas mentioned in Point (ii) of Para 3.1.1.0 are as below:

Approx. present population of the selected SU	Number of Sub-divisions to be formed
less than 750	1
750 to 1199	2
1200 to 1799	3
1800 to 2399	4
...	...

3.1.6.2 Only one Sub-division is selected randomly after forming the required number of Sub-divisions. Further, listing and selection of households are done in the selected Sub-division unit only.

3.1.7 FORMATION OF SECOND STAGE STRATA (SSS)

3.1.7.0 Households listed in the selected FSU/sub-FSU were stratified into three second-stage strata (SSS). The composition of the second-stage strata and the numbers of households planned to be surveyed from different SSS were as follows:

SSS	composition of SSS	number of households surveyed	
		in an FSU without hg/sb formation	in each sub-FSU where sub-FSUs were formed
SSS 1	households having at least one child of age less than 1 year	2	1
SSS 2	from the remaining, households with at least one member (including deceased former member) hospitalised during last 365 days	4	2
SSS 3	other households	2	1

3.1.7.1 **Selection of households:** From each SSS, the sample households were selected by SRSWOR.

3.2 ESTIMATION PROCEDURE

3.2.0 Notations:

S	subscript for s th stratum
t	subscript for t th sub-stratum
i	subscript for i th FSU [SU/ Village / panchayat ward/ UFS block]
j	subscript for j th second stage stratum in an FSU
k	subscript for k th sample household within an FSU
D ₁	total number of sub-divisions formed in the sample FSU. D ₁ =1, if no Sub-division is formed in the SU)
N	total number of FSUs in any rural/urban sub-stratum
n	number of sample FSUs surveyed including 'uninhabited' and 'zero cases' but excluding casualty for a particular sub-stratum
H	total number of households listed in a second-stage stratum of an FSU
h	number of households surveyed in a second-stage stratum of an FSU
x, y	observed value of characteristics x, y under estimation
\hat{X}, \hat{Y}	estimate of population total X, Y for the characteristics x, y

Let y_{stijk} be the observed value of the characteristic y for the k-th household of the j-th second stage stratum of the i-th FSU for the t-th sub-stratum of s-th stratum. For ease of understanding, a few symbols have been suppressed in following paragraphs where they are obvious.

3.2.1 Formulae for Estimation of Aggregates for a stratum × sub-stratum in a sub-round:

3.2.1.0 Schedule 0.0 (Rural/Urban):

For estimating the number of households in a stratum × sub-stratum possessing a characteristic:

$$\hat{Y} = \frac{N}{n} \sum_{i=1}^n D_1 \times y_i$$

where, y_i is the total number of households possessing the characteristic y in i-th FSU.

3.2.1.1 Schedule 25.0: Social consumption on Health Survey:

3.2.1.1.0 For j-th second-stage stratum of a stratum × sub-stratum:

$$\hat{Y}_{stj} = \frac{N_{st}}{n_{stj}} \sum_{i=1}^{n_{stj}} \left[D_{1sti} * \frac{H_{stij}}{h_{stij}} * \sum_{k=1}^{h_{stij}} y_{stijk} \right]$$

where n_{stj} is the number of sample FSUs with non-void j -th second-stage stratum of t -th sub-stratum of s -th stratum.

3.2.1.1.1 Aggregate \hat{Y} is obtained combining all the second-stage strata of a stratum \times sub-stratum:

$$\hat{Y}_{st} = \sum_j \hat{Y}_{stj}, j = 1, 2, 3$$

3.2.2 Overall Estimate of Aggregates for a stratum:

Overall estimate for s -th stratum (\hat{Y}_s) will be obtained as

$$\hat{Y}_s = \sum_t \hat{Y}_{st}$$

3.2.3 Overall Estimate of Aggregates at District/State/UT/all-India level:

The overall estimate \hat{Y} at the district / State / UT/ all-India level is obtained by summing the stratum estimates \hat{Y}_s over all strata belonging to the district / State / UT / all-India.

3.2.4 Estimates of Ratios:

Let \hat{Y} and \hat{X} be the overall estimates of the aggregates Y and X for two characteristics y and x , respectively at the district / State / UT / all-India level.

Then, the combined ratio estimate (\hat{R}) of the ratio ($R = \frac{Y}{X}$) will be obtained as $\hat{R} = \frac{\hat{Y}}{\hat{X}}$.

3.2.5 Estimation of Errors:

3.2.5.0 Formula for estimated variance (for Rural / Urban):

Here, the required number of FSUs will be selected by SRSWOR within the given stratum \times sub-stratum for each sub-round (or quarter). Subsequently, USUs will be selected by SRSWOR within each of the selected FSUs. If the i^{th} FSU has been selected, h_i unit is selected from this particular FSU \times SSS by SRSWOR method.

(a) Formula for aggregate \hat{Y} (for Rural/Urban):

$$\hat{Y}_{ij} = H_{ij} * \bar{y}_{ij} * D_{1si} \quad \text{and} \quad \bar{y}_{ij} = \frac{\sum_1^{h_{ij}} y_{ijk}}{h_{ij}}$$

$$V\hat{a}r(\hat{Y}) = \sum_s V\hat{a}r(\hat{Y}_s) = \sum_s \sum_t V\hat{a}r(\hat{Y}_{st}) = \sum_s \sum_t \sum_j V\hat{a}r(\hat{Y}_{stj})$$

$$V\hat{a}r(\hat{Y}_{stj}) = \frac{1}{n_{stj}(n_{stj}-1)} \sum_{i=1}^{n_{stj}} (N_{st} \hat{Y}_{stij} - \hat{Y}_{stj})^2, \text{ where, } j = 1, 2, 3$$

(b) Formula for ratio \hat{R} (for Rural/Urban):

Note that X^2 MSE (\hat{R}) is unbiasedly estimated by $V(\hat{Y} - R\hat{X})$

$$V(\hat{Y} - R\hat{X}) = v(\hat{u}) \text{ where } u_{ijk} = (y_{ijk} - Rx_{ijk}),$$

$U_i = (Y_i - RX_i)$ and $U = (Y - RX) = 0$ at domain level (State/District).

$$\hat{X}^2 M\hat{S}E(\hat{R}) = \hat{V}(\hat{U}) \text{ at } R = \hat{R}$$

$$M\hat{S}E(\hat{R}) = \frac{1}{\hat{X}^2} \sum_s \sum_t \sum_j M\hat{S}E_{stj}(\hat{R})$$

$$M\hat{S}E_{stj}(\hat{R}) = \frac{1}{n_{stj}(n_{stj}-1)} \sum_1^{n_{stj}} [N_{st}(\hat{Y}_{stij} - \hat{R}\hat{X}_{stij}) - (\hat{Y}_{stj} - \hat{R}\hat{X}_{stj})]^2$$

$$\hat{Y}_{stij} = \frac{1}{N_{st}} \times \sum_{k=1}^{h_{stij}} y_{stijk} \times n_{stj} \times multiplier$$

$$\hat{X}_{stij} = \frac{1}{N_{st}} \times \sum_{k=1}^{h_{stij}} x_{stijk} \times n_{stj} \times multiplier$$

where, $j = 1, 2, 3$

The formulae for multipliers are as given in Section 2.

3.2.5.1 Estimates of Relative Standard Error (RSE):

$$R\hat{S}E(\hat{Y}) = \frac{\sqrt{V\hat{a}r(\hat{Y})}}{\hat{Y}} \times 100$$

$$R\hat{S}E(\hat{R}) = \frac{\sqrt{M\hat{S}E(\hat{R})}}{\hat{R}} \times 100$$

3.2.6 Multipliers for estimate:

The formulae for multipliers at stratum/sub-stratum/second-stage stratum level for different types of schedules are given below.

Schedule	Sector	Formula for multipliers
0.0	Rural / Urban	$\frac{N_{st}}{n_{st}}$
25.0	Rural / Urban	$\frac{N_{st}}{n_{stj}} * D_1 * \frac{H_{stij}}{h_{stij}}$
	j = 1, 2, 3	

Note: Multipliers have to be computed on the basis of information available in the listing Schedule 0.0, irrespective of any misclassification observed between the listing Schedule and detailed enquiry Schedule (Schedule 25.0).