Chapter 5

POPULATION ESTIMATION AND STATISTICAL DEFINITIONS/METHODS

Estimation of Population

In India, the census is providing population figures once in every 10 years. However, based on the Cancer Incidence data, to provide various rates for inter-census years, the calculation of the relevant population estimates, assumes importance.

Population of Bhopal Urban Agglomerate

Bhopal, a small town of 1901, started flourishing soon after receiving the status of state capital in 1956. New areas were included in the Bhopal Municipal Corporation. In 1971, Bhopal became a district place. A large number of migratory populations came and settled here. As per the census data, Bhopal had the maximum growth of 7.4% during the decade 1961-1971. As revealed by the 2001 census, the city had a growth rate of 2.98% for males and 3.04% for females during the decade 1991-2001.

Population and Growth Rates of Area 1 and Area 2

Census data on ward wise population was utilized to arrive at total population of MIC affected and MIC unaffected areas (Area 1 and Area 2) for the year 1981, 1991 & 2001 correspondingly the average annual growth rates were also calculated for males and females separately and shown Table 5.1.

Table 5.1: Population & Growth Rate of Area 1 and Area 2 for years 1981, 1991 & 2001

Year	Male		Female	
	Area 1	Area 2	Area 1	Area 2
1981	230256	132730	201606	114220
1991	347386	223381	311387	198648
2001	442994	325396	397504	292520
Average Annual Growth Rate (1981-1991)	4.2	5.2	4.4	5.7
Average Annual Growth Rate (1991-2001)	2.5	3.8	2.6	3.9

It was observed that the growth rate differed significantly between the Area 1 and Area 2 for the period 1981-1991 & 1991-2001. In view of this the age distribution provided by the census for Bhopal Urban Agglomerate cannot be used for two areas. It may be mentioned that the age distribution for the ward wise population is not available for any of the census. This necessitated the calculation of five yearly age group populations of the two areas. The following data were used in estimation of five yearly age group population:

1. The growth rates of 1981-1991; 1991-2001 of Area 1 and Area 2.
2. Age and sex distribution of ICMR cohort of 1985.
3. Age and sex distribution of NCRP survey 2005 carried out in Area 1 and Area 2.

The details of the ICMR cohort 1985 and the NCRP survey 2005 are provided in Tables 5.2 and 5.3. A significant difference was observed in age distribution of the two areas among males as well as females. This confirmed the fact that a common age distribution cannot be used for both the areas.

Table 5.2: Age & Sex Distribution of Area 1 and Area 2 of ICMR Cohort 1985

Age Group	Male				Female			
	Area 1		Area 2		Area 1		Area 2	
	No.	%	No.	%	No.	%	No.	%
0-4	4903	11.68	1094	12.75	4560	12.08	953	12.94
5-9	5614	13.38	1265	14.74	5063	13.41	1202	16.33
10-14	5302	12.63	965	11.25	4808	12.74	864	11.74
15-19	4491	10.70	774	9.02	4295	11.38	631	8.57
20-24	4496	10.71	789	9.20	4458	11.81	903	12.27
25-29	3696	8.81	843	9.83	3661	9.70	815	11.07
30-34	3132	7.46	779	9.08	2509	6.65	629	8.54
35-39	2526	6.02	686	8.00	2005	5.31	399	5.42
40-44	2096	4.99	463	5.40	1577	4.18	272	3.69
45-49	1659	3.95	310	3.61	1334	3.53	173	2.35
50-54	1421	3.39	219	2.55	1091	2.89	155	2.11
55-59	763	1.82	109	1.27	623	1.65	89	1.21
60-64	979	2.33	138	1.61	920	2.44	152	2.06
65-69	333	0.79	48	0.56	315	0.83	47	0.64
70-74	326	0.78	60	0.70	297	0.79	41	0.56
75+	231	0.55	38	0.44	236	0.63	37	0.50
Total	**41968**	**100.00**	**8580**	**100.00**	**37752**	**100.00**	**7362**	**100.00**

METHOD FOR ESTIMATION OF POPULATION

Difference distribution method *(Takiar & Shobana, 2009)* was used to calculate the five yearly age group population estimates for inter-census years. The method of calculation is shown in Annexure I. The following steps were used in estimation:

1. The total populations were arrived separately for Area 1 and Area 2 utilizing the respective decadal growth rates.
2. Utilizing the five yearly percentage distribution of ICMR cohort 1985 the five yearly age group populations for the year 1985 of Area 1 and Area 2 were arrived.
3. Similarly, utilizing the five yearly percentage distributions of NCRP survey 2005 the five yearly age group populations for the year 2005 of Area 1 and Area 2 were arrived.

Table 5.3: Age & Sex Distribution of Area 1 and Area 2 - NCRP Survey 2005

Age Group	Male				Female			
	Area 1		Area 2		Area 1		Area 2	
	No.	%	No.	%	No.	%	No.	%
0-4	475	8.22	455	7.41	429	8.23	452	7.97
5-9	633	10.95	591	9.63	537	10.30	518	9.13
10-14	665	11.50	660	10.75	583	11.19	573	10.10
15-19	675	11.68	667	10.87	574	11.01	593	10.46
20-24	707	12.23	664	10.82	645	12.38	655	11.55
25-29	497	8.60	593	9.66	524	10.05	576	10.16
30-34	440	7.61	470	7.66	444	8.52	484	8.53
35-39	434	7.51	460	7.49	386	7.41	434	7.65
40-44	326	5.64	376	6.13	307	5.89	317	5.59
45-49	265	4.58	301	4.90	221	4.24	279	4.92
50-54	182	3.15	225	3.67	149	2.86	220	3.88
55-59	145	2.51	226	3.68	131	2.51	160	2.82
60-64	130	2.25	156	2.54	110	2.11	180	3.17
65-69	88	1.52	137	2.23	64	1.23	105	1.85
70-74	64	1.11	97	1.58	57	1.09	70	1.23
75+	55	0.95	60	0.98	51	0.98	55	0.97
Total	**5781**	**100.00**	**6138**	**100.00**	**5212**	**100.00**	**5671**	**100.00**

4. The difference (2005-1985) in each of the five yearly age group populations was arrived and their percentage contribution to total growth (1985 to 2005) was calculated.

5. To estimate the five yearly age group population for a given year its growth in relation to the year 1985 was distributed according to the percentage distribution arrived in step 4 and subsequently added to the base population of the year 1985.

6. The estimated population totals and the 5 yearly age group distributions for 1988 to 2005 of Area 1 and Area 2 are shown in Annexure I.

Definitions, Statistical Terms and Method Used in Calculations

Cancer Case: All neoplasms with a morphology behaviour code of '3' as defined by the International Classification of Diseases - Oncology, (Third edition) are considered reportable and therefore registered.

Age-Group: According to WHO, the following five yearly age groups are in use for reporting the cancer incidences:

0-4, 5-9, 10-14, ...,75+.

Incidence Cases: This refers to new cancer cases diagnosed during a year in a given population.

Rates: Cancer is a rare disease hence its various incidence rates are expressed per 100,000 populations.

Crude Incidence Rate (CR): This is the ratio of the number of new cases to the estimated mid year population (mid-year), multiplied by 100,000.

$$CR = \frac{\text{New cases of cancer of a particular year}}{\text{Estimated mid year population of the same year}} \times 100{,}000$$

Age Specific Rate (ASpR): This is the ratio of the number of new cases of a particular age group to the estimated mid year population of the same age group, multiplied by 100,000.

$$ASpR = \frac{\text{New cases of cancer of a particular year in the given age group}}{\text{Mid year population of the same year for the given age group}} \times 100{,}000$$

Age Adjusted or Age Standardized Rate (AAR): Mostly occurrence of cancer increases as age increases. Therefore a higher proportion of older population implies a higher number of cancers. Most developed western countries have a higher proportion of older population. So in order to make rates of cancer comparable between developed and developing countries, a hypothetical world standard population (Table 5.4) was used to arrive at the age adjusted or age standardized rates. The world standard population approximates the proportional age distribution of the world and is given below:

Table 5.4: Distribution of World Standard Population

Age Group	World Standard Population
0-4	12,000
5-9	10,000
10-14	9,000
15-19	9,000
20-24	8,000
25-29	8,000
30-34	6,000
35-39	6,000
40-44	6,000
45-49	6,000
50-54	5,000
55-59	4,000
60-64	4,000
65-69	3,000
70-74	2,000
75 +	2,000
All Ages	**100,000**

$$\mathbf{AAR} = \frac{\sum_{i=1}^{A} a_i w_i}{\sum_{i=1}^{A} w_i}$$

Where:

a_i is the age specific rate(AspR) in age class i ;

w_i is the world standard population in age class i;

A (=16) represents the number of age intervals

or expressed in more simpler term thus:

$$\text{AAR} = \frac{\sum \text{(ASpR) x (No. of persons in Std. world population in that 5 yr. age group)}}{100{,}000}$$