

# Chapter 1

## POPULATION AND CANCER INCIDENCE

The major concern of Population Based Cancer Registries (PBCRs) is to calculate cancer incidence rates, study the rates of individual cancers by comparing cancer incidence and patterns in other registries and in different subgroups of population in the respective areas.

PBCRs systematically collect information on all reportable neoplasms occurring in a geographically defined population from multiple sources. The comparison and interpretation of population based cancer incidence data support population-based actions aimed at reducing the cancer burden in the community. The systematic ascertainment of cancer incidence from multiple sources can provide an unbiased profile of the cancer burden in the population and how it is changing over time.

These registries have a unique role in planning and evaluating cancer control programmes.

This report on the occurrence of cancer in a defined population provides a framework for assessing and controlling the impact of cancer in the community.

### Geographical Area and Population at Risk

The data from Meghalaya PBCR analysed here belong to the districts of East Khasi Hills, West Khasi Hills, Jaintia Hills and Ri Bhoi, that of Nagaland PBCR belong to the districts of Kohima and Dimapur.

Two PBCRs namely, Pasighat and Naharlagun PBCRs from Arunachal Pradesh cover different districts from the state. Pasighat PBCR's data belongs to the districts of East Siang and Upper Siang. Naharlagun PBCR's data belongs to 8 districts namely, Tawang, West Kameng, East Kameng, Upper Subansiri, Lower Subansiri, Kurng Kumey, Papumpare and West Siang. The data has been analysed for Naharlagun, Papumpare District and Naharlagun excluding Papumpare District.

Patiala PBCR's data covers Patiala District.

The registry area covered by Thiruvananthapuram PBCR has increased from Thiruvananthapuram Taluk (2005-2011) to Thiruvananthapuram District, 2012 onwards.

The growth rate of the population between the census years 2001 and 2011 has been used (through the Difference Distribution Method of Takiar and Shobana, 2009) to estimate the mid-year populations (five year age group and total) for the years of the report, viz., 2012 to 2014. The same has been followed for 25 PBCRs, except for Kamrup Urban and Nagaland PBCRs. Factors such as, net migration, birth rate and death rate have not been considered.

The growth rate of the population between the census years 1991 and 2001 has been used to estimate the mid-year populations (five year age group and total) for the years of the report, viz., 2012 to 2014 for Kamrup Urban PBCR, because of certain concerns in population enumeration in north-eastern states by the Census of India. (Deccan Herald, June 3, 2015).

The 2001 census has been rejected by the Govt. of Nagaland. The population for Nagaland PBCR (Kohima and Dimapur) has therefore been estimated using 1991 and 2011 census to get the mid-year population of 2012 to 2014.

Table 1.1 shows the number of male and female population covered by 27 PBCRs and provides information from 34 geographical areas. The average population covered per year ranged from 1.38 lakhs in Pasighat PBCR (East Siang and Upper Siang districts) from Arunachal Pradesh to 168.9 lakhs in Delhi Registry.

**Table 1.1: Estimated Population of All PBCRs**

Registry	Area (sq.km.)	Male	Annual Average	Female	Annual Average	Total Pop.	Annual Average
<b>Bangalore</b> (2012)	741	4616478	4616478	4269020	4269020	8885498	8885498
<b>Barshi Rural</b> (2012-2014)	3713	798979	266326	719153	239718	1518132	506044
<b>Barshi Expanded</b> (2012)	18262	2257996	2257996	2070963	2070963	4328959	4328959
<b>Bhopal</b> (2012-2013)	350	2088045	1044022	1931368	965684	4019413	2009706
<b>Chennai</b> (2012-2013)	170	4715650	2357825	4693785	2346893	9409435	4704718
<b>Delhi</b> (2012)	1157	9012555	9012555	7884429	7884429	16896984	16896984
<b>Mumbai</b> (2012)	603	6728832	6728832	5777374	5777374	12506206	12506206
<b>Cachar District</b> (2012-2014)	3786	2770786	923595	2668126	889375	5438912	1812970
<b>Dibrugarh District</b> (2012-2014)	3381	2076093	692031	2009170	669723	4085263	1361754
<b>Kamrup Urban District</b> (2012-2014)	336	2141950	713983	1940459	646820	4082409	1360803
<b>Manipur State (MR)</b> (2012-2014)	22327	4600029	1533343	4539808	1513269	9139837	3046612
<i>Imphal West District</i> (2012-2014)	519	790580	263527	820147	273382	1610727	536909
<i>MR - Excl. Imphal West</i> (2012-2014)	21808	3809449	1269816	3719661	1239887	7529110	2509703
<b>Mizoram State (MZ)</b> (2012-2014)	21087	1741869	580623	1716527	572176	3458396	1152799
<i>Aizawl District</i> (2012-2014)	3576	623139	207713	637360	212453	1260499	420166
<i>MZ - Excl. Aizawl</i> (2012-2014)	17511	1118750	372917	1079174	359725	2197924	732642
<b>Sikkim State</b> (2012-2014)	7096	995202	331734	889210	296403	1884412	628137
<b>Ahmedabad Urban</b> (2012-2013)	364	6263952	3131976	5639544	2819772	11903496	5951748
<b>Aurangabad</b> (2012-2014)	148	1980880	660293	1850731	616910	3831611	1277203
<b>Kolkata</b> (2012)	185	2338295	2338295	2149037	2149037	4487332	4487332
<b>Kollam District</b> (2012-2014)	2491	3739048	1246349	4203108	1401036	7942156	2647385
<b>Nagpur</b> (2012-2013)	237	2620014	1310007	2532597	1266299	5152611	2576306
<b>Pune</b> (2012-2013)	613	5477270	2738635	4956064	2478032	10433334	5216667
<b>Thi'puram District</b> (2012-2014)	2192	4753308	1584436	5198769	1732923	9952077	3317359
<b>Meghalaya</b> (2012-2014)	14262	2964519	988173	2968522	989507	5933041	1977680
<i>East Khasi Hills District</i> (2012-2014)	2748	1293767	431256	1316769	438923	2610536	870179
<b>Tripura State</b> (2012-2014)	10492	5799657	1933219	5584512	1861504	11384169	3794723
<b>Nagaland</b> (2012-2014)	2390	1091662	363887	1016933	338978	2108595	702865
<b>Wardha District</b> (2012-2014)	6309	2026323	675441	1922291	640764	3948614	1316205
<b>Naharlagun (NH)</b> (2012-2014)	42095	1256000	418667	1203625	401208	2459625	819875
<i>Papumpare District</i> (2012-2014)	3462	288990	96330	288861	96287	577851	192617
<i>NH - Excl. Papumpare</i> (2012-2014)	38633	967010	322337	914764	304921	1881774	627258
<b>Pasighat</b> (2012-2014)	10193	210521	70174	203495	67832	414016	138006
<b>Patiala District</b> (2012-2014)	3325	3130053	1043351	2800456	933485	5930509	1976836

**Table 1.2: Total Number of Cases Registered for All PBCRs***(Calendar years of data shown in parentheses for each registry)*

Registry	Male	Female	Total Cases
<b>Bangalore</b> (2012)	3824	4547	8371
<b>Barshi Rural</b> (2012-2014)	454	475	929
<b>Barshi Expanded</b> (2012)	901	1131	2032
<b>Bhopal</b> (2012-2013)	1718	1746	3464
<b>Chennai</b> (2012-2013)	5447	6212	11659
<b>Delhi</b> (2012)	10148	9598	19746
<b>Mumbai</b> (2012)	6598	6759	13357
<b>Cachar District</b> (2012-2014)	2666	2100	4766
<b>Dibrugarh District</b> (2012-2014)	1498	1345	2843
<b>Kamrup Urban District</b> (2012-2014)	3071	2392	5463
<b>Manipur State (MR)</b> (2012-2014)	2081	2542	4623
<i>Imphal West District</i> (2012-2014)	640	823	1463
<i>MR - Excl. Imphal West</i> (2012-2014)	1441	1719	3160
<b>Mizoram State (MZ)</b> (2012-2014)	2567	2089	4656
<i>Aizawl District</i> (2012-2014)	1275	1066	2341
<i>MZ - Excl. Aizawl</i> (2012-2014)	1292	1023	2315
<b>Sikkim State</b> (2012-2014)	707	678	1385
<b>Ahmedabad Urban</b> (2012-2013)	5477	4117	9594
<b>Aurangabad</b> (2012-2014)	1123	1118	2241
<b>Kolkata</b> (2012)	2777	2596	5373
<b>Kollam District</b> (2012-2014)	5534	5478	11012
<b>Nagpur</b> (2012-2013)	2236	2417	4653
<b>Pune</b> (2012-2013)	3417	3686	7103
<b>Thi'puram District</b> (2012-2014)	7638	8002	15640
<b>Meghalaya</b> (2012-2014)	2632	1616	4248
<i>East Khasi Hills District</i> (2012-2014)	1624	988	2612
<b>Tripura State</b> (2012-2014)	3628	2702	6330
<b>Nagaland</b> (2012-2014)	815	546	1361
<b>Wardha District</b> (2012-2014)	1306	1424	2730
<b>Naharlagun (NH)</b> (2012-2014)	735	704	1439
<i>Papumpare District</i> (2012-2014)	299	333	632
<i>NH - Excl. Papumpare</i> (2012-2014)	436	371	807
<b>Pasighat</b> (2012-2014)	175	159	334
<b>Patiala District</b> (2012-2014)	2853	3158	6011

**Table 1.3: Crude Rate (CR) , Age Adjusted (AAR) and Truncated (TR) Incidence Rates per 100,000 Population in Different PBCRs**

Registry	Male			Female		
	CR	AAR	TR	CR	AAR	TR
<b>Bangalore</b> (2012)	82.8	105.4	160.3	106.5	125.9	243.2
<b>Barshi Rural</b> (2012-2014)	56.8	53.9	84.6	66.0	60.4	125.3
<b>Barshi Expanded</b> (2012)	39.9	40.9	76.7	54.6	52.0	114.4
<b>Bhopal</b> (2012-2013)	82.3	101.5	181.0	90.4	108.3	223.5
<b>Chennai</b> (2012-2013)	115.5	116.1	181.0	132.3	126.2	252.7
<b>Delhi</b> (2012)	112.6	149.4	235.8	121.7	144.8	286.9
<b>Mumbai</b> (2012)	98.1	113.1	160.4	117.0	118.5	209.8
<b>Cachar District</b> (2012-2014)	96.2	125.4	227.7	78.7	95.2	210.1
<b>Dibrugarh District</b> (2012-2014)	72.2	92.8	155.7	66.9	78.6	178.8
<b>Kamrup Urban District</b> (2012-2014)	143.4	206.0	321.8	123.3	174.0	325.3
<b>Manipur State (MR)</b> (2012-2014)	45.2	60.5	88.7	56.0	68.6	126.1
<i>Imphal West District</i> (2012-2014)	81.0	92.4	119.6	100.3	103.6	184.6
<i>MR - Excl. Imphal West</i> (2012-2014)	37.8	52.2	81.0	46.2	59.2	110.4
<b>Mizoram State (MZ)</b> (2012-2014)	147.4	211.5	372.1	121.7	165.8	296.9
<i>Aizawl District</i> (2012-2014)	204.6	270.7	499.9	167.3	207.7	356.7
<i>MZ - Excl. Aizawl</i> (2012-2014)	115.5	175.0	293.4	94.8	136.6	255.6
<b>Sikkim State</b> (2012-2014)	71.0	90.7	133.0	76.2	100.3	175.7
<b>Ahmedabad Urban</b> (2012-2013)	87.4	98.5	181.0	73.0	76.5	155.7
<b>Aurangabad</b> (2012-2014)	56.7	72.0	122.8	60.4	73.0	153.2
<b>Kolkata</b> (2012)	118.8	100.9	158.5	120.8	103.4	205.6
<b>Kollam District</b> (2012-2014)	148.0	120.5	189.0	130.3	101.7	195.8
<b>Nagpur</b> (2012-2013)	85.3	89.4	151.6	95.4	94.5	194.1
<b>Pune</b> (2012-2013)	62.4	77.6	116.2	74.4	84.9	166.0
<b>Thi'puram District</b> (2012-2014)	160.7	132.0	203.7	153.9	120.4	231.5
<b>Meghalaya</b> (2012-2014)	88.8	169.6	376.1	54.4	94.4	199.3
<i>East Khasi Hills District</i> (2012-2014)	125.5	218.3	482.4	75.0	117.0	241.3
<b>Tripura State</b> (2012-2014)	62.6	76.4	136.5	48.4	54.9	120.0
<b>Nagaland</b> (2012-2014)	74.7	125.8	227.9	53.7	84.9	179.9
<b>Wardha District</b> (2012-2014)	64.5	60.2	105.9	74.1	66.7	145.1
<b>Naharlagun (NH)</b> (2012-2014)	58.5	103.5	207.4	58.5	100.5	227.8
<i>Papumpare District</i> (2012-2014)	103.5	230.4	412.4	115.3	249.0	560.6
<i>NH - Excl. Papumpare</i> (2012-2014)	45.1	76.9	159.7	40.6	66.6	150.3
<b>Pasighat</b> (2012-2014)	83.1	107.4	194.3	78.1	101.4	239.3
<b>Patiala District</b> (2012-2014)	91.1	97.9	175.3	112.8	111.2	244.2

Table 1.2 gives the number of cases registered for the calendar year(s) (1 January to 31 December) by each PBCR from 2012 to 2014. The top five PBCRs to register maximum number of cases were Delhi (19746), Thiruvananthapuram District (15640), Mumbai (13357), Chennai (11659) and Kollam (11012) PBCRs. Cancer cases in males were more in Delhi, Cachar District, Dibrugarh District, Kamrup Urban District, Mizoram State, Sikkim State, Ahmedabad Urban District, Kolkata, Kollam District, Meghalaya State, Tripura State, Nagaland and Naharlagun PBCRs. Female cancers were more in Bangalore, Barshi Expanded, Bhopal, Chennai, Mumbai, Manipur State, Nagpur, Pune, Thiruvananthapuram District, Wardha and Patiala PBCRs. Slight variation was observed in numbers between the sexes in the PBCRs at Barshi Rural, Aurangabad and Pasighat.

### Crude Rate (CR)

Table 1.3 gives the Crude Rate (CR), Age Adjusted (AAR) and Truncated (TR) Incidence Rates per 100,000 population in different PBCRs.

The first five highest CR per 100,000 population among males was observed in Aizawl District (204.6), followed by Thiruvananthapuram (160.7), Kollam (148.0), Mizoram State (147.4) and Kamrup Urban District (143.4) PBCRs.

Similarly, among females, the first five highest CR was observed in Aizawl District (167.3) followed by Thiruvananthapuram (153.9), Chennai (132.3), Kollam (130.3) and Kamrup Urban District (123.3) PBCRs.

Aizawl District showed the highest CR in both males and females. Two PBCRs from the state of Kerala, namely Thiruvananthapuram and Kollam have high CRs in both males and females, Kamrup Urban District from the north east too has high CRs in both males and females and thus they appear within the top 5 PBCRs.

### Age Adjusted Rates (AAR)

The AAR per 100,000 population in males ranged from 40.9 in Barshi Expanded to 270.7 in Aizawl District of Mizoram State followed by Papumpare District (230.4) under Naharlagun PBCR in Arunachal Pradesh. In females, it ranged from 52.0 in Barshi Expanded to 249.0 in Papumpare District under Naharlagun PBCR followed by Aizawl District (207.7).

### Truncated Rates (TR)

In males, the TR per 100,000 population ranged from 76.7 in Barshi Expanded to 499.9 in Aizawl District followed by East Khasi Hills District (482.4). Similarly, in females, it ranged from 110.4 in MR - excluding Imphal West to 560.6 in Papumpare District of Arunachal Pradesh.

### Cumulative Rate and Risk

Day (1987) proposed the Cumulative rate as another age standardised incidence rate. The Cumulative risk is the probability that an individual will be diagnosed with cancer during a certain age period in the absence of any competing cause of death and assuming that the current trends prevail over the time period. For practical purposes, Cumulative rate is a good approximation of Cumulative risk over the defined period of time.

### **Cumulative Risk (%) in 0-64 years**

This cumulative risk (%) gives an idea about a person developing cancer during the life period of 0-64 years of age. Among males, the cumulative risk ranged from 2.8% in Barshi Expanded to 15.9% in Aizawl District of Mizoram State followed by East Khasi Hills (14.9%) of Meghalaya. Hence 15.9% of males in the age group of 0-64 years in Aizawl District are likely to develop cancer in their life time and the males in the age group of 0-64 years in Barshi Expanded at 2.8% are the least at risk.

Among females, the cumulative risk ranged from 3.8% in Barshi Expanded to 17.9% in Papumpare District of Arunachal Pradesh. This means in Papumpare District, on an average about 17.9% of females in the 0-64 age group are likely to develop cancer in their life time whereas in Barshi Expanded the risk is 3.8%.

### **Cumulative Risk (%) in 0-74 years**

Among males, the cumulative risk (%) in the 0-74 year age group ranged from 4.5% in Barshi Expanded to 27.0% in Aizawl District of Mizoram, followed by Papumpare District of Arunachal Pradesh at 25.2% and East Khasi Hills in Meghalaya at 22.9%.

Among females, the cumulative risk percentage in the 0-74 age group ranged from 5.7% in Barshi Expanded to 25.3% in Papumpare District of Arunachal Pradesh, followed by Aizawl District of Mizoram at 21.1%.

**Table 1.4: Cumulative Incidence Rate, Cumulative Risk and Possibility of One in Number of Persons Developing Cancer of Any Site (ICD-10): C00-C97 for All PBCRs (2012-2014)**  
**Calculation based on age specific rates from 0-64 and 0-74 years of age**

Registry	Cumulative Rates (%)				Cumulative Risk (%)				Possibility of one in number of persons developing cancer			
	0-64 Years		0-74 Years		0-64 Years		0-74 Years		0-64 Years		0-74 Years	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
<b>Bangalore (2012)</b>	5.9	8.5	12.7	14.7	5.8	8.2	11.9	13.7	17	12	8	7
<b>Barshi Rural (2012-2014)</b>	3.3	4.3	6.4	7.0	3.2	4.2	6.2	6.8	31	24	16	15
<b>Barshi Expanded (2012)</b>	2.8	3.9	4.6	5.8	2.8	3.8	4.5	5.7	36	26	22	18
<b>Bhopal (2012-2013)</b>	6.5	7.7	11.8	12.6	6.3	7.4	11.2	11.8	16	14	9	8
<b>Chennai (2012-2013)</b>	6.7	8.8	13.3	14.4	6.5	8.4	12.5	13.5	16	12	8	7
<b>Delhi (2012)</b>	8.9	10.2	17.3	16.6	8.5	9.7	15.9	15.3	12	10	6	7
<b>Mumbai (2012)</b>	6.0	7.3	13.1	13.6	5.8	7.1	12.2	12.8	17	14	8	8
<b>Cachar District (2012-2014)</b>	8.1	7.3	15.2	10.2	7.8	7.0	14.1	9.7	13	14	7	10
<b>Dibrugarh District (2012-2014)</b>	5.5	6.2	11.2	9.0	5.3	6.0	10.6	8.6	19	17	9	12
<b>Kamrup Urban District (2012-2014)</b>	11.6	11.5	24.2	20.5	11.0	10.8	21.5	18.6	9	9	5	5
<b>Manipur State (MR) (2012-2014)</b>	3.3	4.6	7.5	8.0	3.2	4.5	7.2	7.7	31	22	14	13
<i>Imphal West District (2012-2014)</i>	4.4	6.9	11.6	11.7	4.3	6.6	10.9	11.1	23	15	9	9
<i>MR - Excl. Imphal West (2012-2014)</i>	3.0	4.0	6.4	7.0	3.0	3.9	6.2	6.7	34	26	16	15
<b>Mizoram State (MZ) (2012-2014)</b>	12.9	10.3	25.0	19.4	12.1	9.8	22.1	17.6	8	10	5	6
<i>Aizawl District (2012-2014)</i>	17.3	12.3	31.4	23.7	15.9	11.6	27.0	21.1	6	9	4	5
<i>MZ - Excl. Aizawl (2012-2014)</i>	10.2	8.9	21.1	16.4	9.7	8.5	19.0	15.1	10	12	5	7
<b>Sikkim State (2012-2014)</b>	4.7	6.2	10.8	11.7	4.6	6.0	10.2	11.1	22	17	10	9
<b>Ahmedabad Urban (2012-2013)</b>	6.5	5.4	11.5	8.8	6.3	5.3	10.8	8.5	16	19	9	12
<b>Aurangabad (2012-2014)</b>	4.6	5.4	8.5	8.6	4.5	5.3	8.1	8.3	22	19	12	12
<b>Kolkata (2012)</b>	5.9	7.2	11.9	11.7	5.7	6.9	11.2	11.1	18	14	9	9
<b>Kollam District (2012-2014)</b>	7.0	7.1	14.5	11.1	6.8	6.9	13.5	10.5	15	15	7	9
<b>Nagpur (2012-2013)</b>	5.7	6.8	10.3	10.4	5.5	6.6	9.8	9.8	18	15	10	10
<b>Pune (2012-2013)</b>	4.2	5.7	9.1	9.9	4.1	5.5	8.7	9.4	24	18	11	11
<b>Thi'puram District (2012-2014)</b>	7.6	8.4	15.7	13.4	7.3	8.0	14.5	12.6	14	12	7	8
<b>Meghalaya (2012-2014)</b>	12.5	6.8	20.0	11.1	11.8	6.6	18.1	10.5	8	15	6	10
<i>East Khasi Hills District (2012-2014)</i>	16.1	8.3	26.0	14.0	14.9	8.0	22.9	13.0	7	13	4	8
<b>Tripura State (2012-2014)</b>	4.9	4.2	9.4	6.3	4.8	4.1	9.0	6.1	21	24	11	16
<b>Nagaland (2012-2014)</b>	8.0	6.1	15.1	9.7	7.7	5.9	14.0	9.2	13	17	7	11
<b>Wardha District (2012-2014)</b>	4.0	5.0	6.8	7.2	4.0	4.9	6.6	7.0	25	20	15	14
<b>Naharlagun (NH) (2012-2014)</b>	7.4	8.0	12.7	11.1	7.2	7.7	11.9	10.5	14	13	8	10
<i>Papumpare District (2012-2014)</i>	15.1	19.7	29.0	29.2	14.0	17.9	25.2	25.3	7	6	4	4
<i>NH - Excl. Papumpare (2012-2014)</i>	5.6	5.2	9.5	7.2	5.5	5.1	9.1	7.0	18	20	11	14
<b>Pasighat (2012-2014)</b>	7.0	8.0	12.4	11.3	6.8	7.7	11.6	10.7	15	13	9	9
<b>Patiala District (2012-2014)</b>	6.3	8.4	11.1	12.4	6.1	8.1	10.5	11.7	16	12	9	9

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## Request of Pavlov to the academic youth of his country

What can I wish to the youth of my country who devote themselves to science?

First, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness and gradualness. From the very beginning of your work, school yourself to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap bubble will rejoice your eyes by its play, it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you never can fly. Without them your 'theories' are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of facts. Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty. Never think that you already know all. However highly you are appraised always have the courage to say of yourself - I am ignorant.

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse useful advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.

**Ivan Pavlov (1849-1936)**  
Nobel Prize winning Russian Physiologist