original reports abstract

Cancer Statistics, 2020: Report From National Cancer Registry Programme, India

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PURPOSE The systematic collection of data on cancer is being performed by various population-based cancer registries (PBCRs) and hospital-based cancer registries (HBCRs) across India under the National Cancer Registry Programme–National Centre for Disease Informatics and Research of Indian Council of Medical Research since 1982.

METHODS This study examined the cancer incidence, patterns, trends, projections, and mortality from 28 PBCRs and also the stage at presentation and type of treatment of patients with cancer from 58 HBCRs (N = 667,666) from the pooled analysis for the composite period 2012-2016. Time trends in cancer incidence rate were generated as annual percent change from 16 PBCRs (those with a minimum of 10 years of continuous good data available) using Joinpoint regression.

RESULTS Aizawl district (269.4) and Papumpare district (219.8) had the highest age-adjusted incidence rates among males and females, respectively. The projected number of patients with cancer in India is 1,392,179 for the year 2020, and the common 5 leading sites are breast, lung, mouth, cervix uteri, and tongue. Trends in cancer incidence rate showed an increase in all sites of cancer in both sexes and were high in Kamrup urban (annual percent change, 3.8%; $P < .05$). The majority of the patients with cancer were diagnosed at the locally advanced stage for breast (57.0%), cervix uteri (60.0%), head and neck (66.6%), and stomach (50.8%) cancer, whereas in lung cancer, distant metastasis was predominant among males (44.0%) and females (47.6%).

CONCLUSION This study provides a framework for assessing the status and trends of cancer in India. It shall guide appropriate support for action to strengthen efforts to improve cancer prevention and control to achieve the national noncommunicable disease targets and the sustainable development goals.

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INTRODUCTION

Globally, noncommunicable diseases (NCDs) accounted for 71% of total deaths. In India, NCDs were estimated to account for 63% of all deaths, and cancer was one of the leading causes (9%).[1] Cancer registries are recognized as vital components of national cancer-control programs.[2] Publications from developed and developing countries provide updated information on cancer occurrence, trends, and projections.[3-7] In India, the systematic collection of data on cancer has been performed since 1982 by the population-based cancer registries (PBCRs) and hospital-based cancer registries (HBCRs) under the National Cancer Registry Programme (NCRP)–National Centre for Disease Informatics and Research (NCDIR) of the Indian Council of Medical Research (ICMR; ICMR-NCDIR-NCRP), Bengaluru (Appendix). NCRP commenced with the objective of generating reliable data on the magnitude and patterns of cancer. Several NCRP reports on cancer from different registries across India have been published.[8-9]

PBCRs provide statistics on the occurrence and outcome of cancer in a geographically defined population. They also provide the framework for assessing the control of cancer in the community. HBCRs are concerned with the recording of information on patients with cancer seen in a particular hospital and are mainly used for reviewing clinical performance and the hospital cancer program.[10]

This article reports the cancer incidence, patterns, time trends, and mortality from 28 PBCRs for the composite period 2012-2016 across India under ICMR-NCDIR-NCRP. Also, it covers the stage at presentation and type of treatment received by patients with cancer from 58 HBCRs for the period 2012-2016 in India under the

ASSOCIATED CONTENT

Appendix

Data Supplement

Author affiliations and support information (if applicable) appear at the end of this article.

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CONTEXT

Key Objective

This study reports the cancer incidence, patterns, trends, projections, cancer mortality, and clinical aspects of stage at presentation and treatment for the period 2012-2016 from 28 population-based and 58 hospital-based cancer registries in India under the network of the National Cancer Registry Programme.

Knowledge Generated

There is heterogeneity in cancer incidence (age-adjusted rate per 100,000: males: Osmanabad and Beed, 39.5 *v* Aizawl district, 269.4; females: Osmanabad and Beed, 49.4 *v* Papumpare district, 219.8) and in patterns across India and a lower proportion (< 33%) of early stage at presentation for common cancers. The projected incidence of patients with cancer for the year 2020 in India in males is 679,421 and in females is 712,758.

Relevance

Results of this study will help in assessing the status and trends of cancer in India. This will assist local- and national-level stakeholders to implement public health action to control cancer.

network of NCRP. Based on estimates from this period, the projection of patients with cancer in India for the year 2020 is also included.

METHODS

Presently, there are 36 PBCRs and 236 HBCRs registered under the ICMR-NCDIR-NCRP. However, this article includes data from 28 PBCRs and 58 HBCRs, which were complete with at least 1 year of good-quality data. All neoplasms with a behavior code of 3 as defined by the International Classification of Diseases for Oncology, 3rd Edition, and the International Statistical Classification of Diseases and Related Health Problems (10th revision; ICD-10) were considered reportable and therefore registered in NCRP.[11] Cancer registration is a complex process. In India, cancer registration is active wherein trained registry staff go to different sources (hospitals, diagnostic laboratories, vital statistics departments) for collection of data on a standardized core form.[10] This is followed by quality control checks, duplicate checks, matching with mortality cases, follow-up of death certificate notifications, and assigning death certificate only (DCO). Patients with cancer who were residents in the registration area for a minimum period of 1 year before the date of diagnosis were included in the registry. Multiple cancer data sources were followed for data collection.[10] Quality of the data was maintained per International Association of Cancer Registries/International Agency for Research on Cancer (IACR/IARC) norms.[12,13]

Incidence and mortality data were retrieved from 28 PBCRs (urban or rural, or both) for the period 2012-2016. Cancer burden measures were calculated as crude rate, age-adjusted rate (AAR) per 100,000 population using world standard population,[14] and cumulative risk (probability that an individual will be diagnosed with cancer [0- to 74-year-old age group] in the absence of any competing cause of death and assuming that the current trends prevail over the time period). Time trends in cancer incidence rate were generated as annual percent change (APC) and considered statistically significant (at $P < .05$) from 16 PBCRs (with minimum of 10 years of data) using the Joinpoint regression program, 4.0.1 (National Cancer Institute).[15] The years of data for trend analysis varied (11 to 35 years) across the PBCRs, and there were 6 PBCRs with more than 25 years of continuous data.

The country was categorized into 6 geographic zones based on the location of the PBCRs: North (Delhi, Patiala), South (Hyderabad, Kollam, Thiruvananthapuram, Bangalore, and Chennai), East (Kolkata), West (Ahmedabad urban, Aurangabad, Osmanabad and Beed, Barshi rural, Mumbai, and Pune), Central (Wardha, Bhopal, and Nagpur) and Northeast (NE; Manipur, Mizoram, Sikkim, Tripura, West Arunachal, Meghalaya, Nagaland, Pasighat, Cachar, Dibrugarh, and Kamrup urban). Population denominators were derived from the Census of India, conducted by the Registrar General and Census Commissioner of India under the Ministry of Home Affairs, Government of India.[16] The census populations of 2001 and 2011 were used to calculate the postcensal population estimates for the years 2012 and 2016 by 5-year age groups and sex. For time trend analysis, the respective 1981, 1991, 2001, and 2011 censuses were taken as the base to estimate inter- or postcensal population by 5-year age groups and sex.[17]

A standardized patient information form for HBCRs under NCRP and the data collection methods have been explained previously.[18] Newly diagnosed and treated patients with cancer (N = 667,666) from 58 HBCRs (with a minimum of 1 year of a complete dataset) in 2012-2016 were pooled and are presented as the relative proportion of clinical stage and treatment. The stage/clinical extent of disease before treatment (excludes previously treated patients with cancer) was classified into localized only, locoregional, distant metastasis, and unknown.[19] The completion of planned cancer-directed treatment after

TABLE 1. Annual Average No. of Patients for All Sites of Cancer With Incidence Rate per 100,000, Cumulative Risk (0-74 age group) and Mortality Rate by Sex and Reporting Year for 28 PBCRs Under NCRP

		Males					Females				
		Incidence				Mortality	Incidence				Mortality
Serial No.	Registry (period of reference)	No.	CR	AAR	Cum Risk	AAMR	No.	CR	AAR	Cum Risk	AAMR
	North										
1	Delhi (2012-14)	10,344	112.3	147.0	1 in 6	22.2	9,688	119.6	141.0	1 in 7	17.8
2	Patiala district (2012-16)	1,079	101.6	108.2	1 in 9	32.7	1,215	127.7	124.6	1 in 8	30.1
	South										
3	Hyderabad district (2014-16)	1,714	84.2	101.6	1 in 9	15.5	2,151	109.8	136.0	1 in 7	12.5
4	Kollam district (2012-16)	1,986	159.4	127.7	1 in 7	66.5	1,956	139.1	107.1	1 in 9	38.3
5	Thiruvananthapuram district (2012-16)	2,701	170.4	137.8	1 in 7	57.7	2,865	164.8	127.3	1 in 8	39.5
6	Bangalore (2012-14)	4,407	96.8	122.1	1 in 7	42.6	5,276	125.1	146.8	1 in 6	41.5
7	Chennai (2012-16)	2,894	121.8	119.9	1 in 8	35.7	3,361	141.4	132.8	1 in 7	28.8
	East										
8	Kolkata (2012-15)	2,547	109.9	91.2	1 in 10	37.9	2,288	105.9	89.2	1 in 11	32.1
	West										
9	Ahmedabad urban (2012-16)	2,916	89.1	98.3	1 in 9	27.0	2,205	74.7	76.7	1 in 12	16.9
10	Aurangabad (2012-16)	385	56.6	70.9	1 in 13	13.5	400	62.9	75.1	1 in 12	8.5
11	Osmanabad and Beed (2012-15)	909	39.3	39.5	1 in 23	10.3	1,117	52.8	49.4	1 in 19	10.4
12	Barshi Rural (2012-16)	145	53.9	50.6	1 in 17	35.0	163	67.2	61.0	1 in 15	36.1
13	Mumbai (2012-15)	6,564	97.3	108.4	1 in 9	66.0	6,865	117.6	116.2	1 in 8	61.4
14	Pune (2012-16)	1,937	67.5	83.0	1 in 11	35.3	2,164	83.3	94.0	1 in 10	35.3
	Central										
15	Wardha district (2012-16)	478	70.4	64.5	1 in 14	42.3	507	78.7	69.9	1 in 14	37.1
16	Bhopal (2012-15)	892	83.3	101.0	1 in 9	38.3	897	90.4	106.9	1 in 8	30.9
17	Nagpur (2012-16)	1,190	89.0	91.1	1 in 10	21.3	1,209	93.1	89.8	1 in 11	17.7
	Northeast										
18	Manipur state (2012-16)	740	47.0	62.8	1 in 14	20.5	900	57.8	71.1	1 in 12	17.3
	Imphal West District (2012-16)	227	85.1	95.3	1 in 9	29.6	300	107.9	110.9	1 in 8	24.3
19	Mizoram state (2012-16)	865	146.1	207.0	1 in 5	121.4	747	127.5	172.3	1 in 5	76.4
	Aizawl district (2012-16)	436	206.2	269.4	1 in 4	152.7	380	174.6	214.1	1 in 5	89.5
20	Sikkim state (2012-16)	234	69.9	88.7	1 in 10	46.4	226	75.3	97.0	1 in 10	46.2
21	Tripura state (2012-16)	1,312	67.0	80.9	1 in 11	46.0	983	52.0	58.3	1 in 16	28.9
22	West Arunachal (2012-16)	244	56.6	101.1	1 in 8	27.3	234	56.3	96.3	1 in 10	18.9
	Papumpare district (2012-16)	94	94.8	201.2	1 in 4	56.5	106	105.1	219.8	1 in 4	37.9
23	Meghalaya (2012-16)	938	92.6	176.8	1 in 5	71.7	566	55.7	96.5	1 in 9	38.1
	East Khasi Hills (2012-16)	577	131.0	227.9	1 in 4	95.0	346	76.9	118.6	1 in 8	51.5
24	Nagaland (2012-16)	281	74.5	124.5	1 in 7	27.8	198	56.3	88.2	1 in 10	11.1
25	Pasighat (2012-16)	64	90.7	120.4	1 in 7	30.9	61	88.1	116.2	1 in 8	22.0
26	Cachar district (2012-16)	933	99.2	129.0	1 in 7	25.2	789	87.0	104.8	1 in 9	17.5
27	Dibrugarh district (2012-16)	507	72.5	91.9	1 in 9	24.0	448	66.0	76.8	1 in 12	14.1
28	Kamrup urban (2012-16)	1,245	190.5	213.0	1 in 4	66.7	958	150.8	169.6	1 in 6	37.3

NOTE. Reporting year data given in parentheses; Meghalaya covers East Khasi Hills, West Khasi Hills, Jaintia Hills, and Ri Bhoi districts; Nagaland covers Kohima and Dimapur districts; Pasighat covers East Siang and Upper Siang; West Arunachal covers Tawang, West Kameng, East Kameng, Upper Subansiri, Lower Subansiri, Kurng Kumey, Papumpare, and West Siang districts.

Abbreviations: AAMR, age-adjusted mortality rate per 100,000; AAR, age-adjusted rate per 100,000; CR, crude rate per 100,000; cum risk, cumulative risk of developing any site of cancer 0-74 years of age; NCRP, National Cancer Registry Program; PBCR, population-based cancer registry.

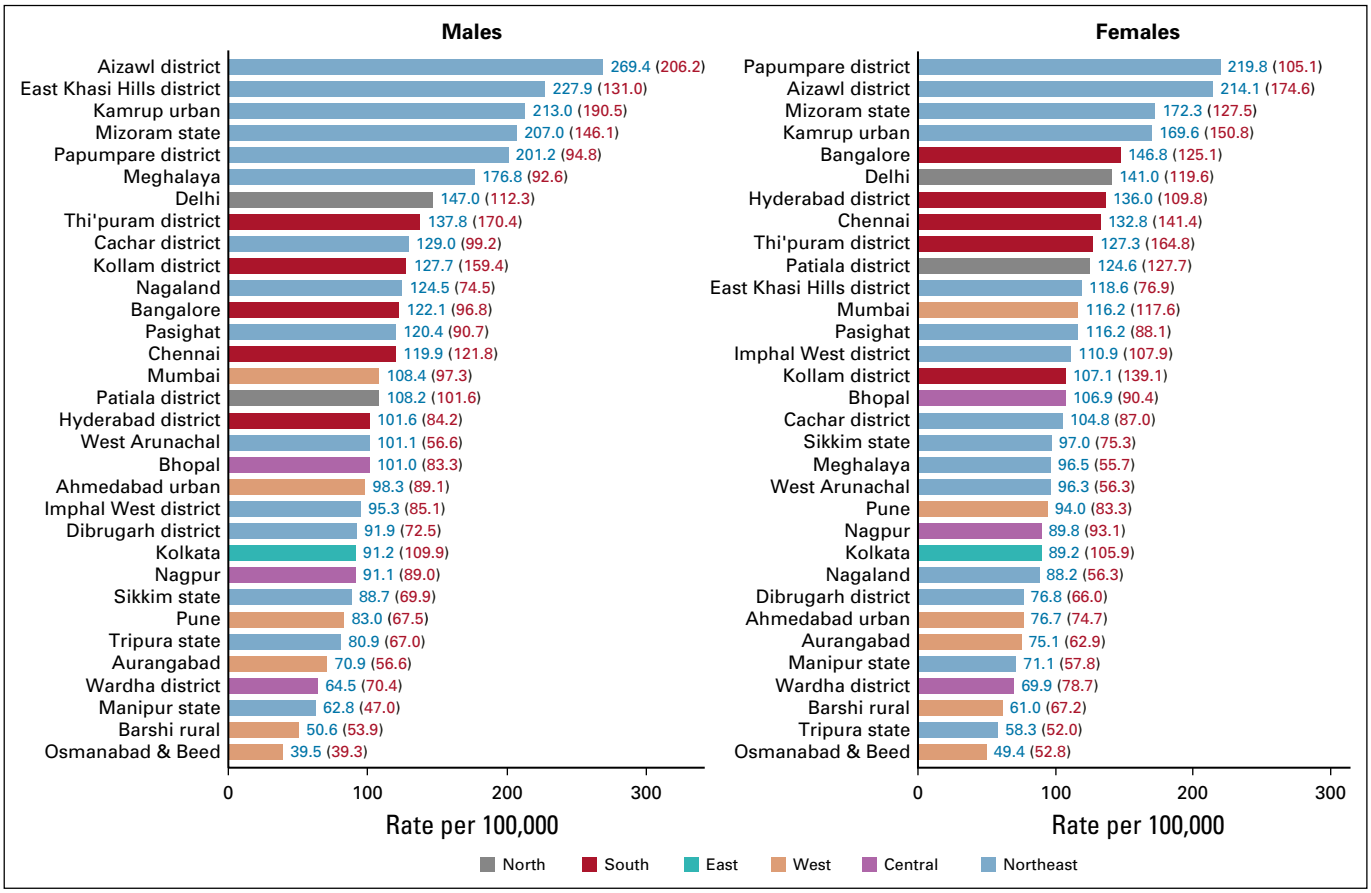

FIG 1. Comparison of all cancer sites' age-adjusted incidence rates (AARs) of all population-based cancer registries, 2012-2016 (International Statistical Classification of Diseases and Related Health Problems, 10th revision: C00-C97). AARs are in blue and crude rates are given in parentheses in red. Thi'puram district, Thiruvananthapuram district.

diagnosis was classified as surgery, radiotherapy, systemic therapy, and multimodality (combination of surgery and/or radiotherapy and/or systemic therapy).

Good-quality data indices of microscopic verification (MV %) above 75%, DCO% below 20%, other and unspecified sites (O&U%) below 15%, and mortality-to-incidence ratio (M:I%) were calculated for each PBCR and accordingly classified.[12,13] NCRP has developed in-house software (PBCR and HBCR Data Management) for data capture, quality checks, duplicates checks (deterministic and phonetic-similar sounding duplicate names), and mortality-incidence matching. The list of errors was sent back to registries for clarifications and corrected at each level. Incidence data for 2012-2016 was used as a reference for projection of patients with cancer in India until 2020 by sex and anatomic site (see Data Supplement for more details).

RESULTS

Average annual number of patients for all sites of cancer with incidence rate, cumulative risk by sex, and mortality rate according to different regions in India between 2012 and 2016 are given in Table 1. PBCRs in the NE showed the highest incidence rate in both sexes. It was observed that Aizawl district had the highest AAR (269.4) and mortality (152.7) rate among males. One of every 4 males in Aizawl district, Papumpare district, East Khasi Hills district, and Kamrup urban are likely to develop cancer in the age group of 0-74 years. One of every 4 females in the Papumpare district and 1 of 5 females in Mizoram state are likely to develop cancer in the age group of 0-74 years.

On comparison of AARs for all sites of cancer (ICD10: C00-C97) across the population among males, Aizawl district (269.4) had the highest AAR and was approximately twice the AAR of Delhi PBCR (147.0). East Khasi Hills district of Meghalaya (227.9) had the second highest AAR, followed by Kamrup urban (213.0) and Mizoram PBCR (207.0). Among females, Papumpare district (219.8) had the highest AAR. In the rest of the regions (excluding NE), Delhi had highest AAR (147.0), followed by Thiruvanathapuram district (137.8) among males; Bangalore (146.8) had highest AAR, followed by Delhi (141.0) among females (Fig 1).

East Khasi Hills district of Meghalaya had the highest relative proportion of cancers associated with the use of tobacco, with 70.4% and 46.5% for males and females,

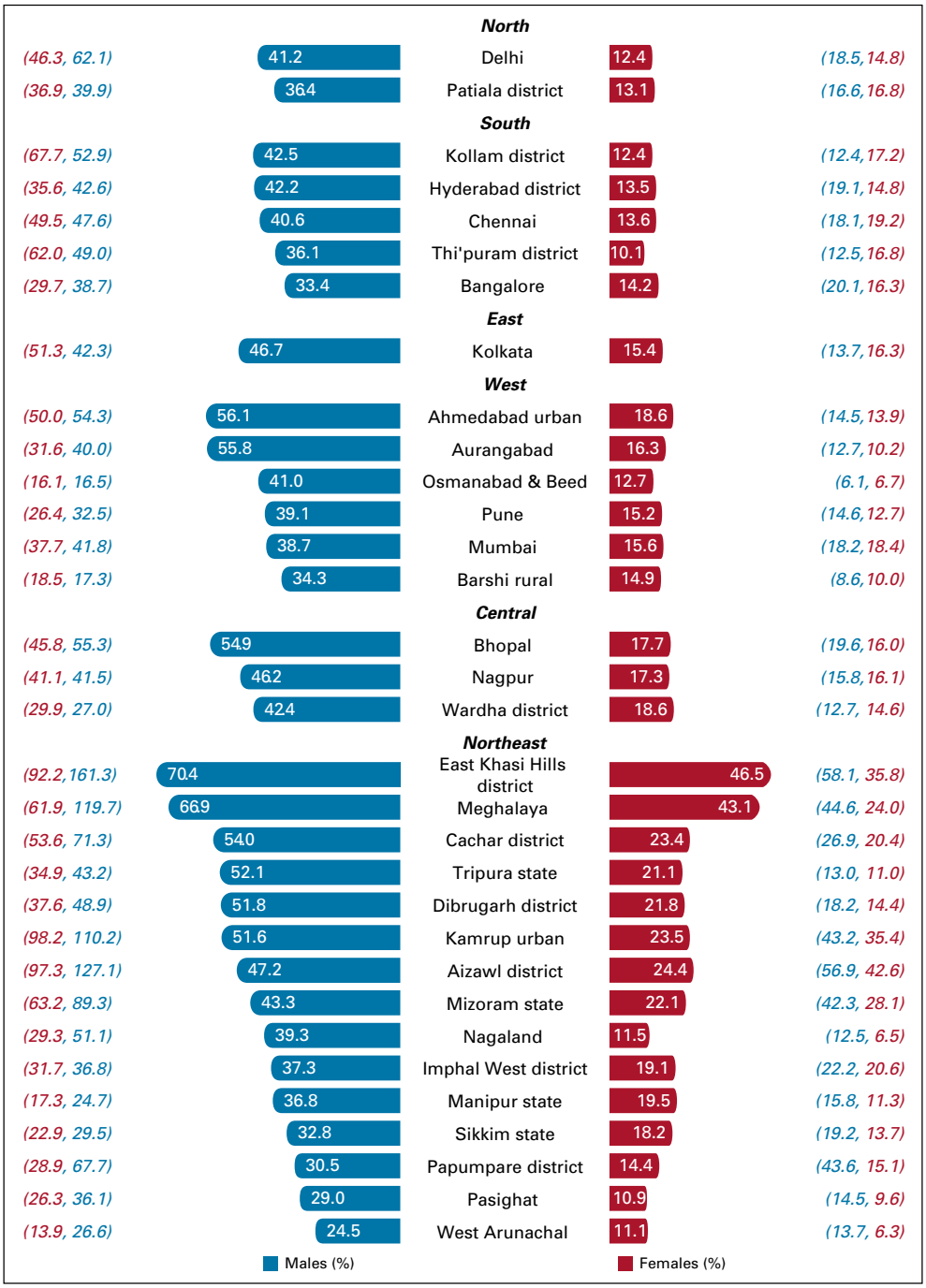

FIG 2. Sites of cancer associated with the use of tobacco (%), 2012-2016. Crude rate in red and age-adjusted rates in blue are given in parentheses. Sites of cancer associated with the use of tobacco, anatomic sites (International Statistical Classification of Diseases and Related Health Problems, 10th revision codes), lip (C00); tongue (C01-C02); mouth (C03-C06); pharynx (C10 and C12-C14); esophagus (C15); larynx (C32); lung (C33-C34); urinary bladder (C67).[33] Thi'puram district, Thiruvananthapuram district.

respectively. The higher proportion of cancers associated with use of tobacco was in the NE states, followed by registries in the West and Central regions (Fig 2).

Among males, lung, mouth, esophagus, and stomach were the most common cancer sites. Among females, breast cancer, followed by cervix uteri and ovary cancer, were the most common sites across the PBCRs. Thyroid cancer was the second most common cancer in the PBCRs of Thiruvananthapuram and Kollam, whereas lung cancer was seen in Manipur and Mizoram state. In the NE region, the third most common cancers were stomach and gallbladder (Data Supplement). The decadal changes in leading sites of

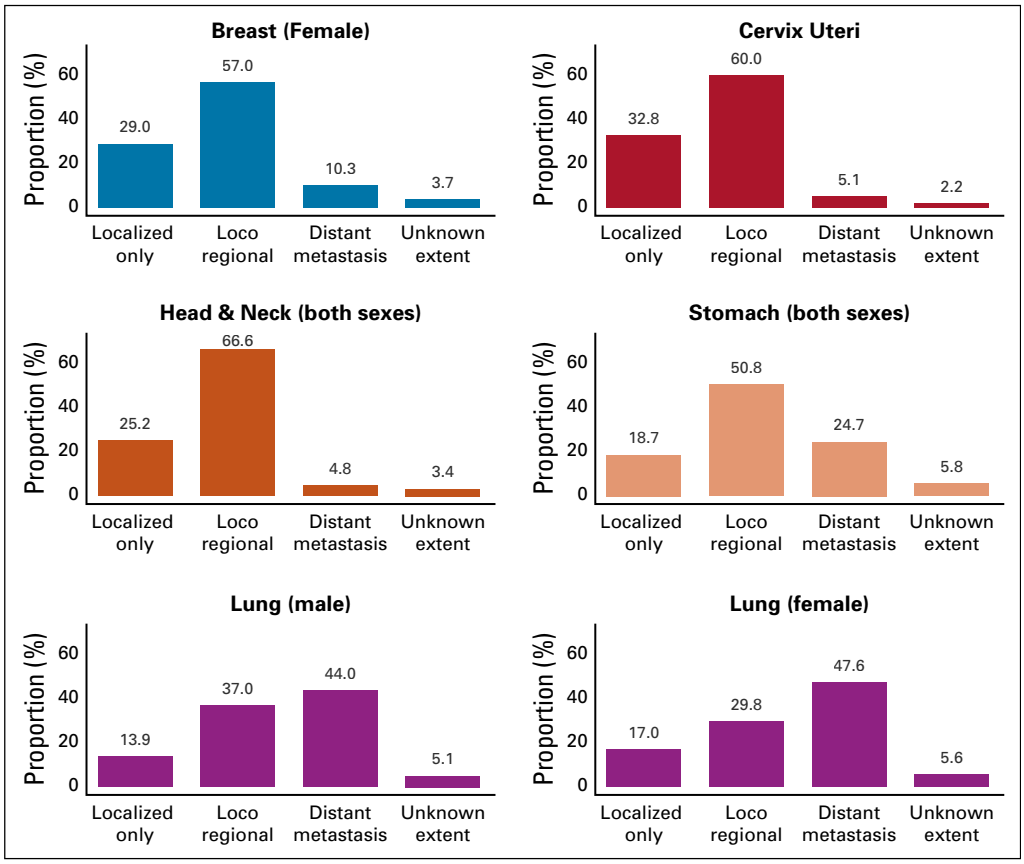

FIG 3. Relative proportion (%) of patients according to clinical extent of disease, 2012-2016 (proportion [%] may not total 100% because of rounding).

cancer from 6 older PBCRs (Barshi rural, Bangalore, Bhopal, Chennai, Delhi, and Mumbai) were observed for the first 10 and last 10 years of data (Data Supplement).

The relative proportion of patients according to clinical extent of disease at the time of diagnosis as seen in the pooled data of 58 HBCRs for common sites of cancer showed that the majority of patients with cancer were diagnosed as locally advanced/locoregional for breast (57.0%), cervix uteri (60.0%), head and neck (66.6%), and stomach (50.8%) cancer. The majority of patients with lung cancer were diagnosed with distant metastasis in males (44.0%) and females (47.6%; Fig 3). The relative proportion of types of cancer-directed treatment received (only at the reporting hospital) according to clinical extent of disease before treatment showed that multimodality was the first choice of treatment (locoregional, 79.5%; localized, 74.4%; distant metastasis, 47.6%; Data Supplement).

The estimated APC in cancer AAR for selected anatomic sites of cancer over the time period showed an increase in the incidence rate of all sites of cancer (12 PBCRs in males and 13 PBCRs in females). There was a significant increase in the incidence rate of breast cancer across all PBCRs over the years, except in Nagpur PBCR. There was a significant decrease in the incidence rate of cervical cancer in 10 PBCRs, except in Dibrugarh district and Pune. Lung cancer showed a significant increase in 11 PBCRs among females (Fig 4).

Among 28 PBCRs, MV%, ranged between 77% (Patiala) and 96.7% (Hyderabad); DCO% ranged between $< 0.05\%$ (Osmanabad and Beed) and 19.4% (Patiala); O&U% ranged between 1.8% (Hyderabad) and 13.0% (Patiala). M:I% was high in Barshi rural (67.2%) followed by Wardha (59.2%) and Mumbai (56.0%; Data Supplement).

The projected incidence of patients with cancer in India among males was 679,421 (94.1 per 100,000) and among females 712,758 (103.6 per 100,000) for the year 2020. One in 68 males (lung cancer), 1 in 29 females (breast cancer), and 1 in 9 Indians will develop cancer during their lifetime (0-74 years of age; Table 2). The projected 5 most common cancers in 2020 for males (lung, mouth, prostate, tongue, and stomach) constitute 36% of all cancers and for females (breast, cervix uteri, ovary, corpus uteri, and lung) constitute 53% of all cancers (Data Supplement).

DISCUSSION

India exhibits heterogeneity in cancer. The incidence rates of Aizawl district were observed to be 7 times and 4 times

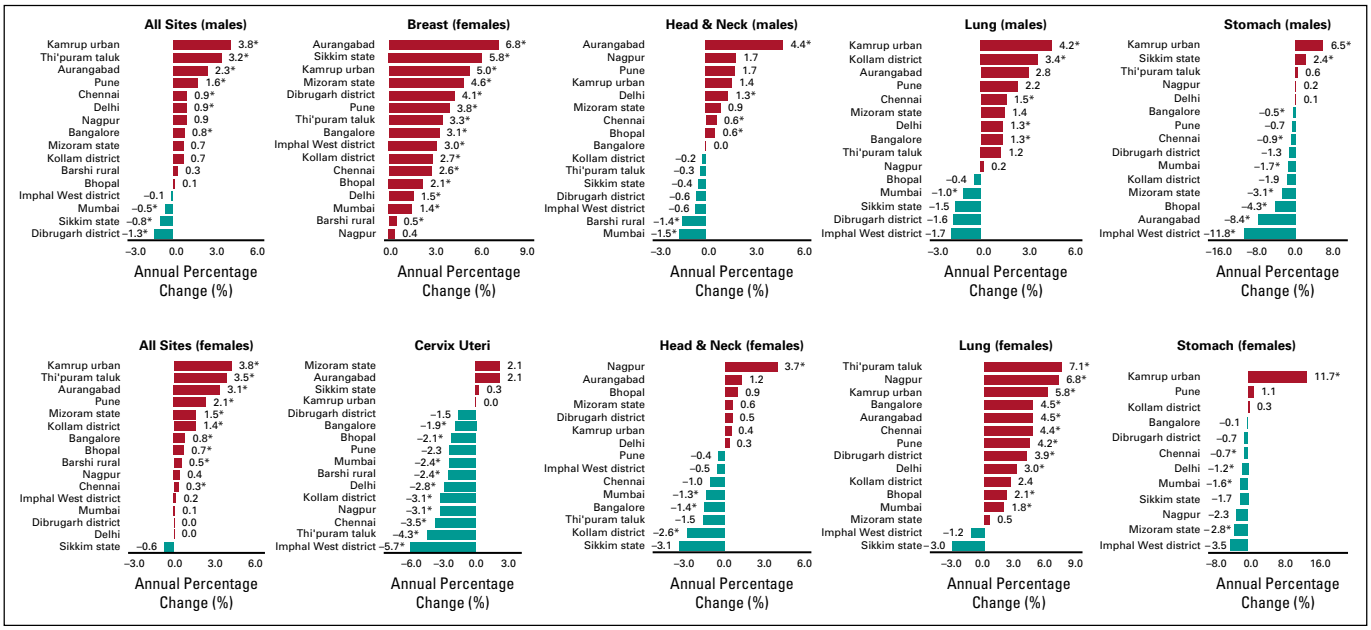

FIG 4. Annual percentage change (APC) in age-adjusted incidence rates (AAR) over the time period. Calendar years of incidence data for each population-based cancer registry (PBCR) used in trend analysis: Chennai (1982-2016); Mumbai (1982-2015); Bangalore (1982-2014); Barshi rural (1988-2016); Bhopal (1988-2015); Delhi (1988-2014); Kamrup urban (2003-2016); Mizoram state (2004-2016); Dibrugarh district, Sikkim state, Imphal West district; Aurangabad; Thiruvananthapuram (Thi'puram) taluk; Nagpur (2005-2016); Kollam district; Pune (2006-2016); PBCRs with small numbers (< 10 patients) per year not analyzed. Increase in APC in red, decrease in APC in green. (*) APC significantly different from zero; $P < .05$. Thi'puram PBCR expanded its coverage to district from the year 2012 onwards. Hence, Thi'puram taluk data was used for trend analysis. Thi'puram taluk, Thiruvananthapuram taluk.

that of Osmanabad and Beed district PBCRs in males and females, respectively. The highest cancer incidence rate was observed in the NE region (6 PBCRs for males and 4 PBCRs for females) than other areas in the country. The leading sites of cancer in the NE region were nasopharynx, hypopharynx, esophagus, stomach, liver, gallbladder, larynx, lung, breast, and cervix uteri. The NE region lacks required infrastructure with respect to specialized treatment facilities, human resources, as seen by the low 5-year survival of breast, cervix, and head and neck cancer compared with rest of India. A substantial proportion of patients with cancer from the NE region are traveling outside the NE for treatment and cancer care.[20,21] Local cultural factors and lifestyle choices may have contributed to the heterogeneity in cancer incidence pattern and differences in India, as was seen in Thailand.[7]

Lung (9 PBCRs), mouth (9 PBCRs), esophagus (5 PBCRs), stomach (4 PBCRs), and nasopharynx (1 PBCR) cancers were the most common cancers in men. Lung cancer was the leading site in metropolitan cities and the southern region, whereas mouth cancer was the leading site in the West and Central regions. Lung cancer and oral/mouth cancer were the most common cancers among males in the Indian subcontinent.[22] Cancers of the esophagus, stomach, and nasopharynx were the leading sites in the NE region of India. Here, the cancer incidence pattern is different from the rest of India. There are similarities in the cancer incidence pattern with the Southeast Asian region.[23] Overall, these findings on patterns of cancer were similar to previously published reports under NCRP.[8]

Cancer of the breast (19 PBCRs) and cervix uteri (7 PBCRs) were the most common cancers in women. The highest burden of breast cancer was observed in metropolitan cities. There is an increase in the trend of incidence of breast cancer, whereas cervix uteri cancer is on the decline. A steady increase in breast cancer in most of the PBCRs including newer PBCRs, poses a great health challenge to women in India.[24] Presently, breast cancer and cervix uteri are the leading sites of cancer among women in India, posing an important public health problem that needs important input from various health and other agencies to tackle.[25] A multidisciplinary approach to breast cancer, including awareness programs, preventive measures, screening programs for early detection, and availability of treatment facilities, are vital for reducing both incidence and mortality of cancer in Indian women.[26]

The incidence rate of thyroid cancer among women is increasing, and it is most common in the districts of Thiruvananthapuram and Kollam in Kerala. The high burden of thyroid cancer in Kerala could be due to overdiagnosis,[27] as was observed even in high-income and low- and middle-income countries.[28] AAR in Barshi rural is almost one third of urban PBCRs (males, 50.6 *v* 147.0; females, 61.0 *v* 146.8), and the increase in APC was

TABLE 2. Projected Incidence of Cancer Statistics in India, 2020

	Male			Female			Both Sexes		
Site	**Patients**	**CR**	**Cum Risk**	**Patients**	**CR**	**Cum Risk**	**Patients**	**CR**	**Cum Risk**
All sites	679,421	94.1	1 in 9	712,758	103.6	1 in 9	1,392,179	98.7	1 in 9
Oral cavity and pharynx	139,018	19.2	1 in 41	49,951	7.3	1 in 112	188,969	13.4	1 in 60
Tongue	39,902	5.5	1 in 147	13,870	2.0	1 in 401	53,772	3.8	1 in 215
Mouth	57,380	7.9	1 in 103	22,483	3.3	1 in 241	79,863	5.7	1 in 144
Pharynx	3,029	0.4	1 in 1,793	1,102	0.2	1 in 5,475	4,131	0.3	1 in 2,701
Other oral cavity	38,707	5.4	1 in 137	12,496	1.8	1 in 476	51,203	3.6	1 in 213
Digestive system	163,845	22.7	1 in 32	110,137	16.0	1 in 50	273,982	19.4	1 in 39
Esophagus	32,622	4.5	1 in 159	20,206	2.9	1 in 264	52,828	3.7	1 in 198
Stomach	32,713	4.5	1 in 160	17,430	2.5	1 in 319	50,143	3.6	1 in 213
Small intestine	2,155	0.3	1 in 2,492	1,451	0.2	1 in 3,901	3,606	0.3	1 in 3,044
Colon	20,572	2.8	1 in 260	15,685	2.3	1 in 348	36,257	2.6	1 in 298
Rectum	21,915	3.0	1 in 244	14,985	2.2	1 in 372	36,900	2.6	1 in 295
Anus, anal canal	2,897	0.4	1 in 1,865	2,028	0.3	1 in 2,682	4,925	0.3	1 in 2,200
Liver and intrahepatic bile duct	26,678	3.7	1 in 189	10,732	1.6	1 in 514	37,410	2.7	1 in 277
Gallbladder and other biliary	12,385	1.7	1 in 422	19,510	2.8	1 in 284	31,895	2.3	1 in 340
Pancreas	11,908	1.6	1 in 429	8,110	1.2	1 in 657	20,018	1.4	1 in 519
Respiratory system	103,552	14.3	1 in 48	32,480	4.7	1 in 165	136,032	9.6	1 in 74
Larynx	27,146	3.8	1 in 184	3,316	0.5	1 in 1,633	30,462	2.2	1 in 331
Lung and bronchus	71,788	9.9	1 in 68	26,490	3.9	1 in 201	98,278	7.0	1 in 101
Other respiratory organs	4,618	0.6	1 in 1,273	2,674	0.4	1 in 2,156	7,292	0.5	1 in 1,600
Bones and joints	8,115	1.1	1 in 1,013	5,840	0.8	1 in 1,370	13,955	1.0	1 in 1,162
Soft tissue	8,047	1.1	1 in 842	6,590	1.0	1 in 1,052	14,637	1.0	1 in 936
Skin (excluding basal and squamous)	11,203	1.6	1 in 510	8,962	1.3	1 in 640	20,165	1.4	1 in 568
Melanoma of the skin	3,003	0.4	1 in 1,904	2,364	0.3	1 in 2,281	5,367	0.4	1 in 2,075
Other nonepithelial skin	8,200	1.1	1 in 695	6,598	1.0	1 in 890	14,798	1.0	1 in 781
Breast	5,377	0.7	1 in 1,022	205,424	29.9	1 in 29	210,801	15.0	1 in 56
Genital system	51,994	7.2	1 in 105	155,630	22.6	1 in 36	207,624	14.7	1 in 54
Uterine cervix	—	—	—	75,209	10.9	1 in 75	75,209	10.9	1 in 75
Uterine corpus	—	—	—	26,514	3.9	1 in 190	26,514	3.9	1 in 190
Ovary	—	—	—	43,886	6.4	1 in 133	43,886	6.4	1 in 133
Vulva	—	—	—	2,138	0.3	1 in 2,459	2,138	0.3	1 in 2,459
Vagina and other genital, female	—	—	—	7,570	1.1	1 in 745	7,570	1.1	1 in 745
Placenta	—	—	—	313	0.0	1 in 30,912	313	0.0	1 in 30,912
Prostate	41,532	5.7	1 in 125	—	—	—	41,532	5.7	1 in 125
Testis	4,352	0.6	1 in 2,095	—	—	—	4,352	0.6	1 in 2,095
Penis and other genital, male	6,110	0.8	1 in 916	—	—	—	6,110	0.8	1 in 916
Urinary system	33,269	4.6	1 in 158	11,265	1.6	1 in 502	44,534	3.2	1 in 240
Urinary bladder	20,470	2.8	1 in 250	5,403	0.8	1 in 1,014	25,873	1.8	1 in 402
Kidney and renal pelvis	12,363	1.7	1 in 442	5,657	0.8	1 in 1,038	18,020	1.3	1 in 620

(Continued on following page)

TABLE 2. Projected Incidence of Cancer Statistics in India, 2020 (Continued)

	Male			Female			Both Sexes		
Site	Patients	CR	Cum Risk	Patients	CR	Cum Risk	Patients	CR	Cum Risk
Ureter and other urinary organs	436	0.1	1 in 10,843	205	0.0	1 in 21,892	641	0.0	1 in 14,531
Eye and orbit	1,304	0.2	1 in 6,870	953	0.1	1 in 9,063	2,257	0.2	1 in 7,792
Brain and other nervous system	19,979	2.8	1 in 341	12,750	1.9	1 in 546	32,729	2.3	1 in 419
Endocrine system	9,263	1.3	1 in 709	26,665	3.9	1 in 279	35,928	2.5	1 in 402
Thyroid	8,570	1.2	1 in 759	26,095	3.8	1 in 285	34,665	2.5	1 in 416
Adrenal gland	693	0.1	1 in 10,797	570	0.1	1 in 14,053	1,263	0.1	1 in 12,209
Lymphoma	32,695	4.5	1 in 197	20,247	2.9	1 in 296	52,942	3.8	1 in 236
Hodgkin lymphoma	7,294	1.0	1 in 1,150	3,936	0.6	1 in 1,871	11,230	0.8	1 in 1,418
Non-Hodgkin lymphoma	25,344	3.5	1 in 238	16,263	2.4	1 in 352	41,607	3.0	1 in 284
Malig Imn Prol D	57	0.0	1 in 101,774	48	0.0	1 in 164,355	105	0.0	1 in 126,050
Multiple myeloma	10,725	1.5	1 in 465	7,756	1.1	1 in 646	18,481	1.3	1 in 541
Leukemia	32,481	4.5	1 in 239	21,132	3.1	1 in 353	53,613	3.8	1 in 284
Lymphoid leukemia	14,159	2.0	1 in 608	7,419	1.1	1 in 1,138	21,578	1.5	1 in 789
Myeloid leukemia	14,913	2.1	1 in 474	11,275	1.6	1 in 617	26,188	1.9	1 in 536
Leukemia uns	3,409	0.5	1 in 2,287	2,438	0.4	1 in 2,980	5,847	0.4	1 in 2,583
Other and unspecified primary sites	48,554	6.7	1 in 114	36,976	5.4	1 in 153	85,530	6.1	1 in 131

Abbreviations: CR, crude rate; cum risk, cumulative risk of developing cancer at 0-74 years of age; Malig Imn Prol D, malignant immunoproliferative diseases; Uns, unspecified.

less compared with urban PBCRs. This needs additional investigation.

There are cancers of several anatomic sites known to be associated with the use of tobacco.[29] Based on PBCR data, almost one third of the cancers were known to be associated with the use of tobacco in India. India state-level disease burden initiative cancer collaborators estimated that tobacco use was the highest contributing risk factor for cancer in India. In India, lung cancer can be attributed to tobacco use and air pollution, which are the leading risk factors.[30] Approximately 70% of cancers in India were potentially preventable through modifiable risk factors.[31]

Because it is difficult to obtain information on the clinical extent of disease and treatment from PBCRs, the hospital database was used for such analysis.[10] The majority of breast and cervix uteri cancers were diagnosed at a locally advanced stage. Chemoradiation was the most common type of treatment of cancer cervix uteri. A multi-institutional study from India on cervix cancer showed significantly better survival with chemoradiation than radiation alone in the locally advanced stage.[18] A study from Chennai showed that concurrent chemoradiation for locally advanced cervical cancer resulted in the best disease-free survival.[32] Two thirds of the patients with cancer were diagnosed at the locoregional stage for head and neck cancers from HBCRs. Similar to that, a low proportion of patients with head and neck cancer presented in the early stage, and a high proportion (88.1%) were seen in Uttarakhand.[33] Multimodality was the most common treatment given for breast and head and neck cancers. A multi-institutional study estimated that 65% of new head and neck cancers with locally advanced disease did not receive the benefit of optimal treatment, resulting in poor survival.[34]

Less than one fifth of lung and stomach cancers were diagnosed as localized only. Systemic therapy was the most common type of treatment given for lung and stomach cancer. A previous report on HBCR results showed similar findings.[8a] A hospital-based study from northern India showed that 90% of patients with lung cancer were diagnosed at an advanced stage of the disease, and there was a delay in diagnostic evaluation and treatment.[35] Creating cancer awareness, preventing risk factors, and improving access to care among people would result in downstaging of cancer.

The measure of validity, MV%, was above 77% for all the PBCRs. Varying patterns of DCO% and M:I% were observed among PBCRs which were dependent on the quality of death registration and certification.[13] Efforts to improve the quality are always underway. In some registries, low DCO% ($< 1\%$) is due to nonavailability of all-cause mortality data and incomplete/incorrect certification of cause of death. Some registries had an efficient trace back procedure by house visit/phone. Data from PBCRs were regularly published in successive volumes of Cancer Incidence

in Five Continents (CI-5) by WHO-IACR/IARC. The incidence data from 15 PBCRs under NCRP (India) were published in Cancer Incidence in Five Continents, Volume XI, by WHO-IACR/IARC.[36-38]

The projected incidence of patients with cancer is higher for females (712,758) than males (679,421) for the year 2020. The projected national cancer incidence burden in 2020 will be 98.7 per 100,000 population (1,392,179 patients) as a conservative estimate. It is assumed that the observed rate of 2012-2016 will remain unchanged until 2020. The time trend in rate was not used to avoid uncertainty in the projection for a populous country like India. NCRP has estimated a slightly higher number of patients with cancer compared with IACR/IARC and GLOBOCAN for all sites of cancer in 2018. This may be because of a difference in methodology and use of recent data (1,392,179 *v* 1,157,294).[22] This is the first such attempt in the country and will be further updated on availability of the next data set and census information. The influencing factors, such as risk factors/behavior, case finding procedure, screening program, and improved techniques for detecting patients with cancer, are likely to influence the projected number of patients.

PBCRs in this study covered 100 million average annual person-years, accounting for coverage close to 10% of the population in India. Cancer registration in India faces several challenges because it is not a notifiable disease, posing challenges to data collection.[39-42] The mortality registration system has several gaps, including incomplete and inaccurate certification of cause of death.[43,44] Registering through passive notification by health care providers to report cancer occurrence in India would improve the coverage with limited resources. Linking of cancer registry data with Ayushman Bharat,[45] mortality databases, and the Hospital Information System would improve cancer registration, follow-up, and outcome data.

This study provides a framework for assessing the status and trends of cancer in India. This shall guide appropriate support for action to strengthen efforts to improve cancer prevention and control to achieve the National NCD targets and the sustainable development goals.[46,47] The data also provide leads to key research questions.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated unless otherwise noted. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/go/site/misc/authors.html.
Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians (Open Payments).

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APPENDIX

INDIAN COUNCIL OF MEDICAL RESEARCH–NATIONAL CENTRE FOR DISEASE INFORMATICS AND RESEARCH–NATIONAL CANCER REGISTRY PROGRAM INVESTIGATOR GROUP

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