Time Trends in Breast Cancer Among Indian Women Population: An Analysis of Population Based Cancer Registry Data

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Abstract

Background The trends observed in cancer breast among Indian women are an indication of effect of changing lifestyle in population. To draw an appropriate inference regarding the trends of a particular type of cancer in a country, it is imperative to glance at the reliable data collected by Population Based Cancer Registries over a period of time.

Objective To give an insight of changing trends of breast cancer which have taken place over a period of time among women in Cancer Registries of India. Breast Cancer trends for invasive breast cancer in women in Indian Registries have varied during the selected period. Occurrence of breast cancers has also shown geographical variation in India.

Materials and Methods This data was collected by means of a ‘Standard Core Proforma’ designed by NCRP conforming to the data fields as suggested by International norms. The Proforma was filled by trained Registry workers based on interview/ hospital medical records/ supplementing data by inputs from treating surgeons/radiation oncologists/involved physicians/pathologists. The contents of the Proforma are entered into specifically created software and transmitted electronically to the coordinating center at Bangalore. The registries contributing to more number of years of data are called as older registries, while other recently established registries are called newer registries.

Results While there has been an increase recorded in breast cancer in most of the registries, some of them have recorded an insignificant increase. Comparison of Age Adjusted Rates (AARs) among Indian Registries has been carried out after which trends observed in populations covered by Indian Registries are depicted. A variation in broad age groups of females and the proneness of females developing breast cancer over the period 1982 to 2010 has been shown. Comparisons of Indian registries with International counterparts have also been carried out. **Conclusions** There are marked changes in incidence rates of cancer breast which have occurred in respective registries in a developing country like India. A steady increase in AARs in most of the registries of India including the newly established registries is indicative of the fact that cancer breast poses a threat to women in India.

Keywords Population Based Cancer Registries · Cancer Breast · Age Adjusted Rates · Time Trends · Geographic variation

Introduction

Breast cancer is the most commonly diagnosed cancer and the leading cause of cancer death in women worldwide [1]. The purpose of this publication is to highlight the changing trends of breast cancer which have taken place over a period of time among females in Indian Cancer registries. It mainly contains extracts of the published report on “Time Trends in Cancer Incidence Rates” by National Centre for Disease Informatics and Research (NCDIR) –National Cancer Registry Programme (NCRP). For the sake of discussion of descriptive epidemiology of breast cancer, the data of the years 1982–2010 collected by Population Based Cancer Registries (PBCRs) has been considered. Breast Cancer trends for

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invasive breast cancer in females in Indian Registries have varied during the selected period. Occurrence of breast cancers has also shown geographical variation in India.

A National Cancer Registry Programme (NCRP) was developed in 1982; under the auspices of Indian Council of Medical Research (ICMR). At present, there are 29 Population Based Cancer Registries and 9 Hospital Based Cancer Registries actively involved in data collection which is covering part of population of India. The population of India in general and that of areas covered by the registries in particular have displayed rapid changes in lifestyles, dietary practices and socioeconomic status. Diagnostic and detection technologies have improved and more population has not only access, but also can afford the same.

The registries which have been operational since 1982 or 1988 are termed as “older PBCRs” for discussion. Since they are functioning for a longer period of time, the time trend based on 5 years Average Age Adjusted Rates (AARs) for at least five such periods can be examined. This provides potency to the findings. The second category of seven registries have contributed at least 7 years of data. All other registries listed have contributed to 5–6 years of data.

Data and Methods

The published data from ‘Time Trends in Cancer Incidence Rates’ published by NCRP (NCDIR) in July 2013 [2] has been used. The data pertains to newly diagnosed cases (incidence) of Cancer Breast among Indian females reported from (a) Six (06) Population Based Cancer Registries that have been involved in providing data for more than two decades (Series A) (b) Seven (07) Population Based Cancer Registries (Series B) that have been involved in providing data for at least 7 years to Coordinating Centre at Bangalore. (c) Six (06) other PBCRs (Series C) consisting of data of 5–6 years. This data was collected by means of a ‘Standard Core Proforma [3]’ designed by NCRP conforming to the data fields as suggested by International norms [4]. The Proforma was filled by trained Registry workers based on interview/hospital medical records/ supplementing data by inputs from treating surgeons/radiation oncologists/involved physicians/pathologists. The contents of the Proforma were entered into specifically created software and transmitted electronically to the coordinating center at Bangalore. At the center, the data was subjected to range and consistency checks [5]. This data is published periodically as Consolidated Reports by NCRP (NCDIR). Probable duplicates are removed after due consultation with registries.

The information on confirmed malignant cases of Cancer Breast (ICD 10: C50) [6] for women is presented in this article. This includes retrospective data collected from 84,513 cases under Series A and 4495 cases under Series B above,

a total of 89,008 cases. The data from Series C who have data collection of 5–6 years has not been analysed. For comparability, the Age Adjusted Rates (AARs) have been used (rates observed in the study have been adjusted to World Standard Population). The inclusion criteria for the PBCR were that the patient should be residing in the demarcated geographic registry area for at least 1 year. Also, only confirmed malignancy cases were included (behaviour code ≥ 3). Exclusion criteria for the PBCR were cases outside the geographical boundaries of the registry, cases with suspected/ benign tumour of the breast.

At present, the Population Based Cancer Registries actively involved in data collection cover part of the population (approximately 7.45 %) [7]. The Registries have been set up in prominent Oncology Centres / Hospitals (Govt. & private) of respective urban/ rural population. For the purpose of statistical analysis, the population census data [8] of India pertaining to the corresponding decade has been referred to. In determining the significance of trends, the actual value of Age Adjusted Standardised Rates (AAR) for a single year, 3 years moving average and 5 years range has been used. This significance of time trend in each PBCR was assessed based on the methods and formula provided by Boyle and Parkin, 1991. In addition, for single year the Joinpoint Regression Program [9] of NCI of USA has been used (Kim et al., 2001). As mentioned, the numerator data used for the above analysis has undergone a series of Range and Consistency checks each year. Clarifications were sought whenever required from the respective PBCRs and the data finalised thereafter. Joinpoint Regression Program (3.5.2)[*] and SPSS 21.0 were used to analyze the data. The tests of significance have been applied and p values calculated. For the current study, the p value of 0.05 has been set as significant. The statistical significance was arrived at using slope (b) and p-value based on simple linear regression.

The validity and reliability of data thus obtained is evident by the quality of data contributed by each registry. However, Pathology Laboratories with amenities for microscopic diagnosis of cancer and radiation oncology treatment facilities have multiplied, increasing the sources of data collection for registry workers underscoring the greater need for cooperation from more persons and institutions. Software application programmes have considerably enhanced the quality of data.

Results

The year-wise incidence rates (AARs) of the older registries (Series A) for Cancer Breast (ICD 10:C50) [6] for the respective years for which data was contributed were observed. The annual trend for registries i.e. Bangalore PBCR showed an increase in AAR by 0.808 ($p < 0.001$) which points towards higher AARs (on an average) in Bangalore when compared to other older registries (Series A) and same result was indicated in 3 and 5 years AARs for other older registries. With the

Table 1 Breast cancer (ICD-10: C50) trends over time in AARs by annual, 3 and 5 years among older registries with statistical significance using slope (b) and p value based on simple linear regression (Series A)

Name of the registries	Years of data	Annual trend		3 years trend		5 years trend	
		Slope (b)	<i>p</i>	Slope (b)	<i>p</i>	Slope (b)	<i>p</i>
Bangalore	1982–2009	0.808	<0.0001	0.785	<0.0001	0.851	<0.0001
Chennai	1982–2009	0.587	<0.0001	0.589	<0.0001	0.587	<0.0001
Mumbai	1982–2010	0.335	<0.0001	0.332	<0.0001	0.322	<0.0001
Barshi	1988–2010	0.121	0.086	0.139	0.07	0.12	0.284
Bhopal	1988–2010	0.394	<0.0001	0.398	<0.0001	0.423	0.006
Delhi	1988–2009	0.321	<0.0001	0.318	<0.0001	0.323	0.001

exception of rural registry of Barshi, all the other older registries have shown a statistically significant rising trend when annual, 3 and 5 years trends (Table 1). The 5 years trend of AARs for older registries has been depicted in form of graph in Fig. 1.

Since the data collection by the newer registries (series B) is for lesser duration, the 3 year moving average over time in AARs has been calculated. Table 2 presents incidence trends by newer registries for a more recent time period. During 2003–2011, the 3 year moving average incidence rate of Thiruvananthapuram was higher when compared to other newer registries and AAR was stable in first three time intervals (AAR of moving average) after which an increase by 2.0 (of AAR) was observed in 2008–2010 with further increase by 2.5 in 2009–2011. This was found to be statistically significant ($p=0.049$). Similarly, Ahmedabad Rural also showed a statistically significant ($p=0.028$) increase.

Aizawl district and Mizoram state (Series B) have been considered separately to bring out the marked differences in

recorded AARs of the urban areas of Aizawl and Mizoram state as a whole.

However, some measure of prudence may be required in drawing conclusions for the newer registries (series B) about the significance of trends as more years of data would provide more stable rates.

Comparison of Age Adjusted Rates (AARs) Among Indian Registries

On combining the AARs for the respective registries for all calendar years for which they have contributed data, the AARs of listed registries can be represented as a single figure. (Table 3)

On comparison of AARs for the listed registries, it was observed that the AARs in all older PBCRs were Bangalore (26.5), Bhopal (27.8) Chennai (23.1), Delhi (29.6) and Mumbai (25.7) while the rural registry at Barshi had AAR as 8.8.

Fig. 1 Increasing five year trends over time in AARs among older PBCRs for Breast cancer (ICD-10: C50)

Table 2 Breast cancer (ICD-10: C50) 3 years moving average over time in AARs among newer registries (Series B)

Name of the registries	AAR (3 years moving average)							Slope(b)	p
	2003–2005	2004–2006	2005–2007	2006–2008	2007–2009	2008–2010	2009–2011		
Dibrugarh	11.0	11.5	11.8	12.0	12.5	10.8	10.6	−0.068	0.638
Kamrup	20.7	17.9	15.6	16.4	19.7	23.0	22.8	0.742	0.220
Imphal West	13.6	15.0	13.5	12.5	13.1	13.8	NA	−0.163	0.469
Aizawl	23.4	21.3	23.1	23.1	24.6	26.0		0.654	0.072
Mizoram	15.6	15.1	15.4	15.0	15.2	14.9		−0.092	0.130
Sikkim	10.2	8.1	6.0	7.2	7.8	8.2		−0.102	0.706
Ahm Rural		9.2	10.3	10.4	10.9	11.0		0.414	0.028
Th'puram			32.6	32.6	32.6	34.6	35.1	0.687	0.049

In the newer PBCRs the rates were Thiruvananthapuram (33.9), Aizawl (25.1), Kamrup Urban (19.7), Imphal west (13.4) while Sikkim state (8.8) and Ahmedabad Rural (10.3) showed lower AARs (Table 3). The rural registry of Ahmedabad which has shown statistically significant increase in AAR over time (refer Table 2 above) –has a comparably lower AAR overall.

On graphical presentation, it was seen that among all registries (older and newer), Thiruvananthapuram and Delhi PBCRs had higher rates (Fig. 2). The recently established PBCR at Patiala [10] which has completed the data collection of 2011–12 shows the AARs as 32.5 which is comparable to Thiruvananthapuram. The registries in the North Eastern states have shown marginally lower AARs (except Aizawl district) when compared to other registries.

Table 3 Comparison of Age Adjusted Incidence Rates (AARs) - Females –Breast (ICD-10: C50) for all registries (combined AARs for the calendar years for the respective registry)

Centre name	Age Adjusted Rate
Bangalore	26.5
Barshi Rural	8.8
Bhopal	27.8
Chennai	23.1
Delhi	29.6
Mumbai	25.7
Dibrugarh District	11.3
Kamrup Urban District	19.7
Imphal West District	13.4
Mizoram State (MZ)	15.6
Aizawl District	25.1
Sikkim State	8.5
Ahmedabad Rural	10.3
Thiruvananthapuram	33.9

Trends Observed in Populations Covered by Indian PBCRs

An observation of AARs across the registries and over the years shows a statistically significant increase in AARs over time in all older PBCRs (Series A) of Bangalore with Annual Percentage Change (APC) of 3.3 %, Bhopal (1.7 %) Chennai (2.4 %), Delhi (1.1 %) and Mumbai (1.3 %). For Bangalore PBCR, the APC was 2.4 % in the period 1982–1999 (Table 4) whereas it was 5.3 % during the period 2000–2009 [2].

Variation with Broad Age Groups

Table 5 and Fig. 3 indicate the Age specific incidence rates (ASpR) for three broad age groups (45 to 49, 50 to 54 and 55 to 59) for five older registries. Variation in trends in AARs over time, by broad age groups for Cancer Breast in females are particularly important for drawing a comparison between the pre-menopausal and post-menopausal age groups. In Bangalore, Chennai and Mumbai PBCRs there was a significant increase in AARs over time across the age groups starting in the 35–44 age group and in Delhi starting in the 45–54 age group [2]. Additionally in Mumbai PBCR, the age group 0–24 also showed increase in AARs over time [2].

Possibility of One in Number of Women Developing Breast Cancer Over the Period 1982 to 2009 –Lifetime Risk and the Changes Therein!

On comparison of possibility of one in number of women developing breast cancer over the period 1982 to 2009 (Table 6), It is seen that it varied from 1 in 69 in 1982 to 1 in 40 in 2009 for age group 0–64 years. While for the age group 0–74 years, it varied from 1 in 50 in the year 1982 to 1 in 28 in the year 2009 (Table 6).

Fig 2 Comparison of Age Adjusted Incidence Rates (AARs) –Cancer Breast (ICD-10: C50) for all registries **Table 4** Breast cancer (ICD-10: C50) trends over time based on value of joinpoint AARs with Annual Percent Change (APC)

Name of the registries	Joinpoint AARs with Annual Percent Change (APC)		
	APC0	APC1	APC2
Bangalore	3.32*	2.42*	5.30*
Barshi	1.36	—	—
Bhopal	1.74*	—	—
Chennai	2.39*	—	—
Delhi	1.11*	—	—
Mumbai	1.28*	—	—

*- represents significant APC ($p < 0.05$) values

International Comparisons

High-quality population-based cancer incidence data have been collected throughout the world since the early 1960s and published periodically in Cancer Incidence in Five Continents [11] (CI5). Cancer Incidence in five continents

(Volume X) has recently been published which depicts recorded data from various continents (68 countries for the year 2003–07). It has been observed that incidence rates vary internationally by more than 5-fold across the globe [1].

Cancer Incidence in five continents (Volume X) mentions higher recorded incidence rates for breast cancer in

Table 5 Comparison of Age Specific Rates for Broad Age Groups for Cancer Breast (ICD 10: C50) among older registries

Name of the registries	Age group		
	45–49	50–54	54–59
Bangalore	55.7	71.2	90.3
Bhopal	62.5	74.7	75.4
Chennai	63.4	72.8	86.3
Delhi	66.3	97.9	96.1
Mumbai	58.0	78.4	88.0

- New Zealand: Maori (107.4) **in Oceania.**
- Belgium (110.8), France: Somme (105.2), Italy Mantua South (102.1) **in Europe.**
- USA, California, San Francisco Bay Area: Non-Hispanic White (104.1) and USA, California, Los Angeles County: Non-Hispanic White (103.4), USA, Alaska: American Indian (105.3) **in North America.**
- Argentina, Cordoba (78.1) and Argentina, Bahroba Bianca (74.7) **in South America.**
- Zimbabwe, Harare: African (33.9) and Egypt, Gharbiah (45.4) **in Africa.**

Fig. 3 Graphical presentation of Broad Age Groups for Cancer Breast (ICD -10:C50) among older registries

Table 6 Possibility of one in number of women developing Breast cancer (ICD-10): C50 for older registries (calculation based on age specific rates from 0–64 and 0–74 years of age)

Year	0–64							0–74						
	Bangalore	Chennai	Mumbai	Bhopal	Delhi	TVM	Pooled	Bangalore	Chennai	Mumbai	Bhopal	Delhi	TVM	Pooled
1982	78	70	65				69	58	51	47				50
1983	77	68	63				67	59	50	45				49
1984	71	67	58				63	53	51	43				47
1985	77	63	53				59	55	48	37				42
1986	84	64	56				63	64	46	35				42
1987	69	64	63				65	49	47	40				44
1988	68	57	61	67	49		58	48	42	41	51	39		42
1989	62	56	60	66	45		55	45	43	40	46	35		40
1990	61	62	49	61	45		51	47	46	32	47	34		37
1991	52	63	46	66	43		49	38	44	30	51	33		35
1992	64	66	48	65	45		52	42	45	31	45	36		36
1993	59	58	50	64	44		51	40	43	32	45	35		36
1994	68	56	51	54	46		52	45	43	32	44	35		36
1995	60	61	49	60	44		51	40	42	34	53	32		36
1996	61	58	50	65	46		52	44	37	33	51	36		36
1997	61	50	52	55	44		50	45	34	34	44	32		35
1998	53	56	53	56	42		49	39	37	35	41	31		34
1999	55	53	52	52	43		50	41	37	32	43	30		34
2000	52	49	53	56	43		49	35	35	35	40	31		34
2001	49	45	50	55	41		46	31	32	34	41	30		32
2002	47	43	48	53	45		46	32	31	32	39	32		32
2003	46	42	49	59	43		46	32	30	33	43	31		32
2004	42	40	45	48	42		43	30	28	30	36	29		30
2005	38	37	46	43	39	35	41	25	28	30	33	28	28	29
2006	36	39	41	51	39	38	40	26	29	27	36	28	28	28
2007	32	40	43	56	39	38	39	22	29	28	41	28	29	28
2008	36	42	41	48	41	35	40	24	29	27	34	28	26	28
2009	36	39	44	49	38	39	40	24	28	29	33	28	29	28

- **In Asia**, comparatively lower rates are found –the higher rates in Asia were in Bahrain: Bahraini (56.0), Japan: Miyagi Prefecture (54.0), Israel: Non-Jews (56.1), Israel: Jews (89.4), Japan: Hiroshima (58.1), Singapore: Chinese (59.2).

Indian registries showing higher rates [7] – Thiruvananthapuram (33.9), new registry at Patiala (32.5) and Delhi (29.6) have lower rates when compared to registries in other continents as well as Asian registries. (Table 7)

Discussion

The frequency of the most common cancer diagnoses and deaths also varies by geographic areas [1]. An atlas of cancer in India has confirmed suspected features of geography of cancer in India [12]. Such variations have been observed for cancer breast in Indian registries, with the rural registries showing comparably lower rates. The rural registries of Ahmedabad and Barshi have lower rates. The registries in the North Eastern states have shown marginally lower AARs (except Aizawl district) when compared to other registries.

On comparing the AARs of cancer breast with other leading site of cancer among females in India i.e. cancer cervix, it

has been observed that the Age Adjusted Rates (AARs) of cancer breast have overtaken those of cancer cervix in most of the PBCRs [7] (Page 55, Chapter 7, Three year Report of the PBCRs: 2009–11). The estimated newly diagnosed cases of breast cancer account for 16.7 % while cervical cancers accounts for 16.1 % among all anatomical sites for India [2, 7] for females. This is indicative of the fact that the incident (newly diagnosed) cases for cancer breast have overtaken cancer cervix as leading site of cancer in most of the Population Based Registries [7].

The primary factors that contribute to the striking international variation in incidence rates include differences in reproductive and hormonal factors [1]. In Indian registries, a significant increasing trend is seen in AARs over time across the age groups starting in the 35–44 age group in older registries which have contributed more years of data. Additionally in Mumbai PBCR, the age group 0–24 also showed increase in AARs over time. These are registries in urban agglomerations where known reproductive factors that increase risk of breast cancer come into play besides age. Though screening for breast cancer with mammography may have prohibitive cost for a developing country like ours, an awareness campaign targeting women of age groups which has shown increase in rates (i.e. commercial products used by that age group) may be of value. Detection of early signs and symptoms by self-examination appears to be the most cost effective, convenient and even medically feasible method of handling the situation.

The proneness to breast cancer has also shown an increase in Indian registries as is evident by increase in possibility of one in number of females developing breast cancer over the selected period. The steady rise in proneness over years is a matter of concern.

A proactive approach towards providing prompt cancer care facilities to these existing cancer breast cases may delay/stall the morbidities occurring due to Cancer Breast. Though the surgical, chemotherapeutic and radiation oncology treatment facilities have multiplied, the health systems may still be ill equipped to deal with this looming threat. The complexities in treating cancer also add to the woes.

Conclusion

A steady increase in AARs in most of the registries of India including the newly established registries is indicative of the fact that cancer breast poses a threat to women in India. Variations have been observed for cancer breast in Indian registries, with the rural registries showing lower rates when compared with their urban counterparts. Despite the increase in various factors within Indian scenario, which can be thought of working as catalysts for development of cancer breast, the

Table 7 Comparison of selected International^a and Indian Population Based Cancer Registries

International comparisons	Age Adjusted Rate
Delhi	29.6
Patiala	32.5
Thiruvananthapuram	33.9
Japan: Miyagi Prefecture	54.0
Bahrain: Bahraini	56.0
Israel: Non-Jews	56.1
Hiroshima	58.1
Singapore: Chinese	59.2
Bahrain: Bahraini	89.4
Israel: Jews	89.4
Italy Manua South	102.1
USA, California, Los Angeles County: Non-Hispanic White	103.4
USA, California, San Francisco Bay Area: Non-Hispanic White	104.1
France: Somme	105.2
USA, Alaska: American Indian	105.3
New Zealand: Maori	107.4
New Zealand: Belgium	110.8

^a Cancer Incidence in Five Continents, Vol. X (electronic version). Lyon: International Agency for Research on Cancer. Available from: <http://ci5.iarc.fr>, accessed [24 July 2015]

rates in Indian registries remain lower than the overall rates observed internationally.

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