### **Research Article**

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# Estimation of burden of female breast cancer in India for the year 2016, 2021 and 2026 using disability adjusted life years

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### **ABSTRACT**

**Background:** Assessment of burden of breast cancer through DALYs would provide insights for formulating health policies and also for the evaluation of disease control programs. The main objective of the study is to estimate the burden of breast cancer in-terms of YLL, YLD (years of life lived with disability) and DALYs for breast cancer for the year 2016, 2021 and 2026 in India.

**Methods:** The YLL, YLD and DALYs have been estimated by employing global burden of disease methodology using DISMOD. The published data on age, sex and breast cancer incidence and mortality for the years 2006-2008 relating to Population Based Cancer Registries under Indian Council of Medical Research, expectation of life for urban areas of country for 2006-2010, population of the country in 2011 and the projected population of the country during years 2016, 2021 and 2026 were utilized for computations.

**Results:** Total DALYs were found to be 12, 44,773; 14, 10,192; 15, 72,071 in 2016, 2021and 2026 respectively showing an increase of 26.29% from 2016-2026 merely due to the increase in the size of the population and ageing. During the prime years of 30-59 years of age, the DALYs accounted for 76.3%, 75.5%, and 74.1% of total DALYs respectively from 2016-2026.

**Conclusion:** It is estimated that total DALYs due to breast cancer in India would increase over the years. Hence, these computations reveal an urgent need for initiating primary & secondary prevention measures for the control of breast cancer in the country.

Key words: Breast cancer, DALYs, Projection, India, Burden

### INTRODUCTION

Burden of disease can be assessed (measured) through a number of epidemiological parameters such as incidence, prevalence, disease specific mortality, and disability caused by the disease. The world development report 1993 which investigated in health presented sophisticated epidemiological parameters like YLD (years of life lived with disability) and disability adjusted life years (DALY) for different regions of the world as a measure of global burden of disease. DALY combines information on

morbidity, mortality and disability to provide a composite index of burden of disease.

Worldwide the number of cancer cases is steadily increasing day by day. Globally, the burden of new cancer cases in 2012 was 14.1 million<sup>2</sup>. An estimated 1.7 million women will be diagnosed with breast cancer in 2020<sup>3</sup>. Breast cancer ranks second in the South East Asia region according to the number of deaths, by cancer site and region.

Among Indian females, breast cancer is one of the most common cancers according to latest reports available from National Cancer Registry Program (NCRP)<sup>4</sup>. According to the published report of NCRP, the number of breast cancer deaths in India will climb to 1,06,124 in 2015 and 1,23,634 in 2020 respectively.<sup>5</sup> A comprehensive assessment of breast cancer burden through DALYs at national level would provide insights at the level of both organizations and individuals who are committed to health policy and also for evaluation of National program for prevention and control of cancer, diabetes, cardio vascular disease and stroke (NPCDCS).

The present communication attempts to estimate the burden of breast cancer in-terms of years of life lost due to premature mortality by cancer (YLL), years lived with disability (YLD) and disability adjusted life years (DALY) for the years 2016, 2021, and 2026 for breast cancer in India.

### **METHODS**

This study is a secondary data analysis carried out during October-December 2014. To estimate the burden of disease (BOD) due to breast cancer in terms of YLL, YLD and DALYs at the national level and for its further projections, the specific data requirements are age and gender wise; (i) incidence and mortality rates of cancer (ii) general mortality rate due to all causes at the national level and (iii) projected population of the country. In the present analysis the estimates of YLD and DALY due to cancer have been estimated based on published data of (a) cancer incidence and mortality data of population based cancer registries (PBCRs) of Indian council of medical research (ICMR), (b) population of the country in 2011 (c) projected population data of the country for the years 2016, 2021, 2026 and (d) general mortality data due to all causes at the national level for urban areas of the country since five of the six PBCRs used in the present analysis are located in urban areas.<sup>6-8</sup>

## Estimation of pooled cancer incidence and mortality rates

The data on occurrence of breast cancer in the country is available from the PBCRs established in the various parts of the country by the ICMR. The data of earlier established six PBCRs located at Bangalore, Barshi, Bhopal, Chennai, Delhi and Mumbai for the year 2006-2008 for breast cancer was used for estimating the pooled incidence and mortality rates representing national level estimates. The six PBCRs covered a population of 38.4 million that is 20.8 million males and 17.6 million females.

The number of breast cancer cases by five-year age group for each of the registries was obtained by multiplying the age-specific-incidence rates with the respective five-year populations. The respective annual number of incident cases and deaths thus obtained through the above step were summed-up for all the registries to get the total number of cases in each five-year age group by site and gender. The annual populations of all the above six registries by age and gender in the respective five-year age groups were added up to obtain the total population for all the registries. The pooled age-specific incidence rates of breast cancer by site and age for all the six registries were obtained by dividing the respective pooled number of cases with the corresponding pooled population.

### Population of the country

Population of the country according to age and gender by different quinquennials from 2016 to 2026 were obtained from the report of population projections carried out for the country for the years 1996 to 2026 by the Registrar General of India.<sup>7</sup>

### Estimation of general mortality data at the national level

The sample registration system (SRS) is the main source of information on fertility and mortality in India. The SRS mechanism involves collection of data through two independent methods, viz., continuous enumeration and retrospective surveys followed by a process of matching of the two records and field verification of the unmatched and partially matched events. This process ensures a crosscheck of the correctness and completeness of the recording of births and deaths from the two methods. The abridged life tables for the year 2006-2010 being published by the Registrar General of India, based on SRS was utilized for getting the all causes mortality and the expectation of life at various age intervals by gender and residential status.<sup>8</sup>

### Estimation of YLD, YLL and DALY

In the present study YLD, YLL and DALY have been estimated by employing the methodology suggested in the Global Burden of Disease (GBD) study (DISMOD procedure) conducted by WHO. 11-14 In the DISMOD (disease modelling) procedure it has been assumed that there are two causes of death: from the disease under study and from all other causes, which are assumed to be independent. With the above assumption it has been shown that the disease model can be completely determined by the three- transition hazards viz. incidence, remission and case fatality (DISMOD I). However, for diseases like cancer, information on remission is difficult to obtain. In such situation, when input variable like prevalence is known, DISMOD II has been suggested to be more useful. DISMOD II has been modified to allow for a wider range of disease input variables than the three transitional hazards such as incidence, remission and case fatality employed under DISMOD I.

In particular, disease incidence, disease specific mortality are input variables. In addition to disease input variables,

DISMOD II needs total general mortality rate and population number for the population under study. When the information relating to these variables are entered in DISMOD II, the programme inserts these values in the equations, and calculates the epidemiologic variables and compares them with the input variables and produces the required results. In the present analysis, DALY Template of WHO was employed for estimating YLD, YLL and DALY for breast cancer. <sup>15</sup>

The projection of estimation of DALYs due to breast cancer have been done with the following assumptions (i)

pooled incidence and mortality rates obtained from the six PBCRs represent the country's incidence and mortality rate due to cancer (ii) age-specific cancer incidence rates and mortality rates due to cancer as well as general mortality rate will remain unchanged over the next 10 years from 2016 till 2026.

### **RESULTS**

The estimates of burden of disease due to cancer in India have been made based on data of earlier established PBCRs working under the network of NCRP of ICMR.

Table 1: Pooled and individual cancer incidence and mortality rates per 100,000 persons (all sites, female breast) in 2006-2008 in population based cancer registries of ICMR.

PBCR	Incidence	Incidence (CR)		Mortality (CR)		Incidence (AAR)		Mortality (AAR)	
	All sites	Breast	All sites	Breast	All sites	Breast	All sites	Breast	
Bangalore	106.3	28.5	29.7	5.9	139.1	28.5	40.9	7.9	
Barshi*	47.3	0.1	38.3	0.4	51.5	0.08	38.6	0.6	
Bhopal	76.2	18.9	31.4	0.1	105.5	25.36	33.8	0.2	
Chennai	113.3	30.1	28.5	5.1	121.1	31.47	26.2	5.4	
Delhi	75.5	22.9	8.0	1.2	121.2	32.25	11.8	1.8	
Mumbai	70.2	29.2	41.1	0.1	110.4	32.30	48.9	0.1	
All registries	94.9	26.4	26.4	5.4	118.9	32.9	33.6	6.8	

Rural registry, CR: crude rate, AAR: Age Adjusted rates.

Table 2: Expectation of life at various ages for urban Indian population, 2006-10.

Age Inter.	Total (Male and female)	Female (yrs)
0-1	69.6	71.4
1-5	71.1	73
5-10	67.7	69.7
10-15	62.9	64.9
15-20	58	60.1
20-25	53.3	55.4
25-30	48.7	50.7
30-35	44.1	46.1
35-40	39.5	41.4
40-45	35	36.7
45-50	30.5	32
50-55	26.3	27.6
55-60	22.2	23.3
60-65	18.4	19.2
65-70	15	15.6
70+	34.2	34.7

\*Source: SRS based abridged life tables, 2006-2010

The estimates of burden of disease due to cancer in India have been made based on data of earlier established PBCRs working under the network of NCRP of ICMR. The pooled estimates of cancer incidence and mortality

data of all the six registries were found to be 94.9, 26.2, 26.4, 5.4, 118.9, 32.9, 33.6 and 6.8 respectively (Table 1).

Table 3: Age wise distribution of population of females in India during various quinquennials.

Age (yea	rs) 2016	2021	2026
0-4	53,748,000	52,465,000	49,257,000
5-14	106,364,000	105,994,000	104,524,000
15-29	169,860,000	166,480,000	161,149,000
30-44	129,487,000	143,586,000	157,423,000
45-59	92,347,000	104,485,000	113,751,000
60-69	33,618,000	41,474,000	50,633,000
70-79	26,368,000	31,177,000	37,927,000
Total	611,792,000	645,661,000	674,664,000

\*Source: Registrar General of India.

Highest breast cancer incidence rate was found in Chennai registry (30.1 per 100,000 females) while the rural registry of Barshi had recorded the lowest incidence rate of breast cancer (0.1). The expectation of life at various ages for urban Indian population for the year 2006-2010 was based on SRS. The expectation of life during infancy was 71.4 years for females (Table 2).

Table 4: Total YLD and YLL due to breast cancer females for the years 2016, 2021, 2026 in India.

	2016			2021			2026		
Age groups	YLDs	YLLs	% of YLL to DALYs	YLDs	YLLs	% of YLL to DALYs	YLDs	YLLs	% of YLL to DALYs
0-4	-	818	100	-	798	100	-	749	100
5-14	799	-		796	-		785	-	
15-29	41339	14281	25.68	40516	14675	26.59	39219	14341	26.78
30-44	274380	117445	29.97	304255	127679	29.56	333575	141767	29.82
45-59	311977	246455	44.13	352983	280192	44.25	384286	305968	44.33
60-69	84116	66593	44.19	103773	82143	44.18	126690	100217	44.17
70-79	45917	40654	46.96	54291	48090	46.97	66046	58427	46.94
Total	758527	486246	39.06	856614	553577	39.26	950601	621470	39.53

Table 5: Total YLDs and YLLs of breast cancer per 100,000 females during various quinquennials in India.

Year	2016		2021		2026	
Age group (Years)	YLD	YLL	YLD	YLL	YLD	YLL
0-4	0	1.5	0	1.5	0	1.5
5-14	0.8	0	0.8	0	0.8	0
15-29	24.3	8.4	24.3	8.8	24.3	8.9
30-44	211.9	90.7	211.9	88.9	211.9	90.1
45-59	337.8	266.9	337.8	268.2	337.8	269
60-69	250.2	198.1	250.2	198.1	250.2	197.9
70-79	174.1	154.2	174.1	154.2	174.1	154.1
Total	124	79.5	132.7	85.7	140.9	92.1
% of YLL to YLD	64.1		64.5		65.3	

Table 6: Total DALYs for breast cancer (per 100,000 females) during various quinquennials in India.

Age(yrs)	2016	2021	2026
0-4	1.5	1.5	1.5
5-14	0.8	0.8	0.8
15-29	32.7	33.2	33.2
30-44	302.6	300.8	302
45-59	604.7	606	606.8
60-69	448.3	448.3	448.1
70-79	328.3	328.4	328.2
Total DALY	203.5	218.4	233

Table 3 gives the age wise distribution of the projected population of the country in 2016, 2021 and 2026. Total projected populations were 611,792,000, 645,661,000, 674,664,000 in the years 2016, 2021 and 2026 respectively. The DISMOD analysis and estimation of YLDs and YLLs for breast cancer for all sites of cancer has revealed that the percentage of YLL to DALYs is estimated to increase to 39.06, 39.26, and 39.53 during 2016, 2021 and 2026 respectively (Table 4). The percentage of YLL to YLD is estimated to increase from

64.1, 64.5 and 65.3 in 2016, 2021, 2026 respectively (Table 5). Comparison of estimates of burden of breast cancer revealed that burden will increase from 203.5 per 1000 females in 2016 to 233 per 100,000 females in 2026 (Table 6).

### **DISCUSSION**

The Global Burden of Disease (GBD) study introduced a new metric disability adjusted life year (DALY) to quantify the burden of disease. DALY helps to combine information on morbidity, mortality and disability to provide a composite index of burden of disease. DALYs contains two major components-the years of life lost (YLL) due to premature mortality and the years of life lost due to disability (YLD). The use of DALY allows combining in a single indicator years of life lost (YLL) from premature death and years of life lived with disabilities (YLD). The data requirement for computation of DALYs is enormous. Many developing countries do not generate data of that kind. The needs are particularly intense for computing YLD component. The data requirement includes incidence, prevalence, and duration of disease, case-fatality and remission rates of each site of cancer in different age-sex groups separately for each severity condition of the cancer site. In the absence of readily available data, workable estimates can be derived by (i) review of epidemiological literature, (ii) using epidemiological models and (iii) consulting experts. In the absence of all such data the weights derived by the Harvard School of Public Health, World Health Organization and the World Bank for different sites of cancer can be employed.

The data requirement for YLL component on the other hand is relatively less. Estimates of years of life lost (YLL) can be computed for various populations based on the age, gender and site-specific cancer mortality rates and the abridged life tables providing expectation of life for the corresponding period and to the related population. In cancer, disability of various severities is caused according to the affected site of cancer and for different duration. Weights are given according to their severity and converted to loss of life. This allows comparison of one DALY lost in a group of persons due to a particular condition like lung cancer with the one lost due to malignant neoplasm of stomach. Although, DALYs may not be the final word on measurement of physical component of health, this has at least initiated some discussion on criteria for setting health priorities for different segments of populations.

The GBD study has calculated the DALYs for India for the year 1990 and has projected till 2020. 13 However, the estimation of burden of breast cancer based on the incidence and mortality data of six PBCRs and its projections till 2026 has been less attempted. Such types of summary measures with a future projection is essential for setting priorities for health planning, public health programs, research and development. These summary measures also help to identify the relative magnitude of different health problems, including diseases, injuries and risk factors.

The present paper was undertaken to quantify the burden of premature mortality and disability by age and sex, at national level for breast cancer using the GBD methodology using existing information. GBD measures the population health status by using the Potential Years of life lost due to Premature Mortality (YLL) and Years of life lived with Disability adjusted for severity of disability (YLD). Measures of potential years of life lost due to premature mortality have been used for many years to measure the mortality burden of various causes of death. 15,16 DALYs were found to be 12, 44,773 in 2016; 14, 10,192 in 2021, and 15, 72,071 in 2026 showing an increase of 26.29% merely due to the increase in the size of the population and ageing. During the prime years of 30-59 years of age the DALYs for breast cancer accounted for 76.3%, 75.5%, and 74.1% respectively from 2016-2026 compared to total DALYs. It may be mentioned that estimation of burden of disease is highly dependent on estimates of disease specific mortality.

There are certain limitations in the collection of mortality data in India. The system of registration of death and certification of the cause of death suffers from many limitations. Though, in urban centres all deaths are generally registered, information on the cause of death is lacking. Very often when cancer is mentioned as a cause of death, the anatomical site is not mentioned and when the site is mentioned, the histology or morphology is not stated. Due to this, there are difficulties in having a clear and complete picture of cancer mortality as opposed to cancer morbidity. The cancer mortality rates among six PBCRs vary widely. Highest breast cancer incidence rate was found in Chennai registry (30.1 per 100,000 females) while Bangalore, Delhi, Bhopal and Barshi reported the incidence of 29.2, 28.5, 22.9, 18.9 and 0.1 respectively. Breast cancer mortality was highest in Bangalore 5.9 per 100,000 females (Table 1).9

The other source of breast cancer mortality in the country is Medical Certification of Causes of Death (MCCD) obtained from hospitals mostly from urban areas. According to this breast Cancer alone accounts for around 14 per cent of total female neoplasm deaths Breast cancer contributes to 0.725 percent of total deaths among females

Strengths of the present study are the uniqueness of the study in trying to estimate DALYs using the most recent scientific method available. We were able to utilize the recently available data for our country. DALYs gives the burden which the policy makers can utilize for planning. Based on the knowledge about burden of breast cancer we can estimate how much life expectancy can be increased if this burden is brought down. One of the limitations is that the estimations are based on the assumptions that the mortality rates will remain the same in the future.

A number of efforts are under way to improve cause of death statistics in the country. It is expected that more reliable data on cause of death will become available in future and this will help in further improvements in estimates of burden of breast cancer. The above estimations reveal that the burden of breast cancer will increase over the years and hence there is a need to identify breast cancer at the earliest by self-breast examination at the individual level or screening program at population level.

### **CONCLUSION**

The analysis and estimation of YLDs and YLLs for breast cancer for all sites of cancer showed that the percentage of YLL to DALYs is estimated to increase from 39.06 to 39.26, and 39.53 during 2016, 2021 and 2026 respectively. The percentage of YLL to YLD is estimated to increase from 64.1 to 64.5 and 65.3 in 2016, 2021, 2026 respectively. Burden of breast cancer will increase from 203.5 per 100,000 females in 2011 to 233 per 1000 females in 2026. Hence, these computations

reveal an urgent need for initiating primary and secondary prevention measures for the control of breast cancer in the country.

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