Economic Burden of Cancer and Their Variations along with Incident Trends, Challenges, and Opportunities in India

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Abstract

Cancer is emerging as a major public health concern in India with the ongoing demographic and epidemiological transition. This paper uses a nationally representative household survey to look at the general prevalence and economic burden of cancer in India. The average out of pocket spending on inpatient care in private facilities is about three-times that of public facilities. These efforts should specialize in the ten cancers contributing the very best DALYs in India, including cancers of the stomach, lung, pharynx aside from nasopharynx, colon and rectum, leukemia, oesophageal, and brain, and Systema nervosum, additionally to breast, lip and oral cavity, and cervical cancer, which are currently the main target of screening and early detection programs. India's current burden of 10,00,000 incident cancers is that the results of an epidemiologic transition, improved cancer diagnostics, and improved cancer data capture. The increasing incidence of cancer in India with wide interstate variations offers useful insights and important lessons for developing countries in managing their increasing cancer burdens. Overall, the cancer epidemiology literature from India is thinly dispersed. More studies with robust designs representing all parts of the country are currently needed.

INTRODUCTION

The term "Cancer" is derived from the Greek word "Karkinos" (for crab) which refers to a generic non-communicable disease (NCD) characterized by malignant (cancerous or neo-plasms) abnormal cells (tumor/lump) growth in any part of the human body.

However several forms of cancer have been detected, the most common sites of these tumors in human bodies are lungs, stomach, colorectal, liver, and breasts[1].

One of the major reasons for not being able to implement a screening program in India has been lack of workforce - physicians, health workers, technical staff, and pathologist to review pathological material. in increasing public awareness, supporting screening, early detection, patient and family support services, and palliative care by providing home care in these several nongovernment organizations are enagaged[2]

After cardiac diseases, as an important cause for morbidity and mortality in India cancer has emerged. The major source of information on cancer incidence and pattern in the country is The National Cancer Registry Programme and was commenced by the ICMR in December 1981.

Cancers are caused by mutations that may be inherited, induced by environmental factors, or maybe result from DNA replication errors.[5]

EPIDEMIOLOGY

Cancer is ranked as the first or second leading cause of death in 91 of 172 countries and it is third or fourth in an additional 22 countries. Cancer is that the second and fourth leading explanation for adult death in urban and rural India, respectively.

Borrowing, sales of assets, and contributions from friends and relatives are the means through which Approximately 40% of cancer costs are met. These costs exceed 20% of annual per capita household expenditure in 60% of Indian households for the patient suffering from cancer.

Census shows that Indian citizens spent 6.74 billion US dollars in 2012 as a result of cancer deaths. from 1990 to 2016 Cancer mortality in India has doubled. India's cancer incidence is estimated to be 1.15 million for new patients in 2018 and is predicted to get almost double as a result of demographic changes alone by 2040.[5]

The low- and middle-income countries (LMICs) are undergoing an epidemiological transition, wherein the burden of communicable diseases is declining and non-communicable diseases like cancers are on the increase.

An estimation of 20 million cancer cases is expected in LMICs by 2025. There has been a considerable variation in the incidence of cancers between high-income countries (HICs) and LMICs. The incidence varies from 95/10 000 in the LMICs to over 571/100 000 in the HIC countries in both men and women.[6]

METHODOLOGY

In study 1 the survey was conducted in 2014 by the National Sample Survey Organization (NSSO), Ministry of Statistics and Program Implementation, Government of India. With a representative sample of households and randomly selected through a stratified multi-stage survey design which is covering India has conducted Social Consumption: Health Survey interviews. A rural/urban stratification is made within clusters called state-regions, which comprises an endless group of districts within a State or Union territory having similar characteristics.

This cross-sectional survey data were collected from January to June 2014. The 71st round of Morbidity and Healthcare Survey covers a sample of 65,932 households and 335,499 individuals and reported levels of cancer prevalence as well as treatment expenditure across socioeconomic categories.

The socioeconomic gradient in cancer prevalence and its healthcare utilization attentively on public and private hospitals separately concentration index (CI) is performed.[1]

In study 2 the accessible data is used from multiple sources, including 42 population-based cancer registries. The nationwide Sample Registration System of India is used to estimate the incidence of 28 types of cancer in every state of India from 1990 to 2016.

Therefore the deaths and disability-adjusted life-years (DALYs) caused by them, as a part of GBD 2016. In these death rates for all cancers together and the trends of all types of cancers, highlighting the heterogeneity in the burden of specific types of cancers across the states of India. It also presents the contribution of major risk factors to cancer DALYs in India.[3]

RESULTS

Table 1: Cancer prevalence per 100,000 persons by background characteristics and place of residence, India, National Sample Survey, 2014.

Background characteristics	All India	All India	Rural India	Rural India	Urban India	Urban India
	Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI
Age						
0–14 years	16	[7.9, 23.5]	14	[4.7, 24.1]	19	19 [5.7, 33.2]
15–49 years	62	[50.7, 73.9]	60	[45.1, 75.7]	66	[48.5, 84.4]
50–59 years	192	[142.5, 240.9]	158	[98.2, 217.2]	268	[180.1, 355.9]
60–69 years	321	[237.5, 404.6]	289	[182.7, 394.8]	391	[252.6, 530.4]
70+ years	385	[268.4, 502.3]	231	[107.2, 355.4]	727	[492.3, 962.7]
Sex						
Male	71	[58.4, 83.7]	56	[40.9, 70.6]	106	[82.8, 130.0]

Background characteristics	All India	All India	Rural India	Rural India	Urban India	Urban India
Female	96	[80.7, 110.5]	88	[68.6, 106.4]	115	[89.9, 139.7]
Reproductive Age and Sex						
Male: 15 to 49 years	29	[18.2, 40.7]	24	[10.5, 38.1]	40	[20.6, 59.9]
Female: 15 to 49 years	96	[76.2, 117.1]	97	[69.9, 124.9]	95	[64.5, 125.5]
Education						
Illiterate	79	[61.7, 96.0]	75	[54.8, 96.1]	93	[60.8, 124.4]
Primary	53	[38.6, 68.1]	47	[29.4, 64.8]	71	[43.1, 97.9]
Secondary	48	[33.2, 63.4]	38	[20.3, 56.7]	38	[41.6, 95.1]
Higher	72	[49.7, 94.7]	36	[9.6, 63.6]	102	[69.1, 135.7]
MPCE quintile						
Lowest	49	[33.0, 65.3]	33	[15.0, 51.0]	92	[59.1, 124.4]
Second	51	[34.0, 68.1]	50	[19.5, 61.2]	75	[45.1, 105.5]
Third	61	[42.1, 80.4]	37	[16.4, 57.1]	112	[73.9, 149.8]
Fourth	110	[85.6, 135.1]	107	[76.3, 137.9]	119	[76.6, 160.3]
Highest	147	[116.8, 176.7]	143	[104.9, 180.2]	156	[105.7, 205.5]
Social group						
Scheduled tribe	42	[22.5, 60.9]	27	[9.4, 45.2]	158	[9.4, 45.2]
Scheduled caste	81	[57.1, 104.2]	75	[46.8, 103.9]	99	[56.1, 142.6]
Other backward classes	89	[73.1, 105.1]	82	[61.5, 101.9]	107	[80.1, 1333.3]
Others	89	[70.4, 107.1]	69	[45.4, 93.7]	114	[86.3, 142.4]
All India	83	[73.2, 92.7]	71	[59.3, 83.2]	110	[93.3, 127.6]
Age-Standardized Prevalence	97	[53.2, 146.1]	83	[28.0, 141.9]	130	[46.0, 211.4]

Table 2. Average OOP hospitalization expenditure per cancer patient by background characteristics and public and private sector treatment, India National Sample Survey 2014.

Background characteristics	Average Hospitalization Expenditure	Average Hospitalization Expenditure	Average Hospit
	Public sector Medical	Public sector Total	Private sector Medical
Age			
0–5 years	19805	30041	55136
6–14 years	32391	36577	56102
15–24 years	18083	20947	97068
25–59 years	31084	36665	85441
60+ years	16758	19912	65060
Sex			
Male	22782	27427	101194
Female	26448	30835	64562
Education			
Illiterate	17641	23176	51754
Primary	20495	24760	88644
Secondary	20057	23413	37718
Higher	37331	42232	121714
MPCE quintile			
Lowest			
Second	22064	27308	44500
Third	21667	24226	44948
Fourth	23117	27138	83933
Highest	28645	34638	89809

Background characteristics	Average Hospitalization Expenditure	Average Hospitalization Expenditure	Average Hospit
Social group			
Scheduled tribe	8596	10941	103079
Scheduled caste	24306	27977	48389
Other backward classes	23710	29528	74766
Others	29994	34015	94923
Place of residence			
Rural	26897	32202	72654
Urban	20686	24044	86941
All India	24523	29066	78045

Table 3 Percentage of total cancer DALYs due to different types of cancers by sex in India, 2016

Both sexes combined	Both sexes combined	Females	Females
Types of cancers	% of total cancer DALYs	Types of cancers	% of total
Stomach cancer	9·0%	Breast cancer	16·8%
Breast cancer	8·2%	Cervical cancer	10·8%
Lung cancer	7·5%	Stomach cancer	9·0%
Lip and oral cavity cancer	7·2%	Colon and rectum cancer	6·1%
Pharynx cancer other than nasopharynx	6·8%	Lip and oral cavity cancer	4·6%
Colon and rectum cancer	5·8%	Ovarian cancer	4·6%
Leukemia	5·2%	Lung cancer	4·4%
Cervical cancer	5·2%	Leukemia	4·3%
Oesophageal cancer	4·3%	Gallbladder and biliary tract cancer	4·3%
Brain and nervous system cancer	3·5%	Pharynx cancer other than nasopharynx	4·3%
Liver cancer	3·5%	Oesophageal cancer	3·5%
Non-Hodgkin lymphoma	3·2%	Brain and nervous system cancer	2·9%
Gallbladder and biliary tract cancer	3·1%	Non-Hodgkin lymphoma	2·6%
Larynx cancer	3·0%	Liver cancer	2·3%
Pancreatic cancer	2·4%	Pancreatic cancer	2·2%
Ovarian cancer	2·2%	Uterine cancer	1·7%
Prostate cancer	1·5%	Thyroid cancer	1·3%
Bladder cancer	1·0%	Larynx cancer	1·1%
Nasopharynx cancer	1·0%	Multiple myeloma	1·0%
Multiple myeloma	1·0%	Nasopharynx cancer	0·7%
Hodgkin's lymphoma	0·9%	Hodgkin's lymphoma	0·6%
Uterine cancer	0·8%	Bladder cancer	0·6%
Kidney cancer	0·7%	Kidney cancer	0·4%
Mesothelioma	0·3%	Malignant skin melanoma	0·2%
Malignant skin melanoma	0·3%	Mesothelioma	0·2%
Testicular cancer	0·2%	Non-melanoma skin cancer	0·1%
Non-melanoma skin cancer	0·2%		

INDICATORS OF SOCIOECONOMIC STATUS (SES)

Hose hold monthly per capita expenditure (MPCE) quintile, education, and social group of the cancer patient are the three SES indicators on which mainly focused. Indian education system categorized the patients as illiterate (no formal schooling), primary education or below (1-5 years), middle school or below (6-10years), secondary education (11-12 years) and higher education (graduate school and above). Social groups were

divided as scheduled tribes (ST), scheduled castes (SC), other backward classes, and other castes. SC and ST groups were economically, socially, and geographically deprived groups in India when compared to other castes which are having better SES.[1]

RISK FACTORS

In the Indian subcontinent, the most common risk factor studied was tobacco in gastrointestinal cancers, head and neck cancers, lung cancers, prostate cancer, and urinary tract cancers.[7,8,9]

The estimated risk in male and female cancer patients is 45% and 17% respectively. Papillomavirus in oral cancer is a good example of cultural practices affecting risk factors.[10]

Female is commonly affected by cervical cancer in India and it is the second most common form.[11]

Studies on Tobacco-related cancers are highest in numbers, proportionate to their prevalence but cervix and breast cancers need to be explored for their risk factors as the number of studies for modifiable risk factors for these two cancers are low. The design of the risk factor studies reviewed if lacks any randomized control trials (RCT) and large prospective cohorts. It may be due to the complexity of conducting RCT and high costs. Most of the studies reviewing risk factors have incorporated cross-sectional or case-control study designs for their studies.[12]

INCIDENCE AND TRENDS

It is not clear whether withholding or no disclosure of the funding source was the result of either the lack of significant funding or potential conflict of interest. We have included manuscripts published in PubMed only, and other databases are excluded. It also missed some of the data published as government reports and gazettes.[6]

Incidence and trends are studied by Seventy-six papers. uniformity was not found in reporting the incidence rates. The incidence has been reported from the population-based registries and trends from secondary data as ASR and expected annual percentage change. The percentage of patients treated represents the incidence of hospital-based studies. The non-uniformity in reporting and predominance of hospital-based registries lead to misrepresentation of the incidence of cancers and Keeping Journal of Medicine had also revised its rules about conflict of interest.[13]

STRATEGIES FOR EARLY DETECTION OF COMMON CANCERS IN INDIA

The cancers of the oral cavity, uterine cervix, and female breast are very susceptible to early detection. Periodic examination for early detection of cervix and breast cancers in the developed countries, Pap smear, and Mammography are the accepted standards. in India Pap smear and mammography are however not practical and affordable methods for cervix and breast cancer screening.[14,15]

MODEL CANCER CONTROL PROGRAM

A comprehensive cancer control program in the backward Ratnagiri and Sindhudurg districts of Maharashtra has been started by The Tata Memorial Hospital. This program proposes to cover the eligible population of these districts with two rounds of screening for oral, cervix and breast cancers at two-year intervals.

Trained primary health care workers will perform screening. The treatment of the screened positive cases will be carried out locally at an NGO Hospital at Chiplun in Ratnagiri, the BKL Walavalkar Hospital. This program, which was started in August 2003, is an 'Xth-plan Project' of the Department of Atomic Energy that will be completed by March 2007 and is expected to form a model for district cancer control programs in the country.[4]

THE FUTURE OF CANCER IN INDIA

India's epidemiologic transition was triggered by large reductions in premature deaths from infections and associated diseases and increased life expectancy. an increase in cancer and other non-communicable diseases are experienced by all Indian states.[16] Due to a lack of adequate and easily accessible cancer care facilities,

in the least developed and rural parts of India, Cancer diagnoses are still missed. In 1993, an autopsy study from India's premier postgraduate medical institute revealed that 25.8% of cancers were incorrectly diagnosed.[17]

There are still chances of error in Indian urban cancer registries in terms of data quality.[18] The 2018 quality report from Cancer Incidence in Five Continents indicates that 23% of cancers in rural Assam were unclassifiable.[19] The increasing availability of minimally invasive diagnostic technologies, including image-guided needle aspiration cytology and immunohistochemistry, will further increase cancer diagnosis in India.[20] The introduction of computed tomography scanning in Mumbai in the mid-1980s was immediately followed by an increase in the incidence of brain tumors, which stabilized later.[21]

The reduction of cardiovascular disease mortality is correlated with increased cancer mortality in many developed countries.[22] Further reduction in cardiovascular disease mortality, which is presently three times higher than cancer in India, will increase the cancer burden further. Cancer screening, which is being considered by the GOI, is known to increase incidence while reducing mortality.[23]

DISCUSSION AND CONCLUSION

Increasing the prevalence of cancer is a major public health concern. the overall self-reported prevalence of cancer is estimated to be 83 per 100,000 persons with a greater prevalence in urban areas (110 per 100,000 persons).[10] In addition to this, cancer prevalence for the age-standardized rate is estimated to be 97 per 100,000 persons. These estimates are also similar to the age-adjusted cancer incidence (94 per 100,000 persons) discussed.[24]

According to table 1, cancer prevalence is highest in urban India when compared to rural India concerning its background characteristics

According to Table 2, the average hospitalization expenditure is greater for the private sector when compared to the public sector following its background characteristics

According to Table 3, the highest percentage of total cancer DALYs is stomach cancer and the lowest percentage of total cancer DALYs is testicular cancer and non-melanoma skin cancer in both sexes combined

In females, the highest percentage of total cancer DALYs is breast cancer, and the lowest percentage of total cancer DALYs is non-melanoma skin cancer. In males, the highest percentage of total cancer DALYs is breast cancer and the lowest percentage of total cancer DALYs is non-melanoma skin cancer, breast cancer, and malignant skin melanoma

The higher burden of cancer among the elderly cohort and in demographically advanced states implies greater requirements of tertiary care facilities. [25]

Cervical cancer is ranked as most frequently caused by cancer among women which are mainly caused by sexually transmitted human papillomavirus (HPV). About three fourth of sexually active adults are likely to be affected by any one type of HPV which is suggested in many studies.[26]

The Indian Academy of Pediatrics and Committee on immunization (IAPCOI) recommends offering vaccines to only those who can afford but HPV vaccination is of public health concern. Policies should be made to check universal risk factors causing cancerous tumors such as tobacco and alcohol, poor diet (insufficient fruit or vegetable intake), overweight and obesity, physical inactivity, chronic infections from Hepatitis B and C virus, and environmental risks including ionizing and non-ionizing radiation. [27]

Between 1992 and 2012, India has a third-highest increase in alcohol per capita (APC) among 40 countries.[28]

After the USA and China, India has the third-highest number of obese individuals in the world. If detected at the right stage properly, half of the cancer cases can be successfully treated which is suggested in a few studies. [29]

In India, the detection rate is very low and about only 20 to 30 percent of cases are diagnosed at Stage I and II respectively which indicates the increase in general awareness regarding cancer symptoms, causes, prevention, and measure and treatment options. Although, in 1984 with four major goals i.e. primary prevention of tobacco-related cancers, early detection of cancers, augmentation of treatment facilities, and establishing palliative care is formulated by the National Cancer Control Programme (NCCP) was formulated.[30]

National Cancer Registry Programme (1982) has been providing authentic information on cancer incidence since more than 30 years, but the functioning of NCRP is according to just 28 Population-Based Cancer Registries (PBCRs)

It is important to reiterate that cancer treatment in India should be received as a priority both to improve cancer survival and to protect households from financial catastrophe. As this study mainly aims at analyzing out of pocket expenditure and financial hardships on cancer inpatient treatment, information on availability and cost of drugs, access to modern techniques of treatment is also desirable, estimates on catastrophic expenditure at different thresholds (i.e. 10%, 20%, and 30%) across different population groups does-not reveal the information about the willingness of households to spend on cancer care. [31]

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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