

## Mapping India's Cancer Burden Regions with Emerging Trends and Public Health Challenges

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**Abstract:** One of the foremost reasons of morbidity and mortality in India is cancer. The cancer rate in India is high and continues to rise despite recent advancements in technology and medicine. Furthermore, there are significant regional differences in the prevalence of cancer and the availability of critical medical resources across the nation. This article aims to characterize the causes and estimate the burden of cancer deaths across India based on secondary data. This work aimed to enhance estimates of the burden of cancers in India and the states to establish cancer screening, testing, treatment and research priorities. Methodology- Data is collected from secondary sources. Findings According to projections, India's cancer burden will increase from 26.7 million in 2021 to 29.8 million in 2025, with the north and northeast experiencing the highest burden (Vemula and Dhakshanamoorthy, 2025). Lung, mouth, prostate, and tongue cancers are frequent in men, whereas breast, cervix-uteri, ovarian, and lung cancers are common in women. Due to various factors contribute to an increase in cancers in both sexes. Except for cancers linked to infections, like cervix uteri, and cancers related to tobacco use, like pharynx (which does not include nasopharynx) and oesophagus. Conclusion- All cancers in both genders increased, except for some types of cancers that decreased, as evidenced by changes in epidemiologic risk factors and demographics. The growing prevalence of cancer and its contributing factors necessitate a deliberate strategy to lessen its impact. Expanding the population coverage of cancer registries must reinforce the burden assessment. To alleviate the cancer burden, public health initiatives to reduce obesity and alcohol consumption, as well as stricter implementation of ongoing tobacco prevention efforts, are required.

**Keywords:** Cancer incidence, gender, mortality, causes, implication, public health

**Introduction:** Cancer refers to the unusual expansion and dissemination of cells in the body. Cells normally grow as needed, but when this is disrupted, abnormal cells develop into tumours. Cancerous tumours spread different parts of the body by invading the surrounding tissues. One in every five people in the world will develop cancer, a public health problem of significant proportion. Up to 40% of cancers could be prevented by preventive strategies, while early detection can be lifesaving (NIC, 2023; WHO, 2024). In 2022, the WHO estimated 20 million new cancer cases and 9.7 million deaths worldwide, with lung cancer being the most prevalent. Other leading cancers are breast, colorectal, and prostate cancer (Diao et al., 2025). Lung cancer is the number one cause of cancer deaths, followed by colorectal, liver, and breast cancers. Estimates indicate cancer incidence may increase to 35 million in 2050, fuelled by shifts in risk factors such as smoking, alcohol intake, overweight or obesity, and air pollution (WHO, 2024; Bray et al., 2022).

In addition to these factors that have contributed to the rise in cancer burden in the world include higher urbanization, ageing of the populations and alterations in lifestyles to a large extent. Other nations such as India are experiencing a double burden of the communicable and non-communicable diseases and cancer is emerging as a leading cause of death. It is not improving in the low- and middle-income countries because of the lack of access to healthcare services, late diagnosis, and inappropriate screening programs. Also, other environmental exposures such as industrial pollutants, occupational hazards, and other environmental inimbrite are also relevant in the development of cancer. The solution to such dilemma must be a complex strategy comprising of prevention, early detection, equal access to treatment, and potent policies on the topic of community health to mitigate the risk factors and improve the overall outcome of cancer treatment.

**Research Methodology:** The proposed research is dedicated to the application of descriptive and analytical research design to trace the cancer burden in an Indian context and examine the novel tendencies and public health concerns. The research will be based on the sole secondary data, which will ensure the in-depth and comprehensive understanding of cancer incidence and mortality and geographical disparity.

The respected national and international databases like the World Health Organization (WHO) global cancer observatory (GLOBOCAN), Indian Council of Medical Research national cancer registry programme (ICMR-NCRP) were used to collect information. The other data was collected based on the published peer-reviewed articles, governmental reports, and national surveys such as NFHS-5. In these sources were found the information on the incidence and mortality, the risk factors and the patterns of distribution of the cancer state by state.

The period of the experiment will be 2020-2025 (estimated) both of which are based on the recent trends and forecasts. A tabular classification of data was done based on gender (male / female), types of cancer and geography. To establish high-burden states and cancer prevalence and mortality variations, a comparative analysis was conducted. The method used was a trend analysis method of studying the changes in cancer incidence over time and comparative interpretation of statistics was used to identify the differences that exist between regions and gender. Although the research did not include any primary data collection, as well as any intricate statistical modeling, it is based on an aggregation of validated data and already known projections (Vemula and Dhakshanamoorthy, 2025; Kulothungan et al., 2022).

Ethical conducts have been witnessed using publicly available information and citing all sources. The use of secondary data is, however, limited to the study by the possibility that such may be underreported or that they vary across geographical areas due to variations in cancer registry coverage.

**Results:** The outcomes of the study show that cancer is a significant and increasing burden in India that is regionally, gender and disease specific.

First of all, the cancer burden will increase markedly, and the number of cancer cases is likely to increase by 29.8 million by 2025, becoming a developing trend in the public health problem (Vemula & Dhakshanamoorthy, 2025). The trafficking shows that cancer is quite common in the north and northeast of India compared to other regions.

Second, the differences are analyzed regarding pattern of the specific cancer according to gender. Cancer of the mouth, lung, esophagus and stomach are the most widespread types of cancer in men and are mainly related to the consumption of tobacco and alcohol. Among women, breast and cervical cancers constitute a significant portion of the overall number of incidences (WHO, 2022; GLOBOCAN, 2022).

Thirdly, state-wise distribution indicates that the highest count of the cancer cases is represented by the states of Uttar Pradesh, Maharashtra, West Bengal, and Bihar. To illustrate this, in 2022, Uttar Pradesh alone has reported more than 210,000 cases, which implies the size of the population and health concerns.

Mortality patterns also indicate that lung cancer kills the greatest number of men and breast cancer kills the greatest number of women, followed in that order by cervical and ovarian cancers (Kulothungan et al., 2022). Expansive death toll is marked by the late diagnosis and accessibility of the treatment facilities.

In addition, it was indicated that lifestyle-related risk factors (tobacco use, alcohol consumption, obesity, and physical inactivity) were the most critical factors that cause cancer. Genetic predispositions and diseases that are related to infection (HPV, Hepatitis B) are also significant contributors to the burden of the disease.

**Discussion:** Findings of the present research are that the cancer burden in India is multidimensional and multifactorial based on the demographic, epidemiological and socio-economic shifts. The increase in cancer rates is reflective of the general shift in non-communicable to communicable diseases particularly in the third world countries.

The most remarkable one is the close correlation between lifestyle factors and cancer prevalence. Tobacco use is another major challenge in India that has remained a major risk to the country as far as a high level of oral and lung cancer is concerned (ICMR, 2020). Likewise, urbanization, sedentary lifestyle and dietary changes could also explain the current higher rates of breast and colorectal cancer (Kim et al., 2023; Mohammad et al., 2022). The paper further suggests that there is a tremendous disparity in the regional burden, and the most populated states and socioeconomically disadvantaged have a higher burden. The imbalance in healthcare facilities, lack of knowledge, and inefficient screening systems, particularly in rural areas may be used to explain such differences. The identification of the disease at the advanced stage is a critical issue at an early stage, reducing the survival and resulting in an increased number of deaths (Yang et al., 2022).

The fact that the trends of cancers differ in men and women also highlights the need to concentrate on the specific interventions to the population health. Despite the higher incidences of women, the mortality rate of males is higher, and this may be due to the fact that males take long to respond to healthcare and social culture (Patel and Chauhan, 2020; Singh et al., 2025).

The existence of cancer related to infections is the other important dimension, particularly the cervical cancer caused by HPV and liver cancer caused by hepatitis B that is mostly preventable with the help of vaccination and early screening (Huang et al., 2015; Luo et al., 2022).

The paper brings out the urgency of extensive public health solution, including:

- Growth in the cancer screening programs.
- More cancer registries.
- Healthy lifestyles.
- Policy of tobacco and alcohol control.
- More affordable treatment.

**Cancer Prevalence in India:** A substantial socioeconomic burden is imposed by cancer, with 1.42 million new cases reported in India in 2022 (WHO, 2022). Breast cancer (27%), cervix uteri cancer (18%), and ovarian cancer (7%) were the most common cancers in women, whereas the most common cancers in men were oesophageal cancer (7%), lung cancer (9%), and mouth cancer (16%) (WHO, 2022). In 2022, the Top 5 Most Common Cancers includes among men, Oral cavity (15.6%), Lung (8.5%), Oesophagus (6.6%), Colorectum (6.3%), Stomach (6.2%), among women, we have Breast (26.6%), Cervix uteri (17.7%), Oral cavity (5%), Ovaries (6.6%), Colorectum (3.7%) and for both ,Breast (13.6%), Oral cavity (10.2%), Lung (5.8%), Oesophagus (5%), Stomach (5.2%) (GLOBOCAN, 2022)

**Table-1: Top five most common cancer in India**

Five most frequent cancer among Males	Number of cases (%)	Five most frequent cancer among female	Number of cases (%)	Five most frequent cancer in both	Number of cases (%)
Lip,oral cavity	107812 (15.6)	Breast	192020 (26.6)	Breast	192020 (13.6)
Lung	58970 (8.5)	Cervix uteri	127526 (17.7)	Lip,oral cavity	143759 (10.2)
Oesophagus	45608 (6.6)	Ovary	47333 (6.6)	Cervix uteri	127526 (9.0)
Colorectum	43360 (6.3)	Lipa and oral cavity	35947 (5.0)	Lung	81748 (5.8)
Stomach	43060 (6.2)	Colorectum	26678 (3.7)	Oesophagus	70637 (5.0)
Others	392368 (56.8)	Others	292634 (40.5)	Others	797 626 (56.4)

Source: <https://gco.iarc.who.int/media/globocan/factsheets/populations/356-india-fact-sheet.pdf>

**Cancer Mortality in India:** The mortality rate is notably higher in breast (13.7%) and cervical cancers (11.2%) for women, while oral cancer (5.6%) and lung cancer (5.3%) lead for men (WHO, 2022). Top cancer-related deaths include, in males: Lung (14.1%), Mouth (7.8%), Oesophagus (7.2%), Stomach (6.2%), Liver (6%) and in females: Breast (21.8%), Cervix uteri (9.2%), Ovarian (7.4%), Lung (6.5%), Gallbladder (5.3%) (Kulothungan et al., 2022)

**Table 2: Top five types of cancer mortality ratio**

Males (%)	Females (%)	Total (%)
Lung 14.1	Breast 21.8	Lung 10.6
Mouth 7.8	Cervix Uteri 9.2	Brest 10.5
Oesophagus 7.2	Ovary 7.4	Oesophagus 5.8
Stomach 6.2	Lung 6.5	Mouth 5.7
Liver 6	Gallbladder 5.3	Stomach 5.2

Source: Burden of cancers in India - estimates of cancer crude incidence, YLLs, YLDs and DALYs for 2021 and 2025 based on the National Cancer Registry Program

**Geographical Distribution of Cancer in India:** West Bengal, Bihar, Maharashtra, and Uttar Pradesh are said to have the highest cancer rates. In 2022, there were 210,958 cases in Uttar Pradesh. In 2040, there would be 2.08 million cancer cases in India, a 57.5% rise from 2020, according to projections (ICMR-NCRP, 2022). Risk Factors for Cancer 35% to 50% of malignancies in men and 17% in women are caused by tobacco use. The following are major cancers: Breast cancer in women over 40 years of age, Cervical cancer is the second most common type of cancer and is linked to abnormal cell proliferation in the cervix, Oral cancer, Common in India, it accounts for over 85% of cases globally and is mostly caused by alcohol and tobacco use (Khandekar et al., 2006).

**Table 3: Estimated incidence of cancer cases top ten states in India**

States	2020	2021	2022
Rajasthan	70987	72825	74725
Uttar Pradesh	201319	206088	210958
Bihar	103711	106435	109274
West Bengal	108394	110972	113581
Madhya Pradesh	77888	79871	81901
Gujarat	69660	71507	73382
Maharashtra	116121	118906	121717
Andhra Pradesh	70424	71970	73536
Karnataka	85968	88126	90349
Tamil Nadu	88866	91184	93536
<b>Estimated Mortality of cancer cases in top ten states India</b>			
Rajasthan	39111	40117	41167
Uttar Pradesh	111491	114128	116818
Bihar	57531	59043	60629
West Bengal	59786	61213	62652
Madhya Pradesh	42966	44056	45176

Gujarat	38306	39328	40356
Maharashtra	63797	65326	66879
Andhra Pradesh	38582	39443	40307
Karnataka	47113	48290	49516
Kerala	31166	31713	32271
Tamil Nadu	48314	49571	50841

**Source:** Indian Council of Medical Research – National Cancer Registry Program (ICMR-NCRP) [https://www.ncdirindia.org/All\\_Reports/Monograph\\_2022/ICMR\\_NCDIR\\_Monograph.pdf](https://www.ncdirindia.org/All_Reports/Monograph_2022/ICMR_NCDIR_Monograph.pdf)

Delays in diagnosis, particularly for oral cancer, which has poor treatment outcomes at later stages, contribute to India's cancer burden. According to predictions, the cancer burden will continue to increase, with an anticipated 29.8 million cases by 2025, and the prevalence of cancer among individuals aged 65 to 69 is noteworthy (Sharma, 2022; Kulothungan et al., 2022).

**Factors Influencing Cancer Prevalence and Mortality in India:** Several lifestyle factors and sociocultural determinants are responsible for the high incidence and mortality rates of cancer in India. The primary risk factors for cancer are alcohol consumption, physical inactivity, obesity, and smoking (Deng et al., 2025). These unhealthy habits increase the risk of developing several cancers, particularly colorectal, lung, and oral cancers. Apart from this, the situation is aggravated by poor knowledge about cancer, insufficient large-scale screening programs, and poor healthcare infrastructure, leading to late diagnosis with limited treatment options. Sociocultural reasons, including poor health literacy and shame in seeking medical help, lead to diagnostic delay and treatment delay. These factors combined constitute cancer as a major public health crisis in India, and this calls for universally comprehensive public health strategies to address such precipitating causes.

**Hormonal Influences:** Cancers such as breast and ovarian cancers, common among Indian women, are highly affected by hormonal factors. It is established that some breast cancer cells are triggered to grow by hormones such as progesterone and estrogen (Losada-García et al., 2023). Risk of breast cancer is elevated by long-term exposure to these hormones, either due to early menstruation, delayed menopause, or hormone replacement therapy (Satpathi et al., 2023). Likewise, women who undergo fertility treatment or have fewer children are at greater risk of developing ovarian cancer, which is linked to hormonal factors (Momenimovahed et al., 2019). To have targeted cancer prevention programs, awareness about these hormonal risk factors should be enhanced, particularly among underprivileged and rural populations that have less access to health care. Early screening efforts can significantly decline the incidence of cancer in Indian women.

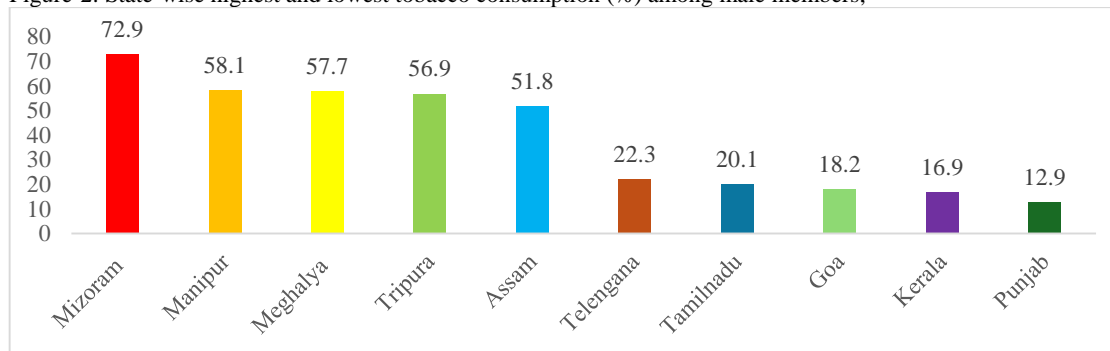
**Genetic Predispositions:** The risk of female breast and ovarian cancers is greatly enhanced by familial genetic defects, particularly in BRCA1 and BRCA2 genes. Up to 10% of cases of cancer may be due to genetic mutations as per studies (Rasnic et al., 2020). Familial genetic defects enhance the risks of ovarian and breast cancers in India at a younger age than in the population at large (Mittal et al., 2022). Most rural women remain unaware of their genetic risk, even though awareness regarding genetic testing and counselling is increasing in urban areas (Salloum et al., 2018). To determine high-risk individuals and make earlier detection and intervention possible, it could be helpful to make genetic testing more accessible, as well as provide education on family history (Tiller et al., 2024).

**Infection-Related Cancers:** Asia had the highest number of malignancies that were infection-related in 2020, with India contributing a substantial number of these cases. Hepatitis B (10.8%), human papillomavirus (HPV, 19.1%), and Helicobacter pylori (52.1%) are prevalent diseases that lead to cancer (Huang et al., 2015). Hepatitis B and HPV vaccines have proved effective in preventing malignancies caused by infections (Luo et al., 2022). The prevalence of such preventable cancers can significantly be reduced by dealing with these diseases using screening and immunization (Capasso et al., 2024).

**Lifestyle Factors:** Research shows that, colon cancer, which constitutes 10% of the global incidence of cancers, is increased by lack of proper diet and physical inactivity (Mohammad et al., 2022). Further, diet, obesity, and physical inactivity all synergize to enhance the risk of cancer (Kim et al., 2023). India was in third position in Asia in 2020 for obesity-related cancers like ovarian, breast, colon, and endometrial cancers (Sharma, 2022). Alcohol Use-Mouth, throat, larynx, liver, and breast cancers are linked to heavy alcohol consumption. Alcohol-related malignancies account for 5% of cancer-related deaths in India. More than 50,000 cases of cancer in India were attributed to alcohol use in 2020; the two most prevalent malignancies were esophageal cancers (26.4%) and oral cavity cancers (38.7%) (Kulothungan et al., 2022).

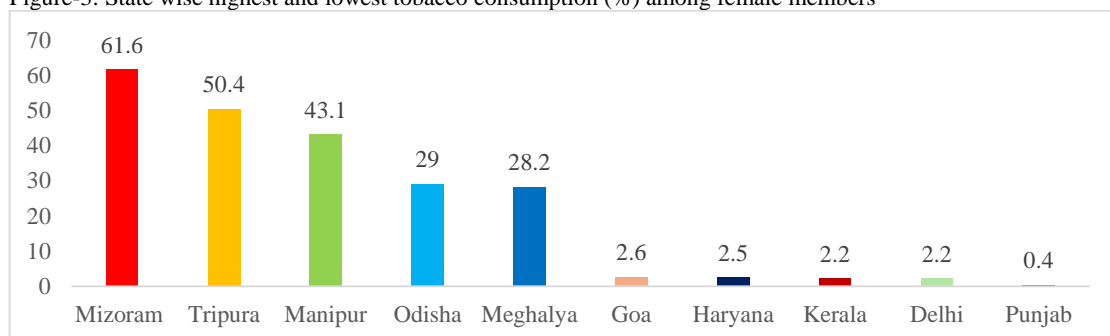
**Tobacco Use-** Over 20% of tobacco-related cancer deaths in India account for its being the nation's biggest cause of cancer death (ICMR, 2020). It is a major risk factor for bladder, kidney, throat, oral, and lung cancers. Tobacco use is highly prevalent in India, and the most frequent rates have been reported from Mizoram, Manipur, and Meghalaya (NFHS-5). It has been reported by the National Cancer Registry Programme that 27% of Indian cancers are due to tobacco smoking (ICMR, 2020).

Figure-2: State-wise highest and lowest tobacco consumption (%) among male members,



**Source:** NFHS-5

Figure-3: State wise highest and lowest tobacco consumption (%) among female members



**Source:** NFHS-5

**Healthcare Access:** Screening and Early Detection- Reducing survival rates hinges on early detection through screening. Yet, numerous Indian women face barriers when it comes to breast and cervical cancer screening initiatives. Insufficient screening is often followed by late-stage detection, which diminishes survival rates and decreases treatment efficacy (Yang et al., 2022). Reducing these disparities can improve early detection and outcomes of treatment among economically disadvantaged communities and rural women. Healthcare Utilization-Healthcare utilization is shaped by cultural factors; women are generally more likely than men to access medical care due to their caregiving roles. Conversely, cultural constructions of masculinity can lead men to delay receiving care (Patel & Chauhan, 2020). Encouraging early medical care for both men and women is essential to improving early diagnosis and treatment outcomes.

**Importance of Awareness Campaigns on Cancer:** Awareness campaigns are significant in addressing the high incidence and mortality of cancer in India, where many are still unaware of risk factors, warning signs, and screening. Lack of awareness translates into late diagnosis, limiting the treatment options and decreasing survival rates. By imparting education to communities about prevention, lifestyle changes, and the significance of periodic health check-ups, these campaigns can yield a significant reduction in cancer incidence (Chintapally et al., 2023). In urban environments, programs emphasizing breast and cervical cancers have improved detection rates for women by spreading the significance of mammograms and Pap tests. These programs, using mediums like social media and community outreach, enable women to be proactive regarding their health, allowing for early diagnosis (Descamps et al., 2024). Males are reminded of early warning signals, such as persistent coughs and mouth sores, by efforts to prevent lung and mouth cancers in males, which are connected to alcohol and tobacco use. Men's cancer impacts can be lessened by being aware of this knowledge (Rodríguez-Muñoz et al., 2020).

**Stigma and Support Systems:** In India, social stigma postpones cancer diagnosis and treatment, particularly for men who may be afraid of coming off as weak because of conventional gender norms. Especially in rural places, where men may be afraid of being shunned, this stigma also affects families (Daniel et al., 2022). Awareness efforts should normalize conversations about cancer and stress that getting medical attention is a sensible course of action in order to address this. Enhancing social groups and counselling as well as other support networks can motivate men to put their health first, which would ultimately improve cancer outcomes in India (Kataria et al., 2024).

#### **Implications of Public Health Strategies for Women**

**Enhanced Screening Programs-** Advanced breast and cervical cancer screening programs are needed to help identify cases earlier and provide better treatment outcomes, especially in underserved areas. Pap tests and regular mammograms can detect malignancies at an early stage, enhancing the survival rate. These programs need to be extended so that all women across socioeconomic strata can avail themselves of and afford them. Women can appreciate the value of routine screenings more by increasing awareness through educational efforts and community participation (Nilima et al., 2022; Chakravarti et al., 2024). **Targeted Awareness Campaigns-**It is important to raise awareness of less common malignancies, including ovarian and bowel cancers, even though breast and cervical cancers are familiar. Delayed diagnoses are caused by many women's lack of knowledge about the symptoms or risk factors. By informing women about early warning signs such as persistent bloating or altered bowel habits, specific campaigns can encourage early medical consultation. It's also important to highlight genetic and family history risks, particularly for ovarian cancer (Puckett et al., 2018).

**Support Systems-**It is necessary to strengthen support systems for women undergoing cancer treatment. Counselling, peer support groups, and practical support such as childcare and financial assistance are some examples of such networks. Women's quality of life during therapy can be enhanced by collaborating with NGOs and healthcare professionals to create an extensive support system that addresses logistical, emotional, and economic concerns (Bahrami et al., 2024).

#### **Implications of Public Health Strategies for Men**

**Tobacco Control Programs-**To fight diseases such as oral and lung cancer, the use of tobacco needs to be curbed. Tobacco control programs must aim prevention as well as cessation, especially among youths. Initiation rates can be lowered by effective enforcement of laws and awareness-generation schemes regarding the dangers of tobacco consumption. Smokers may gain from enhanced access to cessation services like counselling and quit lines (Ghose et al., 2019; Noor and Ramanarayana, 2024). **Awareness and Education-**It is critical to initiate awareness campaigns that highlight early diagnosis of malignancies prevalent in men, including oral and lung cancer. One of the lifestyle risks is tobacco use, which is often associated with these tumors. Early medical consultations can be encouraged through campaigns by educating men on early signs, including mouth ulcers or long-standing coughs. A large audience can be accessed with the help of social media, public service announcements, and community outreach (Chintapally et al., 2023; Noronha et al., 2024). **Gender-Sensitive Healthcare-** To fight social stigma and encourage men to get timely medical care, gender-sensitive healthcare programs are needed. Campaigns must promote regular checkups and make it common to discuss health. Men can be more proactive in their health by breaking barriers through the provision of specialized clinics, male-only tests, and counselling services (Graf et al., 2023; Novak et al., 2019; Mokuia et al., 2024).

**Conclusion:** The increasing cancer burden in India poses significant challenges, impacting individuals, families, communities, and healthcare systems physically, emotionally, and financially. In the analysis, it was observed that the estimated burden of cancer is enormous, and it has been increasing with a very high proportion among Indians. All types of cancers have increased as evidenced by changes in epidemiologic risk factors and demographics. Women in India show a slightly higher incidence of cancer. However, the mortality rates are higher amongst men. This suggests that while women are more likely to be diagnosed with cancer, men are more likely to die from it (Singh et al., 2025). Multiple factors are responsible for this outcome such as biological differences, lifestyle choices, healthcare access, and sociocultural influences.

The growing prevalence of cancer and contributing factors necessitate a deliberate strategy to lessen its impact. Expanding the population coverage of cancer registries must reinforce the burden assessment. To alleviate the cancer burden, public health initiatives to reduce obesity and alcohol consumption as well as ongoing tobacco prevention efforts, are required. In order to tackle the growing rate of cancer in India, deliberate and persistent efforts should be taken. It is also essential to strategically allocate financial and infrastructural resources to provide better access to care, prevention, early detection, and management of cancer.

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