Original Article

Occurrence and Distribution of Cancers with Emphasis Upon Oral Cancers in Registered Oncology Institutes of South India – A Retrospective Study

P. K. Asmin, Fareed Nusrath[1], Darshan D. Divakar[2]

Department of Public Health Dentistry, Coorg Institute of Dental Sciences, Virajpet, Karnataka, [1]Department of Public Health Dentistry, KVGDCH, Sullia, Karnataka, India, [2]Dental Biomaterials Research Chair, Dental Health Department, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia

Abstract

Background: In the past two decades, the growing economy associated with changes in lifestyle-related behavior is partially responsible for the increasing cancer burden in India. To assess the occurrence and distribution of oral cancer based on the analysis of hospital records from registered oncology institutes of South India over a period of three years. **Materials and Methods:** A multicenter, retrospective study was conducted at seven major hospitals in South India to assess the incidence and distribution of cancer among patients over a period of three years (2016–2018). Data were collected on a custom-made validated proforma. Analysis was done using R commander software. **Results:** A total of 156090 various types of cancers were reported to the included institutes over a three-year period, an almost similar gender distribution was observed, males (n = 78806, 42.99% per lakh) compared to their female counterparts (n = 77284, 42.16% per lakh). Among males' lung cancer was the most common type with 17709 cases (9.65% per lakh) and among females, breast cancer was the leading cancer type with 22855 total cases (12.46% per lakh). Over a period of three years, a total of 21084 records of malignancies pertaining to oral cavity were identified accounting for 13.51% of cases. Among oral cancers, tongue was the most common site to be involved accounting for 44.22% (2016–2018) cases followed by buccal mucosa (14.69%), least common site to be involved was lip which accounted for 3.49% of the total oral cancer cases. **Conclusion:** Breast cancer was the most common cancer followed by lung cancer. Oral cancers occupied second among males and fifth rank in the order of occurrence among females. Tongue was the most common site followed by buccal mucosa. The least common site affected by oral cancer was the lip.

Keywords: Cancer, distribution, hospital-based, oral cancer, retrospective study, South India

Introduction

Over the last 20 years, India has emerged as a fast-growing economy with improvements in lifestyle-related actions. Better health, improved life expectancy, and an increasing and aging population have all been attributed to more income, economic opportunities, and education.[1] Such global developments are often linked to negative consequences, such as increased opportunities for and exposure to poor lifestyle choices such as tobacco usage, increased intake of high-calorie foods, and reduced exercise. The overall result of these poor lifestyle choices on the growing population of the world has resulted in an increase in the burden of noncommunicable diseases such as cancer.[2] Many developing and underdeveloped countries are experiencing this trend clearly, including India.

Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/ijcm.ijcm_106_23

Cancer is, to a large degree, a modern man's disease, now widespread and firmly known as one of the leading causes of death worldwide.[3] The findings indicate that cancer must be controlled urgently by reducing exposure to risk factors and improving existing screening and treatment facilities, which are insufficient to handle the current burden. In India, its incidence is increasing significantly and is now the most common cause of morbidity and mortality.[4] India's economic

Address for correspondence: Dr. P. K. Asmin, Department of Public Health Dentistry, Coorg Institute of Dental Sciences, Virajpet, Karnataka, India. E-mail: asminbahja@gmail.com

How to cite this article: Asmin PK, Nusrath F, Divakar DD. Occurrence and distribution of cancers with emphasis upon oral cancers in registered oncology institutes of South India – A retrospective study. Indian J Community Med 2024;49:120-30.

Received: 20-02-23, **Accepted:** 06-11-23, **Published:** 12-01-24

growth and changes in lifestyle may be partially responsible for the increase in cases of cancer; in India's rural and urban areas, the disease is one of the top three killers of adults. Although still low in comparison to many Western countries, cancer incidence rates have been changing in recent decades.[5] India has the highest global mortality rate for both ovarian and breast cancer. The main causes of these alarming statistics include low doctor-to-patient ratios, inadequate medical infrastructure, a lack of knowledge, and limited screening options. The patients' low socioeconomic level is the other factor.[6]

In 2016, an estimated 3.9 million cancer cases were reported in India. Uttar Pradesh had the highest number of cases (674,386), followed by Maharashtra (364,997) and Bihar (359,228). Among the southern states, Tamil Nadu recorded 222,748 cancer cases, Karnataka had 202,156, Andhra Pradesh had 159,696, Telangana had 115,333, and Kerala had 115,511 cancer cases.[7] Because these figures only apply to incidents that have been registered, they might only represent the tip of the iceberg. The majority of instances remain undetected. The National Cancer Prevention Programme was established in India between 1975 and 1976. As a result, financing for the purchase of teletherapy equipment has been provided, oncology wings in medical colleges have expanded, and Regional Cancer Centres (RCCs) have grown.

In India, more than 40% of cancer cases, especially lung and oral cancers, are completely preventable. One of the major reasons for oral cancer and lung cancer is tobacco chewing. Any malignancy found on the lip, floor of the mouth, lining of the cheek, gingiva, palate, or tongue is referred to as oral cancer.[8] Oral cancer is one of India's top three cancers. The most common risk factors associated with oral cancer are chronic alcoholism, tobacco use (including cigarettes, smokeless tobacco, and chewing betel nut), and the human papillomavirus (HPV). Oral cancer can also occur due to poor dental care and poor diet.[9] A study conducted by Varshitha A,[10] 2015 had demonstrated that oral cancer is interrelated with low income. Additionally, the study demonstrated the relationship between low socioeconomic class and risk factors for oral cancer development, including diet, health care, living conditions, and risk behaviors. The use of smokeless tobacco is very common in India. The states with the highest frequency of smokeless tobacco users found in Uttar Pradesh and Bihar.[11] Squamous cell carcinoma accounts for 90–95% of oral cancer cases in India.[12] The International Agency for Research on Cancer predicts that by 2035, there would be over 1.7 million cases of cancer in India, up from 1 million cases in 2012. This suggests that throughout the same time span, the death rate from cancer will rise from 680000 to 12 million.

According to the statistics, oral cancer was diagnosed in 53842 men and 23161 women in India in 2012.[10] Oral cancer is thought to be a disease that affects the elderly. Oral cancer affects the majority of people between the ages of 50 and 70, although it may affect children as young as ten years old. Incidence of oral cancer increases with age. Oral cancer affects 20 people out of every 100,000 people in India, accounting for roughly 30% of all cancers. Oral cancer claims the lives of over 5 people in India every hour, and oropharyngeal and hypopharyngeal cancer claim the lives of the same number of people.[13] Cancer registration is not compulsory in India, so the true cases of incidence and mortality may be higher than reported.

Oral cancer is a significant public health problem, and early detection and preventive efforts will help to alleviate the burden. Cancer management necessitates the effective implementation of data gathered over a two-decade period of active research. Both for study and for the planning and implementation of cancer prevention programs, accurate data on the incidence and outcome of cancer are critical. Despite the fact that the majority of underlying causes and other characteristics are generally consistent across the world, each area has its own distinct characteristics. Concerns about the rising number of cancer patients in many low- and middle-income countries prompted our health planners and scientists to focus on cancer prevention and control. Understanding the disease's burden, pattern, and patterns is critical for this. Oral cancer is a serious issue in India. Efforts to expand the literature on disease etiology and geographic distribution of risk factors have started to gain attention here. In view of this, a retrospective analysis looks backward at data obtained from previous patients to examine results specified at the beginning of the study. Following the clinical event of interest or exposure, patients are enrolled; this is often done by going over the medical records. Retrospective designs are a very elegant and time-efficient approach to use data that already exist to answer new queries.

By reviewing the reported cancer cases in various registered cancer hospitals in South India, it is critical to understand the occurrence and distribution of oral cancer. This study is thus planned to retrospectively analyze hospital records of randomly selected registered cancer institutes in South India.

Materials and Method

Study design

A hospital-based retrospective study was designed and conducted to analyze the occurrence and distribution of oral malignancies in South India between 2016 and 2018.

Ethical clearance/Informed consent

Ethical clearance was obtained by the Institutional Ethics Committee bearing a registration number IECKVGDCH/0/2018–19. Permission to conduct the study was obtained from the Directors/Medical officers of the included oncology institutes. Co-operation by the department of cancer registry of respective institutes was solicited. An informed consent was obtained from each included oncology institutes.

Study setting

Registry section of the included registered oncology institutes.

Inclusion criteria

All hospital records from the included registered oncology institutes for the past three years from South India.

Exclusion criteria

Duplicate records.

Incomplete patients' data due to migration/transfer of oncologist from hospital.

Selection of hospitals

A list of all registered cancer institutes was obtained from Cancer Registry Abstract (CRAB) 2016, National Institute of Cancer Prevention (NICPR), and International Agency for Cancer Research (IACR). India has 27 regional cancer institutes and an additional 300 general or multispecialty hospitals providing care to cancer patients.

A total of six institutes included randomly from three states in South India were involved in this study. The three states were Karnataka, Kerala, and Tamil Nadu. Each of the institutes included is regarded as one of the best tertiary hospitals in the country, serving as regional referral centers for pathology, surgery, radiotherapy, medical oncology, and routine follow-up treatment for cancer patients.

Study procedure

Permission to conduct the study was obtained from the director/medical officer of the included oncology institutes. After obtaining prior appointment from the heads of the institutes, investigator herself visited the venue and provided a brief introduction about the study, co-operation by the department of cancer registry was solicited. Data from the hospital records of the patients were recorded on a specially designed and validated proforma.

Data collection instrument

Data were collected on specially designed proformas containing two parts. Part 1 recorded basic information pertaining to the institutes. Part 2 was a validated checklist of 15 parameters pertaining to the study.

Validation

A literature review was used to prepare a collection of 25 criteria related to several domains (state, gender, age, geographic region, outpatient/inpatient, cancer site, year of detection, etc.). To validate the content using a five-point Likert scale, these were emailed to five cancer specialists. By figuring out each parameter's Aiken's index, the relevance of each was evaluated. The study covered parameters that scored at least 0.6.

Statistical analysis

Data from the included institutes were collated and processed using Excel and analyzed by R commander software. Descriptive analysis was performed to characterize the demographic variables of the patients. Categorical variables were analyzed as frequencies and percentages, while quantitative variables were summarized as means and standard deviation. Proportions and percentages were calculated. Trend test was used to detect the change trend of the related variables along with time. Statistical significance was set at the *P* value <0.05.

Results

A total of 162673 records were retrieved; of these, 3919 records were excluded because of duplicate incomplete data. Analysis revealed that a majority of cases (97.42%) were reported from the three main South Indian states of Karnataka, Kerala, and Tamil Nadu, a very small proportion of cases were from Telangana and Andhra Pradesh (1.84%), and other Indian states (0.74%) accounting for 2664 records. To enable ease of understanding in analysis and interpretation, this insignificant minority of records was excluded, thus yielding a total of 156090 records for a detailed analysis. According to the records, the overall average prevalence of cases was 30.46 per lakh population over a three-year period. A significantly higher prevalence was reported from the state of Kerala 47.11 per lakh compared to the other states Karnataka 27.9 and Tamil Nadu 21.4. As shown in Table 1, number of cases over a period of three years (2016 to 2018) remained almost consistent across the three states.

Gender differentiated analysis of records revealed a similar distribution of cases among males (n = 78806, 42.99% per lakh) compared to their female counterparts (n = 77284, 42.16% per lakh). Throughout all three time periods, this finding was consistent as shown in Figure 1.

The types of malignancies were analyzed separately by gender, and a ranking of the types of cancers in relation to gender was created. It was discovered that lung cancer was the most prevalent type among males, with

Table 1: Distribution of cases in relation to different states per lakh population

STATE	2016 (#)	2017 (#)	2018 (#)	Total (#)
Karnataka	18412 (29)	18180 (27)	19039 (28)	55631 (82)
Kerala	14700 (44)	14876 (43)	16369 (47)	45945 (132)
TN	16230 (21)	17021 (22)	17230 (21)	50481 (63)

#- in per lakh population

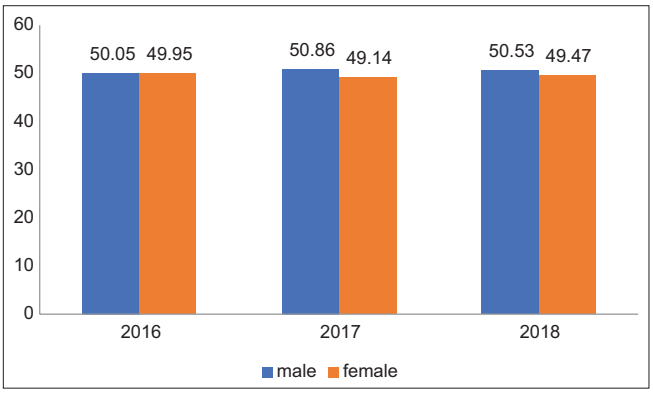

Figure 1: Annual Distribution of cancers in relation to gender

17709 cases (9.65% per lakh) followed by oral cancers at 15198 (8.28% per lakh), prostate and lymphoma at 8362 (4.56% per lakh), and 5375 (2.93% per lakh), respectively. A systematic study of different types of cancers in men over time showed a gradual rise in lung cancers (2016 -2.78% per lakh, 2017-3.34% per lakh, 2018-3.67% per lakh), oral cavity (2016 -2.33% per lakh, 2017-2.92% per lakh, 2018-3.16% per lakh) and liver (2016 -0.57% per lakh, 2017-075% per lakh, 2018-2.10% per lakh) and a reduction in the occurrence of cancers of lymphoma (2016 1.51% per lakh, 2017, 0.65% per lakh, 2018,0.82% per lakh) rectum (2016, 1.2% per lakh, 2017, 0.60% per lakh, 2018, 0.65% per lakh) and prostate [Table 2 and Figure 2].

Breast cancer was found to be the most common cancer type among females, accounting for 22855 cases (12.46% per lakh) followed by thyroid cancer at 11179 (6.09% per lakh). Cancer of the cervix uteri and ovary ranked third and fourth, respectively.

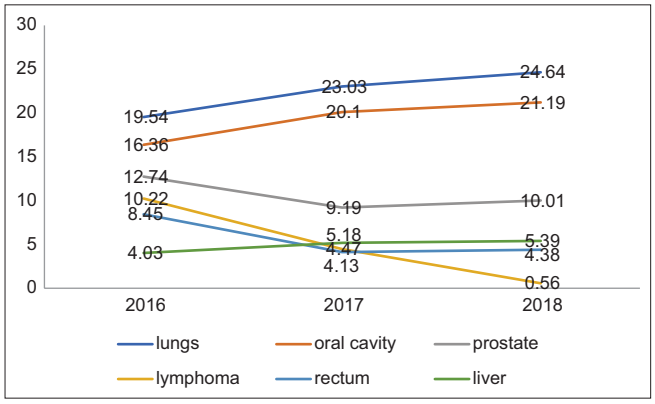

Figure 2: Time trends of the most common cancer types among males

Oral cancers occupied the fifth rank in the order of occurrence. This pattern of ranking has remained consistently same over a period of three years as shown in Table 3 and Figure 3.

Over the course of three years, 21084 reports of oral cavity malignancies were discovered, accounting for 13.51 percent of all cases and ranking as the second most common cancer type among men and the fifth most common cancer type among women. Analysis of gender-related differences revealed that 15198 (72.08%) among male, compared to 5886 (27.92%) among females suggesting a cancer preponderance ratio of 2.6 in favor of males. Whereas the number of cases increased among males, they remained almost consistent among females over the period of our study [Table 4].

The highest percentage of cases were reported from rural areas of Karnataka, followed by Tamil Nadu, and the least from

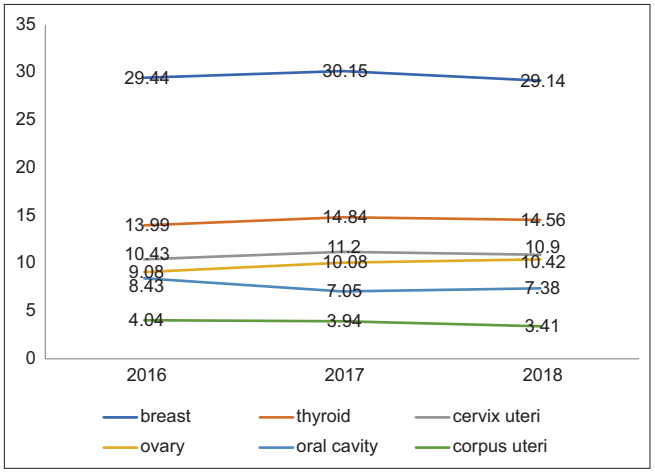

Figure 3: Time trends of the most common cancer types among females

Table 2: Distribution of cases in relation to type of cancer among males

Site	2016		2017		2018		2016-2018	
	number (#)	%	number (#)	%	number (#)	%	number (#)	%
Lungs	4935 (2.78)	19.54	6038 (3.34)	23.03	6736 (3.67)	24.64	17709 (9.65)	22.47
Oral cavity	4131 (2.33)	16.36	5272 (2.92)	20.10	5795 (3.16)	21.19	15198 (8.28)	19.28
Prostate	3218 (1.81)	12.74	2410 (1.33)	9.19	2734 (1.49)	10.01	8362 (4.56)	10.61
Lymphoma	2682 (1.51)	10.22	1172 (0.65)	4.47	1521 (0.82)	0.56	5375 (2.93)	6.82
Rectum	2135 (1.2)	8.45	1085 (0.60)	4.13	1196 (0.65)	4.38	4416 (2.40)	5.6
Liver	1018 (0.57)	4.03	1358 (0.75)	5.18	1475 (0.81)	5.39	3851 (2.10)	4.89
Leukemia	936 (0.52)	3.71	1273 (0.70)	4.86	1285 (0.70)	4.70	3494 (1.90)	4.43
Larynx	914 (0.51)	3.62	1443 (0.80)	5.50	1096 (0.59)	4.01	3453 (1.88)	4.38
Bladder	904 (0.51)	3.58	973 (0.54)	3.71	875 (0.48)	3.20	2752 (1.50)	3.49
Stomach	897 (0.51)	3.55	838 (0.46)	3.19	881 (0.48)	3.22	2616 (1.42)	3.32
Pharynx	764 (0.43)	3.02	1152 (0.64)	4.39	763 (0.42)	2.79	2679 (1.46)	3.39
Colon	698 (0.39)	2.76	869 (0.48)	3.31	652 (0.36)	2.39	2219 (1.21)	2.82
Esophagus	660 (0.37)	2.61	738 (0.41)	2.81	751 (0.41)	2.75	2149 (1.17)	2.77
Myeloma	558 (0.31)	2.20	729 (0.40)	2.78	580 (0.32)	2.12	1867 (1.01)	2.36
Thyroid	528 (0.30)	2.09	559 (0.31)	2.13	587 (0.32)	2.15	1674 (0.91)	2.12
Others	275 (0.16)	1.09	307 (0.17)	1.17	410 (0.22)	1.50	992 (0.54)	1.25
Total	25253 (14.23)	100	26216 (14.50)	100	27337 (14.91)	100	78806 (42.98)	100

#- in per lakh population. %- percentage

Table 3: Distribution of cases in relation to type of cancer among females

Site	2016		2017		2018		2016-2018	
	number (#)	%	number (#)	%	number (#)	%	number (#)	%
Breast	7421 (4.18)	29.44	7636 (4.22)	30.15	7798 (4.25)	29.14	22855 (12.46)	29.57
Thyroid	3527 (1.98)	13.99	3757 (2.1)	14.84	3895 (2.12)	14.56	11179 (6.09)	14.46
Cervix uteri	2628 (1.48)	10.43	2837 (1.6)	11.20	2918 (1.59)	10.90	8383 (4.57)	10.85
Ovary	2289 (1.29)	9.08	2554 (1.41)	10.08	2790 (1.52)	10.42	7633 (4.16)	9.87
Oral cavity	2125 (1.19)	8.43	1786 (0.99)	7.05	1975 (1.1)	7.38	5886 (3.21)	7.62
Corpus uteri	1020 (0.57)	4.04	998 (0.55)	3.94	912 (0.50)	3.41	2930 (1.59)	3.79
Lung	985 (0.56)	3.91	879 (0.49)	3.47	938 (0.51)	3.51	2804 (1.52)	3.63
Lymphoma	861 (0.49)	3.42	758 (0.41)	2.99	869 (0.47)	3.25	2488 (1.35	3.22
Rectum	740 (0.42)	2.94	647 (0.36)	2.55	857 (0.47)	3.20	2244 (1.22)	2.9
leukemia	647 (0.36)	2.57	558 (0.31)	2.20	639 (0.35)	2.39	1844 (1.01)	2.38
Colon	595 (0.34)	2.36	438 (0.24)	1.73	459 (0.25)	1.72	1492 (0.81)	1.93
Skin	459 (0.26)	1.82	565 (0.31)	2.23	632 (0.34)	2.36	1656 (0.90)	2.14
Stomach	445 (0.25)	1.77	459 (0.25)	1.81	498 (0.27)	1.86	1402 (0.76)	1.81
Brain and other CNS	417 (0.24)	1.65	428 (0.24)	1.69	478 (0.26)	1.79	1323 (0.72)	1.71
Myeloma	387 (0.22)	1.54	379 (0.21)	1.49	398 (0.22)	1.49	1164 (0.63)	1.51
Pancreas	348 (0.20)	1.38	318 (0.18)	1.26	359 (0.20)	1.34	1025 (0.55)	1.34
Others	305 (0.17)	1.21	328 (0.18)	1.29	345 (0.19)	1.29	978 (0.53)	1.27
Total	25199 (14.20)	100	25325 (14.01)	100	26760 (14.61)	100	77284 (42.15)	100

#- in per lakh population. %- percentage

Kerala, according to an analysis of geographic variations in reported oral malignancies. These variations were consistent over the three-year period of our study.

Analysis of age and occurrence of oral cancer revealed an upward trend as age advanced especially after 50 years, the same trend continued till 75 years and above. A significant downward trend was observed among the younger population, especially 0 to 34 years and 40- to 44-year-old as shown in Table 5. An examination of the gender-related age distribution of cases showed a spike in cases among males in their fourth decade (n = 3227,21.23 percent) and a peak incidence of the malignancies in their seventh decade (n = 3974,26.15 percent). An almost similar distribution but with a lower intensity was observed among the females as well [Figure 4].

The tongue was the most commonly involved site, accounting for 44.22 percent of all oral cancer cases (2016–2018), followed by the buccal mucosa (14.69 percent), and the least common site to be involved was lip, which accounted for 3.49 percent of all cases.

The tongue was the most common site of occurrence among both genders, followed by the buccal mucosa, according to a gender-related site distribution study. However, when it came to ranking, cancers of the buccal mucosa, palate, and alveolus were slightly higher in females than in males, with cancers of the floor of the mouth and lip outweighed in ranking [Table 6].

Table 4: Distribution of oral cancer in relation to gender

	2016 (%)	2017 (%)	2018 (%)	2016-2018 (%)
Males	4131 (66.03)	5272 (74.69)	5795 (74.58)	15198 (72.08)
Females	2125 (33.97)	1786 (25.31)	1975 (25.42)	5886 (27.92)

Table 5: Incidence and prevalence rates of oral cancer in relation to age

	2016 (%)	2017 (%)	2018 (%)	2016-18 (%) (prevalence)
0-34	278 (4.44)	2 (0.02)	0	280 (1.32)
35-39	344 (5.49)	410 (5.80)	446 (5.74)	1190 (5.64)
40-44	442 (7.06)	306 (4.33)	334 (4.29)	1082 (5.13)
45-49	826 (13.20)	809 (11.46)	831 (10.69)	2466 (11.69)
50-54	455 (7.27)	503 (7.12)	559 (7.19)	1517 (7.19)
55-59	843 (13.47)	1185 (16.78)	1274 (16.39)	3302 (15.66)
60-64	377 (6.02)	524 (7.42)	570 (7.33)	1471 (6.97)
65-69	916 (14.64)	1083 (15.34)	1215 (15.63)	3214 (15.24)
70-74	663 (10.59)	689 (9.76)	703 (9.04)	2055 (9.74)
75+	1112 (17.77)	1547 (21.91)	1848 (23.78)	4507 (21.37)
Total	6256	7058	7770	21084

Discussion

A significant number of deaths worldwide are presently attributed to noncommunicable diseases (NCDs),[14] with cancer predicted to be the top cause of death and the main obstacle to raising life expectancy in every nation by the year 2000. The World Health Organization (WHO) statistics from 2015 show that cancer is the first or second major cause of death before the age of 70 in 91 of 172 nations, and it ranks third or fourth in another 22 countries.[15] Lifestyles, population age composition, and total population are all known determinants of cancer severity. In the developing world, these

Table 6: Distribution of oral cancer by specific site for males and females (%) 2016-2018

Oral cancer by specific site (%) 2016-2018								
Sites	**Male**				**Female**			
	2016	**2017**	**2018**	**2016-2018**	**2016**	**2017**	**2018**	**2016-2018**
Tongue	1900 (45.99)	2463 (46.72)	2709 (46.75)	7072 (46.53)	785 (36.94)	644 (36.05)	824 (41.72)	2253 (38.27)
Buccal mucosa	453 (10.97)	738 (13.99)	874 (15.08)	2065 (13.58)	398 (18.72)	289 (16.18)	347 (17.56)	1034 (17.56)
Gingiva	392 (9.48)	548 (10.39)	525 (9.06)	1462 (9.61)	186 (8.75)	204 (11.42)	186 (9.41)	576 (9.78)
Floor of mouth	332 (8.04)	495 (9.39)	462 (7.97)	1289 (8.48)	48 (2.26)	54 (3.02)	37 (1.87)	139 (2.36)
Palate	313 (7.58)	438 (8.3)	512 (8.84)	1263 (8.31)	174 (8.11)	145 (8.12)	228 (6.48)	547 (9.29)
Alveolus	209 (5.06)	216 (4.09)	207 (3.57)	632 (4.15)	184 (8.65)	183 (10.24)	185 (9.36)	552 (9.37)
Lip	245 (5.9)	149 (2.83)	207 (3.57)	601 (3.95)	62 (2.29)	35 (1.95)	38 (1.92)	135 (2.29)
Premalignant lesions	163 (3.94)	86 (1.63)	124 (2.14)	373 (2.45)	130 (6.12)	88 (4.93)	76 (3.84)	294 (4.99)
Others	124 (3)	139 (2.64)	175 (3.02)	438 (2.88)	158 (7.44)	144 (8.06)	54 (2.73)	356 (6.05)
Total case	4131	5272	5795	15198	2125	1786	1975	5886

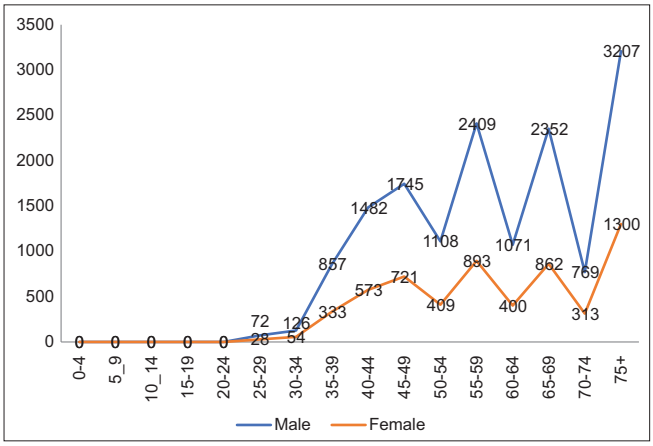

Figure 4: Age-specific incidence rates of oral cancer in relation to gender

factors gradually shifted, and as a result, cancer has become one of the leading causes of death.[16]

Using registry data, different models have been tried in developing countries, to forecast the cancer situation. Taking ecological data into account improves the accuracy of the estimates. Through the use of distinct samples of disease cases and controls who are at risk of getting sick, retrospective studies aim to investigate any relationships between a disease and possible risk factors. Although the retroactive nature of these studies can devalue them at times, they are a useful method for determining a correlation between an exposure and an outcome. They are frequently the only ethical means of looking into any association. These studies have been specifically employed in epidemiological research of cancers. It can be rightly said that cancers prompted their methodological development. We used this methodological analysis to better understand cancer epidemiology in South India, with a particular emphasis on the occurrence and distribution of oral cancers.

Globally, the incidence and death of cancer are rising quickly. Although the causes are multifaceted, they include changes in the distribution and prevalence of the main risk factors for cancer, some of which are connected to socioeconomic development, as well as population aging and growth.[16] With a rapidly growing and aging population worldwide, cancer has emerged as a leading cause of death, coinciding with the marked decline in mortality rate of stroke and coronary heart disease, relative to cancer, in many countries.

According to estimates, the global cancer incidence has increased to 18.1 million new cases and 9.6 million deaths in 2018. One in every five men and one in every six women in the world get cancer at some point in their lives, and one in every eight men and one in every eleven women die from it. Despite housing just 9.0% of the world's population, Europe is responsible for 20.3% of cancer-related fatalities and 23.4% of all cancer diagnoses worldwide. With a cancer incidence rate of 21.0% and a cancer-related death rate of 14.4% worldwide, the Americas comprise 13.3% of the world's population. Compared to other regions of the world, Asia and Africa have higher proportions of cancer deaths (57.3 percent and 7.3 percent, respectively) than incident cases (48.4 percent and 5.8 percent, respectively). This is because these regions have higher rates of certain cancers, which are linked to poorer prognoses and higher death rates, as well as inadequate access to timely diagnosis and care. Due to the fact that roughly 60% of the world's population lives in Asia, the area is expected to account for almost half of all new cancer cases and more than half of all cancer deaths in 2018. Although it exhibits a progressive increase by year, India's rate (106.6 per 1 lakh population) was far lower than that of nations with the highest incidence rates of cancer, like the US (532.9), Australia (743.8), and New Zealand (542.8).[15]

We have obtained data from six oncology institutes which are operational in South India. The data from these institutes are reasonably reliable and complete. Every year, the number of people diagnosed with cancer rises, owing to improvements in lifestyle, poor eating habits, and longer life expectancy. When we analyzed our data, we saw an increase in overall cancer cases across all three states in which Kerala was having highest

cancer cases in per lakh population [44 per lakh-2016,43 per lakh -2017,47 per lakh-2018] followed by Karnataka [29 per lakh-2016,27 per lakh -2017,28 per lakh-2018] and the least was from Tamil Nadu [21 per lakh-2016,22 per lakh -2017,21 per lakh-2018]. Because of changes in population size and composition, our projections indicate a rise in cancer incidence for all major sites.

An estimated 18 million cancer cases were reported globally in 2018; 9.5 million of these cases were males and 8.5 million involved women.[11] Male and female cancer cases totaled 156090 over a three-year span (2016–2018). With a male-to-female ratio of 1.02:1, males outnumber females in cancer incidence. The result here was in agreement with studies in other parts of the country Trivandrum,[17] Srinagar,[18] Gandhinagar[19] but contrary to the finding of the studies conducted at Chandigarh,[17] Amritsar,[20] Bengal[21] which showed female predominance**.** More men are affected by cancer than women in different parts of the world. Nonetheless, in certain regions of India, this tendency is inverted. Studies show that exposure to carcinogens and lifestyle factors might play a significant role in explaining the differences in how cancer affects different genders. Compared to women, men are more likely to smoke, drink alcohol, and eat foods higher in fat. Aging populations, advances in cancer knowledge and diagnosis, increased access to health care, and several risk factors are probably the causes of the rising sex- and cancer-type-specific incidence rates that India has seen over time.

The occurrence rate of various forms of cancers varies dramatically across India. Significant variations can occur even between states that are next to each other in the northeast; for instance, there is a reported 15-fold discrepancy in the age-standardized incidence rates of nasopharyngeal cancer between Nagaland and Tripura.[22] The numerous variations between the states highlight the necessity of developing state-specific cancer prevention plans. If the reasons for the diverse distribution of major cancer types in different parts of the country are better understood, then large-scale collaborative research could aid in the preparation of more focused efforts to lower the cancer burden across India's states.

Lung cancer accounts for both genders' combined percentage of cancer cases diagnosed (11.6%) and the majority of cancer deaths (18.4% of all cancer deaths) globally. Female breast cancer ranks second (11.6%), followed by colorectal cancer (10.2%), prostate cancer (7.1%), and stomach cancer (8.2%), liver cancer (8.2%), and colorectal cancer (9.2%) in terms of incidence.[15] In terms of incidence, colon and prostate cancer are next in line, while stomach and liver cancer are last in terms of fatality. Lung cancer is the most common type of cancer diagnosed in men and the primary cause of cancer-related deaths. In terms of incidence and mortality, colorectal and lung cancer are in second and third places, respectively, behind breast cancer, which is the most common disease diagnosed in women and the primary cause of cancer-related deaths. Cervical cancer comes in fourth place.[15] Because of the shift in population size and composition, our projections indicate a rise in cancer incidence in all major sites. Breast, cervix, and lung cancer are the top three cancer sites in India. In 2018, 12.3 percent of new cases worldwide were diagnosed with lung and breast cancer, making them the most frequent cancers.

Our research yielded similar findings where lung cancer among males [n = 17709, 9.65 per lakh population (2016–2018)]) and cancer of breast among females [n = 22855, 12.46 per lakh population (2016–2018)]) are leading sites. Lung cancer is the most prevalent type of cancer diagnosed globally. It is also the primary cause of cancer-related mortality, accounting for 1.38 million cancer-related deaths annually globally. According to the GLOBOCAN 2012 report, the estimated incidence of lung cancer in India was 70,275 in both sexes and all ages[15]; the crude incidence rate per 100,000 was 5.6 which was almost showing similarity with our findings of incidence rate per 100,000 of 8.28 among males from 2016 to 2018. The effect of industrialization and smoking trends on cancer in the population is reflected in the history of published data on lung cancer epidemiology in India. After an initial erroneous perception of lung cancer's rarity, possibly due to a lack of lung cancer reporting, Viswanathan *et al*. observed a rising burden of lung cancer across various centers in the country in their seminal paper in 1962.[23] For the years 1950–1959, they gathered data from many Indian hospitals. They found similarities with Western data in terms of rising lung cancer rates among male smokers and the most common primary histology of squamous cell carcinoma during the study period (1950–1959).[23] According to studies, there is a connection between indoor and outdoor air pollution and an increase in lung cancer incidence among nonsmokers, especially among women and young people. In 2013, the World Health Organization's specialized cancer department, the International Agency for Cancer Research (IACR), declared outdoor air pollution to be carcinogenic to humans, claiming a higher risk of lung cancer due to increased exposure to particle matter and air pollution.[24]

Breast cancer accounts for 24.2% of all new cancer cases diagnosed in women globally, making it the most common kind among women. Of the 185 countries included by GLOBOCAN 2018, 154 had the highest prevalence of breast cancer.[11] According to our findings, breast, cervical, ovarian, and corpus uteri cancers account for more than half of all cancers in women. Breast cancer ranked first among all cancers followed by cervical cancer while oral cancer occupied the fifth place which showed a similar trend with global distribution. In India, about 50–60% of all cancers in women are linked to four organs: the cervix, breast, corpus uteri, and ovaries.[25] According to another study, cancers of the breast, cervix, and ovary account for about half of all cancers in women.[26] Breast cancer has become more common in India over time, with up to 100,000 new cases being diagnosed each year.[27] Similar pattern was observed in our study. In India, there were an

estimated 82,000 new cases of breast cancer in 2007.[28] It is increasingly displacing cervix cancer as the most common form of cancer among women correlating with the present study.[29] Breast cancer is on the rise, which may be linked to a change in the urban population toward a more westernized lifestyle.[30] Research undertaken on a range of female populations through epidemiological studies has demonstrated a correlation between reproductive characteristics, such as early menarche or late menopause, and dietary factors, such as excessive calorie consumption or a diet low in fruits and vegetables, to increase the risk of breast cancer.[31] In India, there are no widespread cancer screening programs for diseases like oral, cervical, or breast cancer.

The most significant and obvious patterns seen are in female breast and cervical cancer, where a rise in breast cancer in both rural and urban India is accompanied by a decrease in cervical cancer in both populations. The current research report found that the trend in breast and cervix cancer was close to previous trend reports.[32-34] The trends that are observed in sex-specific and cancer type-specific incidence rates over time in India are likely due to a variety of factors, such as population aging, changes in cancer literacy, detection, healthcare access, and a variety of risk factors.

Oral cancer is a diverse category of cancers that arise in different parts of the oral cavity, each with its own set of risk factors, prevalence, and treatment outcomes. It is the sixth most prevalent cancer in the world, with over 300,000 cases registered each year, 62 percent of which occur in developing countries.[13]

Oral cancer incidence varies significantly across different regions of the world, with rates which are age-adjusted ranging from over 20 per 100,000 in India to 10 per 100,000 in the United States and less than 2 per 100,000 in the Middle East. In contrast to the US population, where oral cavity cancer accounts for just around 3% of all cancers, it accounts for over 30% of all cancers in India.[13] The prevalence of risk factors varies by country, which affects the incidence and pattern of oral cancer. According to Ferlay *et al.* (2018),[15] India is responsible for a quarter of the global burden of oral cancer. Moore *et al*. (2000), in a global analysis of the epidemiology of mouth cancer, stressed the scarcity of accurate data from developed countries, but when compared, India's incidence rates far outnumber those of the rest of the world in both genders.[48]

Oral cancer is a worldwide health issue with rising rates of occurrence and mortality. Oral cancer is one of the top three cancers in the Indian subcontinent. The true burden of cancer of head and neck in India is far higher than what is reported in the literature and thus can be considered a "tip of the iceberg" situation.[35] The latest studies of the "Net-based Atlas of Cancer in India" further demonstrate this. In 2020, the number of cancer deaths in Southeast Asia is expected to rise by more than 75% when compared to 2000. Since India's population has grown at nearly twice the rate of the rest of the world in the last 15 years, the cancer burden is likely to grow at the same rate. As per this atlas districts emerging as new sites for the highest incidence of different cancers worldwide are Aizawl-tongue (10.2) and hypopharynx (16.1); Kolar-mouth (10.7). Five districts (Wardha, Kanyakumari, Pondicherry, Thiruvananthapuram, and Kollam) have mouth cancer incidence ranging from 9.1 to 14.1-much higher than recorded worldwide.[35]

This study highlighted that oral cancer is ranked second position among males and fifth position among females. In our study, analysis of gender-related differences revealed that 15198 (72.08%) among male, compared to 5886 (27.92%) among females suggesting a cancer preponderance ratio of 2.6 in favor of males. Males had a higher rate of oral premalignant and malignant lesions than females, indicating that males had a higher rate of oral premalignant and malignant lesions. Palve *et al*.[36] found that in their sample of 50 patients, 60% were males and 40% were females, with a male-to-female ratio of 3:2, i.e., male preponderance which is similar to our findings. Sengüven *et al*.[37] and Pudasaini *et al*.[38] were reported slightly male preponderance in their study.

Other PBCRs in India have reported similar patterns among men and women. According to NCRP data from Mumbai, the incidence of mouth cancer increased sharply in men from 1999 to 2009 (3.3% annually), while it increased somewhat in women from 2002 to 2009.[39] The world's highest incidence rates of oral cancer have been found in South Asian nations like Bangladesh, India, Pakistan, Sri Lanka, and Taiwan. These countries' chewing practices of tobacco and betel nut combined with a lack of knowledge and access to health care. Taiwan[40] and Pakistan[41] have continuously shown increasing trends in both men and women, whereas Sri Lanka[42] has recently demonstrated a decreasing trend of approximately 1.9% per year ($P < 0.05$) in oral cancers. Of the European nations with a high prevalence of oral cancer, Slovakia and France have seen declines in male rates and increases in female rates.[43,44] All other affluent countries have seen a decline in the patterns of oral cancer in both men and women, except the United Kingdom, Denmark, and the Netherlands, where women's rates have increased recently.[43,45,46] The decrease in the incidence patterns of oral cancer in these affluent areas aligns with the growing consciousness and reduction in tobacco consumption.[43]

Our analysis of the age distribution of oral cancers has shown that there is a direct correlation between the incidence of the disease and age; for both genders, the highest incidence was observed after the seventh decade and between the ages of 50 and 59, and the lowest incidence was observed in the youngest age group (less than 35 years) for all years from 2016 to 2018, which is also consistent with previous studies.[47]

In India, mouth and buccal mucosa cancers are the most common tobacco-related cancers, with tongue and buccal mucosa cancers being the most common. Even though tongue is the most common intra-oral cancer site in most countries,

its epidemiology reveals a broad geographic distribution.[48] In a global contrast, India has a far higher incidence than the rest of the world. Despite the fact that India has a remarkably high incidence of both sexes, there appears to be a significant gap in sex incidence not only in India but globally. The overall patterns are a result of underlying cancer trends in major subsites that appear to be linked to changing risk factor prevalence. In the new world, Indians (immigrants) have popularized the practice of chewing betel. According to Yoganathan (2002), areca nut preparations are widely available in New Zealand and Australia.[49] Pillai *et al*.[50] (1993) of the Regional Cancer Centre in Trivandrum, oral and oropharyngeal cancer accounts for 30% of all cancers seen in the world. The highest microscopic age-standardized rate (MASR) is found in Aizawl, Mizoram state (10.2/100,000) according to a recently established cancer atlas (2005) in India. This is higher than the PBCR of Bhopal (10/100,000), which was previously thought to be the highest in India.[51] According to Iype *et al*.[52] (2004) from the Regional Cancer Center in Trivandrum, tongue cancer accounts for 43.6 percent of all oral cancer cases under the age of 35. In a study of all cases at the Regional Cancer Center in Trivandrum, Nair *et al*.[53] (1988) found a 23.97 percent prevalence of cancer tongue. According to Yeole *et al*.,[54] a high prevalence of tongue cancer is associated with a high propensity for regional spread among oral subsites. The second most common cancer is cancer of the buccal mucosa. These findings were in accordance with our study results which concluded that the tongue was the most common site of occurrence among both genders, followed by the buccal mucosa, according to a gender-related site distribution study.

In a survey of oral cancer cases from the Regional Cancer Center in Trivandrum, Nair *et al*.[53] (1988) found that cancer of the buccal mucosa (49.9%) was more common than cancer of the tongue (23.97%). It's worth noting that patients who are young and develop this form of cancer without smoking or chewing tobacco have the worst prognosis.[52] On the other hand, gingival cancer (gum, alveolar ridge) is more common in women than in men before the age of 50. However, in a recent study from Maharashtra, Shenoi *et al*.[55] (2012) found that the mandibular alveolus area was the most common site in their study.

As a result, we decided to monitor the number of patients who presented with these cancers in South India from 2016 to 2018. In our research, we found that the percentage of patients with tongue and buccal mucosa cancer has increased over time. In comparison with the 2.55 percent rise in tongue cancer, buccal mucosa cancer increased by 2.11 percent. This likely shows that chewing tobacco is still the most prevalent addiction on the Indian subcontinent.

The male-to-female ratio for both tongue and buccal mucosa cancer has risen over time. In 2016, it was 2.42 and 1.14, respectively, and in 2018, it was 3.28 and 3.52. In comparison, with the number of male patients rose from 4131 in 2016 to 5795 in 2018, while the number of female patients decreased from 2125 in 2016 to 1975 in 2018. This demonstrates that the issue is still much more widespread among men.

Between 2016 and 2018, the data indicate a three-year pattern. The population's lifestyle and tobacco-related legislations have also changed dramatically over this time span. This was a retrospective analysis that looked at hospital records from a number of major oncology institutes in South India. The data analyzed were from patients who visited this oncology institute, not from a population-based cancer registry (PBCR) that tracks the entire population. Nonetheless, since the center receives referrals from all over the subcontinent, it is a strong representation of general trends.

Conclusion

Oral cancer is not an uncommon disease in India. The number of patients diagnosed with oral cancer has risen in recent years, according to this report. Oral cancers are more common in men than in women. This may necessitate increased public awareness campaigns, as well as screening protocols for the early detection of cancerous lesions and other potentially malignant oral diseases.

Limitation

One can argue this retrospective study, with its inherent limitation is not a true reflection of a community prevalence of the disease. Additionally, this study being a hospital-based study, may represent a selected subpopulation (i.e., those who can afford hospital care, have symptoms, and have affected their quality of life) which may not reflect the actual prevalence percentages. These may be shown to differ from (and possibly be higher than) the data reported here if a proper study using a highly sensitive method and multiple centers from each state were to be performed on a community-wide basis. However, an attempt is made to include data from well-known recognized oncology institutes across three different states over a period of three years.

Recommendations

More than two-thirds (68%) of the population live in rural India (World Bank, 2015), and one PBCR is currently covering rural population and 11 PBCRs which cover urban populations (PBCR, 2018). The compiled data from PBCRs have urban dominance as majority of data are collected from urban areas of India. Thus, it is recommended to have more rural cancer registry centers in rural areas with a uniform method of recording. It is also essential to have inbuilt mechanism to avoid multiple registration and enable to link of the concerned individual if entered again in the registry. Records of the follow-up of patients discharged from the institutes either due to successful treatment or terminally ill patients should be done meticulously which will enable us to study cancer survival rates and cancer mortality. There is an urgent need to study the impact of the disease on the quality of life among both survivors and terminally ill patients.

Serious consideration will have to be made to the equitable utilization of hospital records for the purposes of epidemiologic

research. At present, the epidemiologic studies done in hospitals are few and of uncommon conditions; and they have not imposed a serious strain on the cooperating hospitals. For instance, problems in the record room of space, time, and personnel must be considered. Inducements should be offered to hospitals to increase and maintain the efficiency of their diagnostic recording practices because this will eventually lead to a marked saving in time and effort in searching for the necessary data.

Because of possible diagnostic variability among hospitals, an increase in the number of institutions participating in a study may greatly improve the chances of obtaining a more representative result. The amount of such variability can usually be evaluated in multiple-hospital studies.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Paul NS, Asirvatham M. Geriatric health policy in India: The need for scaling-up implementation. J Family Med Prim Care 2016;5:242-7.
2. Steyn K, Damasceno A. Lifestyle and related risk factors for chronic diseases. Disease Mortality Sub-Saharan Africa 2006;2:247-65.
3. Anand P, Kunnumakara AB, Sundaram C, Harikumar KB, Tharakan ST, Lai OS, *et al*. Cancer is a preventable disease that requires major lifestyle changes. Pharmac Res 2008;25:2097-116.
4. Available from: https://www.who.int/macrohealth/action/NCMH_Burden%20of%20disease_%2829%20Sep%202005%2.
5. Badwe RA, Dikshit R, Laversanne M, Bray F. Cancer incidence trends in India. Jpn J Clin Oncol 2014;44:401-7.
6. Mehrotra R, Yadav K. Breast cancer in India: Present scenario and the challenges ahead. World J Clin Oncol 2022;13:209-18.
7. Kumar A, Ali M, Kumar R, Kumar M, Sagar P, Pandey RK, *et al*. Arsenic exposure in Indo Gangetic plains of Bihar causing increased cancer risk. Scientific Reports 2021;11:2376.
8. Borse V, Konwar AN, Buragohain P. Oral cancer diagnosis and perspectives in India. Sens Int 2020;1:100046.
9. Sharma S, Satyanarayana L, Asthana S, Shivalingesh KK, Goutham BS, Ramachandra S. Oral cancer statistics in India on the basis of first report of 29 population-based cancer registries. J Oral Maxillofac Pathol 2018;22:18-26.
10. Varshitha A. Prevalence of oral cancer in India. J Pharm Sci Res 2015;7:845.
11. Sinha DN, Palipudi KM, Gupta PC, Singhal S, Ramasundarahettige C, Jha P, *et al*. Smokeless tobacco use: A meta-analysis of risk and attributable mortality estimates for India. Indian J Cancer 2014;51(Suppl 1):S73-7.
12. Radhika T, Jeddy N, Nithya S, Muthumeenakshi RM. Salivary biomarkers in oral squamous cell carcinoma–An insight. J Oral Biol Craniofac Res. 2016;6(Suppl 1):S51-4.
13. Coelho KR. Challenges of the oral cancer burden in India. J Cancer Epidemiol 2012;2012:701932. doi: 10.1155/2012/701932.
14. Boutayeb A, Boutayeb S. The burden of non communicable diseases in developing countries. Int J Equity Health 2005;4(1):2. doi: 10.1186/1475-9276-4-2.
15. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2018;68:394-424.
16. Dsouza ND, Murthy NS, Aras RY. Projection of cancer incident cases for India-till 2026. Asian Pac J Cancer Prev 2013;14:4379-86.
17. Annual Report of National Cancer Registry. New Delhi: Published by Indian Council of Medical Research; 1982.
18. Shah A, Jain GN. Pattern of cancer in Srinagar (Kashmir). Indian J Pathol Microbiol 1990;33:118-23.
19. Jivarajani PJ, Patel HV, Mecwan RR, Solanki JB, Pandya VB. Major sites of cancer occurrence among men and women in Gandhinagar district, India. Indian J Community Med 2015;40:56-61.
20. Prabhakar BR, Arora RK, Vadehra PL, Nagpal BL. Incidence and pattern of cancer in Amritsar (Punjab) (a ten year retrospective study 1974-1983). Indian J Pathol Microbiol. 1988;31:8-15.
21. Banarjee AK, Bhattacharya N, Chowdhary MK, Chattopadhya R, Sengupta J. Incidence of malignancy in Bankura (Bengal). J Ind Med Assoc 1994;92:400-2.
22. Dhillon PK, Mathur P, Nandakumar A, Fitzmaurice C, Kumar GA, Mehrotra R, *et al*. The burden of cancers and their variations across the states of India: The Global Burden of Disease Study 1990–2016. Lancet Oncol 2018;19:1289-306.
23. Viswanathan R, Gupta S, Iyer PK. Incidence of primary lung cancer in India. Thorax. 1962;17:73.
24. Loomis D, Huang W, Chen G. The International Agency for Research on Cancer (IARC) evaluation of the carcinogenicity of outdoor air pollution: Focus on China. Chinese J Cancer 2014;33:189-96.
25. Devi KU. Current status of gynecological cancer care in India. J Gynecol Oncol 2009;20:77-80.
26. Kurkuri AP, Yeole BB. Social inequalities in cancer with special reference to South Asian countries. Asian Pac J Cancer Prev 2006;7:36-40.
27. Thun MJ, Jemal A. Cancer epidemiology, prevention and screening. Cancer Medicine. Holland Frei. American Cancer Society, Philadelphia: BC Decker Inc; 2003. p. 367-81.
28. Yip CH, Taib NA, Mohammed I. Epidemiology of breast cancer in Malaysia. Asian Pac J Cancer Prev 2006;7:369-74.
29. Nandakumar A, Ramnath T, Chaturvedi M. The magnitude of cancer breast in India: A summary. Indian J Surg Oncol 2010;1:8-9.
30. Notani PN. Global variation in cancer incidence and mortality. Curr Sci 2001;81:465-74.
31. De Cicco P, Catani MV, Gasperi V, Sibilano M, Quaglietta M, Savini I. Nutrition and breast cancer: A literature review on prevention, treatment and recurrence. Nutrients 2019;11:1514. doi: 10.3390/nu11071514.
32. Dikshit RP, Yeole BB, Nagrani R, Dhillon P, Badwe R, Bray F. Increase in breast cancer incidence among older women in Mumbai: 30-year trends and predictions to 2025. Cancer Epidemiol 2012;36:e215-20.
33. Dhillon PK, Yeole BB, Dikshit R, Kurkure AP, Bray F. Trends in breast, ovarian and cervical cancer incidence in Mumbai, India over a 30-year period, 1976–2005: An age–period–cohort analysis. Br J Cancer 2011;105:723-30.
34. Takiar R, Srivastav A. Time trend in breast and cervix cancer of women in India. Asian Pac J Cancer Prev 2008;9:777-80.
35. Mishra A, Meherotra R. Head and neck cancer: Global burden and regional trends in India. Asian Pac J Cancer Prev 2014;15:537-50.
36. Palve DH, Tupkari JV. Clinicopathological correlation of micronuclei in oral squamous cell carcinoma by exfoliative cytology. J Oral MaxillofacPathol 2008;12:234-6.
37. Sengüven B, Baris E, Yildirim B, Shuibat A, ÖzerYücel Ö, Museyibov F, *et al*. Oral mucosal lesions: A retrospective review of one institution's 13-year experience. Turk J Med Sci 2015;45:241-5.
38. Pudasaini S, Baral R. Oral cavity lesions: A study of 21 cases. J Pathol Nepal 2011;1:49-51.
39. Shridhar K, Rajaraman P, Koyande S, Parikh PM, Chaturvedi P, Dhillon PK, *et al*. Trends in mouth cancer incidence in Mumbai, India (1995-2009): An age-period-cohort analysis. Cancer Epidemiol 2016;42:66-71.
40. Tseng CH. Oral cancer in Taiwan: Is diabetes a risk factor? Clin Oral Investig 2013;17:1357-64.
41. Rao SV, Mejia G, Roberts-Thomson K, Logan R. Epidemiology of oral cancer in Asia in the past decade-an update (2000-2012). Asian Pac J Cancer Prev 2013;14:5567-77.
42. Ariyawardana A, Warnakulasuriya S. Declining oral cancer rates in Sri Lanka: Are we winning the war after being at the top of the cancer league table? Oral Dis 2011;17:636-41.

43. Chaturvedi AK, Anderson WF, Lortet-Tieulent J, Curado MP, Ferlay J, Franceschi S, *et al*. Worldwide trends in incidence rates for oral cavity and oropharyngeal cancers. J Clin Oncol 2013;31:4550-9.
44. Ligier K, Belot A, Launoy G, Velten M, Delafosse P, Guizard AV, *et al*. Epidemiology of oral cavity cancers in France. Rev Stomatol Chir Maxillofac 2011;112:164-71.
45. de Souza DL, de Camargo Cancela M, Pérez MM, Curado MP. Trends in the incidence of oral cavity and oropharyngeal cancers in Spain. Head Neck 2012;34:649-54.
46. Ariyawardana A, Johnson NW. Trends of lip, oral cavity and oropharyngeal cancers in Australia 1982–2008: Overall good news but with rising rates in the oropharynx. BMC Cancer 2013;13:333. doi: 10.1186/1471-2407-13-333.
47. Kumar A, Popli G, Bhat S, Mohan S, Sowdepalli A, Kumari K. Oral cancer incidence trends in Delhi (1990–2014): An alarming scenario. South Asian J Cancer 2019;8:116-9.
48. Moore SR, Johnson NW, Pierce AM, Wilson DF. The epidemiology of tongue cancer: A review of global incidence. Oral Dis 2000;6:75-84.
49. Yoganathan P. Betel chewing creeps into the New World. N Z Dent J 2002;98:40-5.
50. Pillai MR, Nair MK, Kannan S, Chandran GJ, Balaram P. Immuno-pathological and immunological features of oral precancers. Singapore Dent J 1993;18:28-38.
51. Nandakumar A, Gupta PC, Gangadharan P, Visweswara RN, Parkin DM. Geographic pathology revisited: Development of an atlas of cancer in India. Int J Cancer 2005;116:740-54.
52. Iype EM, Pandey M, Mathew A, Thomas G, Nair MK. Squamous cell cancer of the buccal mucosa in young adults. Br J Oral Maxillofac Surg 2004;42:185-9.
53. Nair MK, Sankaranarayanan R, Padmanabhan TK, Padmakumari G. Clinical profile of 2007 oral cancers in Kerala, India. Ann Dent 1988;47:23-6.
54. Yeole BB, Kurkure AP, Sunny L. Cancer survival in Mumbai (Bombay), India, 1992-1999. IARC Sci Publ 2011:133-42.
55. Shenoi R, Devrukhkar V, Sharma BK, Sapre SB, Chikhale A. Demographic and clinical profile of oral squamous cell carcinoma patients: A retrospective study. Indian J Cancer 2012;49:21-6.