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Original Research Article

Head and neck cancer dominance and emerging multi-site burden: a three-year hospital-based cancer registry analysis from central India (2022-2024)

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ABSTRACT

Background: Cancer registries provide epidemiological information for regional public health planning. Central India has a unique cancer burden driven by high tobacco use and limited early-detection infrastructure, yet the hospital-based cancer registries (HBCRs) data from this region remain scarce. This study characterised the site-specific distribution, sex-based disparities, age-group variation, and state-wise referral patterns of confirmed malignant cases at Cancer Hospital and Research Institute (CHRI), Gwalior, over three years (January 2022 – December 2024), to identify priority sites for region-specific cancer control interventions.
Methods: A retrospective descriptive study was conducted on 25,692 Outpatient Department (OPD) records from CHRI, Gwalior, a regional cancer centre serving Madhya Pradesh (MP), Uttar Pradesh (UP), and adjacent states. International Classification of Diseases -10 (ICD-10) was used to classify malignant cases (n = 20,062). They were analyzed by sex, cancer site, age group, state and year of registration.
Results: Among the 20,062 malignant cases, males constituted the majority (n=12,394; 61.78%) versus females (n=7,665; 38.21%). Mouth (n=5,255; 26.04%) and tongue (n=2,746; 13.69%) were the most common sites. Gallbladder cancer ranked third overall (8.11%) with marked female predominance. Breast (7.42%) and cervical (5.74%) cancers predominated among females. Patients aged ≥50 years had the largest disease burden, though oral cancers appeared as early as 19-35 years.
Conclusions: Head and neck cancers accounted for 46.59% of all malignant cases (9,347 /20,062), with the oral cavity and tongue representing the most frequently affected sites. The co-existing burdens of gallbladder, breast, and cervical cancers highlight the need for region-specific, multi-site cancer screening programmes.

Keywords: Cancer epidemiology, Gallbladder cancer, Head and neck cancer, Hospital-based cancer registry, Oral cancer

INTRODUCTION

Cancer is a major and growing public health concern worldwide. The International Agency for Research on Cancer (IARC) estimated nearly 20 million new cancer cases and over 9.7 million cancer deaths worldwide in 2022.[1] Asia accounts for approximately 49.2% of global incident cancer cases, with India ranking third in cancer incidence and second in cancer mortality among countries in the South-East Asian region.[1,2] According to the Global Cancer Observatory (GLOBOCAN) 2022, there were around 1.41 million new cancer cases diagnosed and 916,827 cancer deaths in India in 2022, while the incidence of cancer cases in the country has increased by 36% between 2012 and 2022.[2]

The Indian Council for Medical Research-National Centre for Disease Informatics and Research (ICMR-NCDIR) set up the National Cancer Registry Programme (NCRP) in 1981. NCRP established in 1982, comprises a network of population-based cancer registries (PBCR) and hospital-based cancer registries (HBCR).[3,4] While PBCRs provide population-level incidence data, HBCRs record clinical patterns, site distributions, and referral demographics, making them indispensable for tertiary care planning.[5] Cases in the present study were classified using the International Classification of Diseases, 10th Revision (ICD-10).[6]

Central India, which includes Madhya Pradesh (MP), Uttar Pradesh (UP) and Rajasthan, is characterized by a high incidence of tobacco-related cancers. The data from 37 Population-based cancer registries across India show that the central region records the third-highest head and neck cancer incidence rate in males (28.3 per 100,000 population), after the northeastern (31.7) and northern (28.5) regions. Across all central region registries, Oral cavity cancer is the leading site, attributable to widespread consumption of areca-nut-based smokeless tobacco products such as gutka and khaini.[7-9] Additionally, the Gangetic belt is a globally recognized hotspot for gallbladder cancer.[10,11]

Although this is a unique epidemiologic profile, there is limited published HBCR data from Central India. The present study examines the three-year (2022-2024) cancer trend registered at this centre to inform the region-specific cancer control measures.

METHODS

Study design

This was a single-center, retrospective, descriptive case-mix study conducted at the Cancer Hospital and Research Institute (CHRI), Gwalior, Madhya Pradesh, India, a tertiary care center. All patients registered in the OPD of CHRI between January 2022 and December 2024 were included. The study analysis was restricted to frequencies and proportions within the registry.

Data source

Data were sourced from the hospital cancer registry at CHRI. Cancer Hospital and Research Institute (CHRI), Gwalior, is a tertiary regional cancer centre in MP that provides oncological services to patients in the state of MP, UP and neighbouring states, including Rajasthan, Delhi, and Chhattisgarh. Patient identity numbers were used to retrieve medical record files, from which data were abstracted into the National Cancer Registry Programme (NCRP) core pro forma.

Case ascertainment and classification

All patients with a confirmed diagnosis of malignancy were included. The cases were categorized based on ICD-10 at the cancer site level. Non-malignant cases were recorded separately and were excluded from site-specific analyses.

Sample size

All consecutive patients registered in the OPD of CHRI, Gwalior, during the study period (January 2022 to December 2024) were screened (N=25,692). Of these, 20,062 patients with a confirmed diagnosis of malignancy constituted the final study sample for site-specific analyses, while the remaining 5,630 non-malignant cases were excluded. The analysed sample comprised 12,394 males, 7,665 females and 3 transgender patients.

Epidemiological parameters

The study variables included age, sex, cancer site (classified according to ICD-10), state of residence (MP, UP, and Others), district of residence, and year of registration with annual breakdowns covering 2022, 2023, and 2024.

Statistical analysis

Descriptive analysis was performed to calculate absolute frequencies and proportions. Descriptive statistics were used to summarize all variables. Site-specific frequencies and proportions were calculated for the overall cohort and stratified by sex, age group (0-18 years, 19-35 years, 36-49 years, and ≥50 years), and state of residence (MP, UP, and Others). No inferential statistical tests were performed, given the descriptive nature of this registry analysis.

Ethics consideration

The study was approved by the Institutional Ethics Committee. Patient consent was waived due to the retrospective and anonymized nature of the study.

RESULTS

Overall case volume and malignancy ratio

In the three years, 25,692 patients were enrolled in the OPD. Of these, 20,062 (78.09%) were confirmed malignant and 5,630 (21.91%) were non-malignant (Table 1). Three transgender patients were included in the study but were analysed separately.

Sex distribution

Among 20,062 malignant cases, males constituted 12,394 (61.78%) and females 7,665 (38.21%), yielding a male-to-female ratio of approximately 1.62:1. Three patients (0.01%) were transgender. Male predominance was consistent across all three years (Table 1).

Table 1: Summary of OPD registrations at CHRI, Gwalior (2022-2024).

Category		Count	Percentage
Total OPD patients (2022-2024)		25,692	100.0
Non-malignant cases		5,630	21.91[a]
Malignant cases	All	20,062	78.09[a]
	Male	12,394	61.78[b]
	Female	7,665	38.21[b]
	Transgender	3	0.01[b]

OPD: Outpatient department; CHRI-Cancer Hospital and Research Institute; Percentages for sex are calculated from total malignant cases (N=20,062); [a]Percentage of total OPD patients (N=25,692); [b]Percentage of malignant cases (N=20,062); male, female and transgender patients are sub-groups of the malignant cases

Site-wise distribution of malignant cases

The most common cancer site was the oral cavity (mouth, C03-06) with 5,255 cases (26.04%), followed by the tongue (C01-02) at 2,746 cases (13.69%). Using the standard ICMR-NCDIR head and neck grouping (ICD-10 codes C00-C14, C30-31 and C32), Head and Neck cancers collectively accounted for 9,347 cases (46.59% of all malignant cases). The oral cavity (C03-06 + C01-02) contributed 7,971 of these cases (39.73% of all malignancies). Cancer of the gallbladder and biliary tract was ranked third overall with 1,628 cases (8.11%). Table 2 provide the details of the top 15 cancer sites.

Sex-specific cancer patterns

Oral cancer constituted 35.66% of all male malignancies (4,420 of 12,394) compared with 10.89% in females (835 of 7,665). Laryngeal cancer showed a marked male predominance (571 males vs. 38 females). Gallbladder cancer showed a notable female preponderance: 1,061 females (13.84%) vs. 570 males (4.60%). Breast cancer was the most common female-specific cancer (1,424 cases; 18.58%), followed by cervical cancer (1,153 cases; 15.04%). Breast cancer cases increased from 494 (2022) to 522 (2024); cervical cancer declined from 426 (2022) to 377 (2024). Table 3 summarize sex-specific distributions. A male predominance was observed in head and neck cancers.

Table 2: Top 15 cancer sites by ICD-10 classification among malignant cases at CHRI, Gwalior (2022-2024).

Rank	Cancer site (ICD-10)	Total cases	Percent of malignant cases
1	Mouth (C03-06)	5,255	26.04
2	Tongue (C01-02)	2,746	13.69
3	Gallbladder and Biliary (C23-24)	1,628	8.11
4	Breast (C50)	1,489	7.42
5	Cervix Uteri (C53)	1,120	5.58
6	Lung (C33-34)	1,081	5.39
7	Larynx (C32)	605	3.02
8	Ovary (C56)	488	2.43
9	Esophagus (C15)	418	2.08
10	Liver (C22)	312	1.56
11	Myeloid Leukemia (C92-94)	252	1.26
12	Connective and Soft Tissue (C47+C49)	246	1.23
13	Rectum (C19-20)	230	1.15
14	Bladder (C67)	229	1.14
15	Prostate (C61)	217	1.08

CHRI-Cancer Hospital and Research Institute; ICD-International Classification of Diseases; The percentages are calculated based on the total malignant cases (N=20,062); The sites are ranked in descending order of frequency

Table 3: Sex-specific distribution of selected cancer sites at CHRI, Gwalior (2022-2024).

Cancer site (ICD-10)	Males (n=12,394), N (%)	Females (n=7,665), N (%)
Mouth (C03-06)	4,420 (35.66)	835 (10.89)
Tongue (C01-02)	2,212 (17.85)	538 (7.02)
Larynx (C32)	571 (4.61)	38 (0.50)
Lung (C33-34)	793 (6.40)	297 (3.87)
Gallbladder (C23-24)	570 (4.60)	1,061 (13.84)
Breast (C50)	73 (0.59)	1,424 (18.58)
Cervix Uteri (C53)	-	1,153 (15.04)
Ovary (C56)	-	487 (6.35)

CHRI-Cancer Hospital and Research Institute; ICD-International Classification of Diseases; Percentages calculated from total male (n=12,394) or female (n=7,665) malignant cases; '—' denotes anatomically sex-specific sites

Age-group distribution

Hematological malignancies and bone tumors predominantly characterized the pediatric and young adult

group (0-18 years); the leading sites were bone tumors (39 cases), lymphoid leukemia (33), connective & soft tissue (27), leukemia not otherwise specified (24) and myeloid leukemia (23). In the 19-35-year age group, oral cavity cancers were most prevalent (mouth, 774; tongue, 381), followed by breast (180), ovary (79) and gallbladder (77). The 36-49-year group showed the highest burden of oral cavity cancers (mouth, 2,433; tongue, 1153), breast (553), gallbladder (455) and cervix uteri (356). Patients aged ≥50 years had the greatest overall cancer burden, with mouth (2,013), tongue (1,207), gallbladder (1,095), lung (850), and breast (749) being the five leading sites. Data representing the five most frequent cancer sites within each age group are presented in Table 4.

Table 4: Top five cancer sites by age group at CHRI, Gwalior (2022-2024).

Age group in years	Most common cancer (n)				
	1st	2nd	3rd	4th	5th
0-18	Bone (39)	Lymphoid leukemia (33)	Connective and soft tissue (27)	Leukemia NOS (24)	Myeloid leukemia (23)
19-35	Mouth (774)	Tongue (381)	Breast (180)	Ovary (79)	Gallbladder (77)
36-49	Mouth (2,433)	Tongue (1,153)	Breast (553)	Gallbladder (455)	Cervix uteri (356)
≥50	Mouth (2,013)	Tongue (1,207)	Gallbladder (1,095)	Lung (850)	Breast (749)

n- Number of cancer cases; Leukemia NOS -Leukemia not otherwise specified

State-wise distribution

UP had more cases of mouth cancer (2,898 vs. 2,233 cases of MP) and tongue cancer (1,385 vs. 1,312 cases of MP). Gallbladder cancer was more frequently reported from MP (895) than UP (717). State-wise distributions are represented in Table 5.

Table 5: State-wise distribution of the six most frequent cancer sites at CHRI, Gwalior (2022-2024).

Cancer site (ICD-10)	MP	UP	Others	Total
Mouth (C03-06)	2,233	2,898	94	5,255
Tongue (C01-02)	1,312	1,385	49	2,746
Gallbladder (C23-24)	895	717	16	1,628
Breast (C50)	933	533	23	1,489
Cervix Uteri (C53)	684	416	20	1,120
Lung (C33-34)	731	336	14	1,081

MP: Madhya Pradesh; UP: Uttar Pradesh; 'Others' includes Rajasthan, Delhi, Himachal Pradesh, Gujarat, Haryana, Maharashtra, Bihar, Chhattisgarh, and other states; CHRI-Cancer Hospital and Research Institute; ICD- International Classification of Diseases

District-wise distribution

Gwalior district reported the highest cumulative case burden, with 2,959 cases. Other high burden MP districts were Morena, Bhind, Shivpuri and Datia. In UP, Jhansi, Jalaun, Etawah, Firozabad and Mainpuri reported the highest volumes (Table 6).

Year-wise trend in cancer registrations

Total case registrations increased from 6,379 (2022) to 6,606 (2023) and 7,077 (2024), representing 10.94% overall growth. Of the total 20,062 malignant registrations, 10,797 cases were from MP, 8,911 from UP, and 354 from other states, predominantly Rajasthan, Delhi, Himachal Pradesh, Gujarat, and Maharashtra, reflecting the multi-state referral catchment of CHRI. Trends on an annual basis are shown in Figure 1.

Table 6: Year-wise case counts in selected high-burden districts (2022-2024).

State	District	2022	2023	2024	Total
MP	Gwalior	966	985	1008	2959
MP	Morena	543	559	649	1751
MP	Bhind	525	544	577	1646
MP	Shivpuri	325	373	401	1099
MP	Datia	323	295	327	945
UP	Jhansi	513	560	613	1686
UP	Jalaun	419	373	459	1251
UP	Etawah	361	361	375	1097
UP	Firozabad	274	250	213	737
UP	Mainpuri	223	231	269	723

MP: Madhya Pradesh; UP: Uttar Pradesh; Year-wise case counts include the total of male, female and transgender cases per district

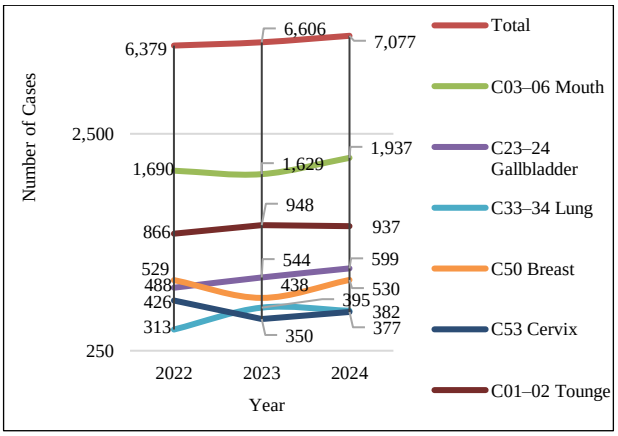

Figure 1: Year-wise trends in cancer registrations at CHRI, Gwalior, from 2022 to 2024.

DISCUSSION

This retrospective study of 20,062 malignant cases provides detailed epidemiological data on cancer patterns at a regional referral centre serving MP and UP predominantly, with additional referrals from Rajasthan, Delhi and Chhattisgarh. The magnitude of head and neck cancers, which constitute 46.59% of all malignancies, is consistent with national trends reported in HBCR data.[9,12] The ICMR HBCR report has continually reported that head and neck cancers constitute almost one-third of all malignancies in men in the country.[5]

The high prevalence of oral cavity and tongue cancers is attributable to widespread consumption of smokeless tobacco products like gutka and khaini in central India compared to other regions.[7,13] The central region of India ranks third in the country for head and neck cancer (HNC) incidence (28.3 per 100,000 males) according to the population-based cancer registry data from 37 cancer registry centres. Mouth cancer is the most prevalent type in all central region registries and MP reported the highest prevalence of areca nut-based smokeless tobacco use among Indian men (Global Adult Tobacco Survey (GATS 2016-17)).[9] The overall consumption rate of tobacco in the central region was higher than that of all other regions.[14]

The large catchment population from UP and the high prevalence of smokeless tobacco use throughout the Bundelkhand region likely account for the greater mouth and tongue cancer burden from UP (2,898 and 1,385 cases, respectively) compared with MP (2,233 and 1,312 cases, respectively).[7,14]

Gallbladder cancer was the third most prevalent site, with a notable female predominance (1,061 females vs. 570 males). This female predominance is well documented in North Indian Gangetic-belt centres, with male-to-female ratios as low as 1:4.83.[15]

India accounts for about 10% of the world's gallbladder cancer cases, with the Gangetic belt having the greatest frequency.[10,16] Established risk factors in this region include cholelithiasis, chronic Salmonella typhi infection, environmental carcinogen exposure, and dietary patterns specific to the Gangetic belt.[11,17] Lung cancer was more prevalent among patients from MP (712 cases) than from UP (336 cases). According to GATS India 2016-17 statistics, compared to other Indian states, MP has a high rate of tobacco smoking, including bidi smoking, which is a significant risk factor for lung cancer and explains this inter-state disparity.[14]

Breast cancer (1,424 cases; 18.58% of female cancers) increased from 494 (2022) to 522 (2024), consistent with the documented rising national trend linked to urbanization-associated lifestyle changes, including delayed childbearing, reduced parity, and shorter breastfeeding duration.[18-20] Cervical cancer declined from 426 in 2022 to 377 in 2024, consistent with ICMR-reported national downward trends, though screening uptake remains critically low nationally per NFHS-5 data, the ever-uptake of breast cancer examination and cervical cancer testing was only 9 and 20 per 1,000 women, respectively.[19,21]

The age-group analysis revealed distinct patterns. Haematological malignancies and bone tumours dominated the paediatric group (0-18 years), consistent with published paediatric cancer registry data from India.[22] The early onset of oral cavity cancers-already prominent in the 19-35-year age group-reflects initiation of tobacco use in adolescence and early adulthood, a well-documented phenomenon in Central Indian populations.[23] The largest overall burden was observed in patients aged ≥50 years, confirming the age-dependent nature of most solid tumors and the increasing cancer burden associated with demographic ageing.[4,24]

The 10.94% rise in case registrations over the study period (6,379 in 2022 to 7,077 in 2024) reflects both a genuine increase in cancer burden and enhanced healthcare access and community outreach by CHRI.

This registry analysis benefits from a large, multi-state referral catchment and standardised ICD-10 classification, lending site-level findings regional applicability.

Limitations include the retrospective design, absence of staging and survival data, and the inherent constraints of a hospital-based registry: frequencies and percentages reflect the case-mix of a single tertiary centre and cannot be extrapolated to population-level incidence. The absence of a defined catchment population denominator precludes direct comparison with PBCR data or estimation of community-level cancer burden.

CONCLUSION

Head and neck cancers, predominantly oral cavity and tongue cancers driven by tobacco use, constitute the largest burden at CHRI, Gwalior. Gallbladder cancer in females, lung cancer predominantly from MP, and rising breast cancer incidence represent additional site-specific priorities. These findings support the design of region-specific, multi-site cancer screening programs targeting oral cavity, breast, cervical, and gallbladder cancers, alongside robust tobacco cessation initiatives.

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