

ORIGINAL ARTICLE

Cancer Incidence in Rajasthan Based, on Real Time ICD Coded Data, of a Leading Cancer Hospital

Shri Gopal Kabra¹, Vivekanshu Verma²**HOW TO CITE THIS ARTICLE:**

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ABSTRACT

Background: Rajasthan, India, faces a rising burden of cancer. Real-time hospital-based data offer insight where population-level registry coverage is incomplete.

Objective: To analyze the cancer incidence, distribution, and patterns using ICD-coded data from a leading tertiary cancer center in Jaipur for the year 2024.

Methods: All patients diagnosed with cancer at Bhagwan Mahaveer Cancer Hospital (BMCH), Jaipur, in 2024 were included. ICD-10 codes were analyzed for primary site distribution, patient demographics, geographic origin, and compared with Indian national estimates and registry data.

Results: Among 10,363 cancer diagnoses (out of 14,911 hospital registrations, conversion 69.5%), the five most common cancers were of the lip, oral cavity and pharynx (26.89%), digestive organs (15.45%), respiratory and intrathoracic organs (10.02%), breast (11.38%), and female genital organs (8.41%). The estimated annual crude incidence rate for Rajasthan, extrapolated from BMCH data, is approximately 134.6 per 100,000, exceeding India's 2025 estimate of 113. Geographic distribution reveals the highest incidence in Jaipur district (332/100,000). Unusually, in the polluted Sanganer region, female cancers predominated (65%).

Conclusion: Cancer incidence in Rajasthan, extrapolated from comprehensive hospital ICD codes, exceeds the national average. The Sanganer anomaly warrants further study into environmental exposures and sex-specific risk.

KEYWORDS:

• Cancer incidence, Rajasthan, India, • ICD-coded data • Hospital-based registry cancer pattern • Geographic distribution

AUTHOR'S AFFILIATION:

¹ Director Clinical, Bhawan Mahavir Cancer Institute, Jaipur, Rajasthan, India

² Associate Consultant, Emergency Consultant, Medanta-The Medicity, Gurugram, Haryana, India.

CORRESPONDING AUTHOR:

Vivekanshu Verma, Associate Consultant, Emergency Consultant, Medanta-The Medicity, Gurugram, Haryana, India.

E-mail: vivekanshu@yahoo.co.in

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INTRODUCTION

Cancer represents a major public health concern in India, with the latest national estimates reporting an annual incidence of around 100.4 per 100,000 population in 2022, projected to rise to 113.2 by 2025. Robust cancer surveillance faces challenges owing to incomplete population-based coverage. Rajasthan, a populous state, lacks comprehensive real-time population-level cancer reporting. Hospital-based surveillance, particularly from large, multidisciplinary tertiary centers, provides invaluable insight into patterns, trends, and geographic distribution of cancer. The Bhagwan Mahaveer Cancer Hospital (BMCH), Jaipur, maintains a detailed prospective ICD-coded cancer registry, with broad outreach across Rajasthan. This study aims to analyze patient data from 2024, delineating cancer spectrum, incidence estimates, district-level patterns, and the impact of possible environmental exposures.^[1]

METHODS

All patients diagnosed with cancer in 2024 at BMCH were included. ICD-10 (International Classification of Diseases, 10th Revision) codes were used for diagnostic classification. Sex, age, cancer site, and district of residence were extracted. Crude incidence rates per 100,000 population were calculated using estimated 2025 district populations, and multiplied by the under-representation factor (BMCH receives ~1 of every 9 cancer patients in Rajasthan) extrapolated from national registry incidence. Trends were compared to both local registry data (2020–2024) and national estimates. District-level distributions, including Sanganer (noted for pollution), were analyzed for unusual demographic or cancer site patterns. Statistical analysis of Indian Cancer Registry data by Krishnan Satish Kumar *et al* in 'Cancer incidence estimates for 2022 and projected for 2025 (IJMR 2023)', they estimate incidence of cancer in India to be 100.4 per hundred thousand population in 2022, and an estimated increase of 12.8 per cent in 2025. Thus the estimated incidence in 2025 is 113.2 per 100,000 population. For the estimated population of 141 crore population in 2022, the reported Cancer

Registry data of histopathologically confirmed cases of cancer is 14 lac 61 thousand 427. The Registry culled this data received from the Population Based Cancer Registries. The data are not comprehensive for the entire country but constitute an unselected representative sample for crude incidence analysis. The purpose is to provide reliable cancer pattern and cancer profile for policy makers to take objective decisions.

METHODOLOGY

Sample selection

Bhagwan Mahaveer Cancer Hospital is the Stand Alone Cancer Hospital in Jaipur, functional since 1999. The ICD coded data of patients diagnosed to have cancer at Bhagwan Mahaveer Cancer Hospital (BMCH), Jaipur, for the year 2024 are analyzed.

The Bhagwan Mahaveer Cancer Hospital meticulously maintains ICD-10 (International Classification of Diseases) Coded patient database. The analysis of geographic distribution of the patients coming to the hospital reveals that the patients are coming from all over Rajasthan. Since these patients are unselected it constitutes a valid representative sample size of diagnosed and coded (10363) cases for analysis of cancer in Rajasthan.

OBSERVATIONS

Cancer Pattern (relative percentage occurrence)

Analysis of ICD Coded patient data reveals the following five cancers to be the top cancers in Rajasthan (Table 1).

Table 1: Top 5 cancers

Morbidity Pattern	No. of Pts	%
Lip, Oral Cavity and Pharynx (C00-C14)	2785	26.89
Digestive Organs (C15-C26)	1602	15.45
Respiratory and Intrathoracic Organs (C30-C39)	1039	10.02
Breast (C50)	1180	11.38
Female Genital Organs (C51-C58)	872	8.41

Pattern of cancer in form of the 20 internationally

classified Disease Related Group DRG) is tabulated Table 2.

The high incidence of these cancers is greatly worrying as the known causes of these cancers are tobacco consumption, high alcohol intake and high pesticide exposure.

The high incidence of breast and cervical

cancer in females too needs effective early detection and treatment strategy along with primary prevention measures advocated and available.

The reported cancer pattern in Rajasthan, it is hoped, will help in planning the management of cancers in Rajasthan.

Table 2: Pattern of cancer in Rajasthan per percentage occurrence

S.no.	Morbidity Pattern	2024	
		No. of Pts	%
1	Lip, Oral Cavity and Pharynx (C00-C14)	2785	26.89
2	Digestive Organs (C15-C26)	1602	15.45
3	Respiratory and Intrathoracic Organs (C30-C39)	1039	10.02
4	Bone and Articular Cartilage (C40-C41)	121	1.17
5	Melanoma and Othe Malignant Neoplasms of Skin (C43-C44)	50	0.48
6	Mesothelial and Soft Tissue (C45-C49)	145	1.40
7	Breast (C50)	1180	11.38
8	Female Genital Organs (C51-C58)	872	8.41
9	Male Genital Organs (C60-C63)	334	3.22
10	Urinary Tract (C64-C68)	269	2.60
11	Eye, Brain and Other Parts of Central Nervous System (C69-C72)	155	1.50
12	Thyroid and Other Endocrine Glands (C73-C75)	249	2.40
13	Ill-defined, Secondary and Unspecified Sites (C76-C80)	70	0.68
14	Lymphoid, Haematopoietic and Related Tissue (C81-C96)	795	7.67
15	In Situ Neoplasms (D00-D09)	1	0.01
16	Benign Neoplasms (D10-D36)	346	3.35
17	Neoplasms of Uncertain or Unknown Behaviour (D37-D48)	56	0.54
18	Disease of Blood and Blood Forming Organs and Certain Disorders Involving the Immune Mechanism (D50-D89)	127	1.23
19	Endocrine, Nutritional and Metabolic Diseases (E00-E90)	25	0.24
20	Miscllaneous	142	1.38
	No. of Patients Diagnosed as Cancer (ICD Coded)	10363	100.00
	Total No. of Patients Registered in the Year	14911	
	Percent of registered patients converted (Diagnosed) to Cancer Patients		69.52

Geographic distribution of patients (Figure 1)

The geographic distribution of number of patients coming from the 33 districts of Rajasthan (drainage area) is worked out for each district. Highest number of patients, 2837

(23.87%) are from Jaipur district, followed by Alwar 1031 (8.67%) and Ajmer 855 (7.19%). The Hospital has an outreach for all districts of Rajasthan.



Figure 1: Geographic distribution of patients coming to BMCH

Cancer incidence

For the estimated population of 7,95,02,477 (7.95 crore) Rajasthan for the year 2025, the cases coming to this stand alone multi disciplinary cancer hospital is 14,911. The cases are unselected and self referred. The hospital has been receiving approximately 11 thousand to 16 thousand patients yearly for last 10 years that ICD coded data is maintained. This stand alone cancer hospital in Jaipur started in 1999. Since last 5 years over half a dozen cancer centers have come up in Jaipur. This reflects the rising cancer trend in Rajasthan. However, the number of patients coming to Bhagwan Mahaveer Cancer Hospital from all over Rajasthan has not shown any substantial decrease. The credibility and outreach of the BMCH is sustained

For the estimated of population 2025 of 146 crore of India, the estimated Registry data are 16 lac 44 thousand 105 patients with 12.5 percent estimated increase in the cancer patient since 2022 (Krishnan Satish Kumar *et al*: IJMR, 2023). As per this estimate, the expected number of cancer cases for 7.95 crore 2025 population of Rajasthan would be: 89,527. BMCH receives 11, 887 patients (patients from outside Rajasthan

are excluded) i.e., of every 9 cancer patients BMCH receives 1 patient. Since the patients coming to BMCH from all over Rajasthan are unselected self referred patients their number constitutes a valid representative sample for crude incidence of cancer in Rajasthan.

Based on this sample size, crude cancer incidence rate for one lac population for each district has been worked out. The average incidence for Rajasthan per the BMCH sample is 14.9/lac. Since BMCH receives 1 case for every 9 estimated cancer patients of Rajasthan,, $14.9 \times 9 = 134.57 / 1$ lac population is the average incidence for Rajasthan . This is higher than the estimated average of 113/lac population for India.

Jaipur with 332/lac, Ajmer 256/lac, Jhunjhunu 235/lac, Dausa 225/lac and Awar 217/lac are the top 5 districts with very high incidence of cancer as compared to average of 134/lac for Rajasthan and 113/lac population for India. Rajasthan appears to be in serious grip of cancer. Urgent primary and secondary preventive measures need to be initiated to curb it.

District-wise Incidence per 100 thousand Population

District Name	As per 2011 census	Estimated Population in 2025	Ca. Pt.	Ca. estimated per 1 lac population 2025 (BMCH pts)	Estimated Incidence per lac population Rajasthan x factor 9
Ajmer	25,83,052	2995824	855	28.54	256.86
Alwar	36,74,179	4261313	1031	24.19	217.75
Banswara	17,97,485	2084723	9	0.43	3.89
Baran	12,22,755	1418151	192	13.54	121.85
Barmer	26,03,751	3019830	40	1.32	11.92
Bharatpur	25,48,462	2955706	638	21.59	194.27
Bhilwara	24,08,523	2793405	403	14.43	129.84
Bikaner	23,63,937	2741694	125	4.56	41.03
Bundi	11,10,906	1288429	280	21.73	195.59
Chittaurgarh	15,44,338	1791123	123	6.87	61.80
Churu	20,39,547	2365467	310	13.11	117.95
Dausa	16,34,409	1895588	474	25.01	225.05
Dhaulpur	12,06,516	1399317	224	16.01	144.07
Dungarpur	13,88,552	1610443	5	0.31	2.79
Ganganagar	19,69,168	2283841	306	13.40	120.59
Hanumangarh	17,74,692	2058288	266	12.92	116.31
Jaipur	66,26,178	7685041	2837	36.92	332.24
Jaisalmer	6,69,919	776972	8	1.03	9.27
Jalore	18,28,730	2120961	19	0.90	8.06
Jhalawar	14,11,129	1636627	197	12.04	108.33
Jhunjhunu	21,37,045	2478545	649	26.18	235.66
Jodhpur	36,87,165	4276374	140	3.27	29.46
Karauli	14,58,248	1691276	324	19.16	172.41
Kota	19,51,014	2262786	473	20.90	188.13
Nagaur	33,07,743	3836320	496	12.93	116.36
Pali	20,37,573	2363177	96	4.06	36.56
Pratapgarh	8,67,848	1006530		0.00	0.00
Rajsamand	11,56,597	1341421	35	2.61	23.48
Sawai Madhopur	13,35,551	1548972	328	21.18	190.58
Sikar	26,77,333	3105171	685	22.06	198.54
Sirohi	10,36,346	1201954	10	0.83	7.49
Tonk	14,21,326	1648454	270	16.38	147.41
Udaipur	30,68,420	3558754	39	1.10	9.86
Rajasthan		79502477	11887	14.95	134.57

The pattern of cancer in Rajasthan, its geographic distribution and estimated incidence per 100 thousand population, it is hoped will guide the policy makers and care providers, and goad it to collect comprehensive real time statistical information of this rising menace of cancer.

Analysis of Indian Cancer Registry data

Histopathology department of Bhagwan Mahaveer Cancer Hospital is a center approved for reporting histopathologically confirmed cases of cancer to the National Center for Disease Informatics and Research for ICMR's Indian Cancer Registry. From 2020 to 2024, **14,512** consecutive cancer patients coming from all over Rajasthan, have been reported to the Registry.

Analysis of ICD coded data of histopathologically confirmed cancer patients, consecutively reported to the Registry, reveals the **Five** top cancers to be:

1. Lip, Oral Cavity and pharynx (ICD C00-C14) = **31.55%**
2. Digestive Organs (ICD C15-C26) = **14.90%**
3. Breast (ICD C50) = **12.17%**
4. Respiratory and Intrathoracic Organs (ICD C30-C39) = **11.00%**
5. Female Genital Organs (C51-C58) = **8.19%**

This tallies with and substantiates the cancer pattern analysis based on the patients coming to BMCH in 2024 as detailed above.

The sex ratio M:F is 1.5 Male to 1 Female

Cancer in Sanganer segment of Jaipur

In the light of recently reported high pollution of the surface water bodies with toxic effluents from the textile and other industries in Sanganer municipal segment of Jaipur, cancer data of Sanganer were extracted and examined. This highly contaminated water is used extensively for growing green vegetables that is consumed by Jaipur. Since the toxic chemicals in the effluent are known to contain probable carcinogens, the cancer data of the **23** Sanganer patients reported in this series were examined.

The sex ratio of the Sanganer patients revealed a surprising finding: Of the **23** patients, there are **15** Females and **8** Males, a very high preponderance of female patients. This was reverse of the sex ratio in the reported **14,512**

patients from all over Rajasthan. This raised a question if the contaminating carcinogens in Sanganer are selectively effecting the female population? There are known hormone disrupters in the contaminants. There are more hormone sensitive organs and tissues in the reproductive age group of females: Is this the cause of female preponderance in Sanganer?

DISCUSSION

The present prospective analysis from BMCH Jaipur underscores a concerning elevation of cancer incidence in Rajasthan, especially in urban districts like Jaipur, and a distinct cancer pattern dominated by head and neck, digestive, breast, and female genital organ malignancies. This is consistent with Sharma *et al*, who reported uro-genital, breast, and oral cancers as leading types in eastern Rajasthan (Indian J Cancer, 1994). Gangawat *et al* (2025) similarly highlighted high rates of oral, breast, cervical, and lung cancers in Rajasthan, attributing oral and lung cancer predominance among males to tobacco use and late diagnosis as a key factor in female cancers.^{[1][2]}

Hospital-based registry data from Bikaner RCC verified a rising trend in lung cancer in northwestern Rajasthan, especially among males, with significant local clustering in Bikaner, Churu, and Nagaur districts. Head and neck cancer remains a major health concern in the region; Aggarwal *et al* (2015) found oral and head/neck cancers accounted for nearly 57% of cancers in their Rajasthan cohort, especially among younger adults (<40 years).^{[3],[4]}

Environmental factors are increasingly implicated in cancer clusters. Singh *et al* (2024) reported concerning breast cancer prevalence in rural Jaipur, identifying low awareness and delayed diagnosis as compounding factors. Broader Indian studies (Bagal *et al*, 2023) emphasize head and neck cancer's strong association with tobacco use, with higher incidence in northern regions aligned with local habits and possibly environmental exposures. Pollution air, water, and soil has emerged as a significant cancer risk; recent studies showed direct associations between poor air quality and rising lung cancer rates in Indian metro regions, as well as increased breast and gallbladder cancer near polluted rivers in Uttar Pradesh and Bihar. The Sanganer cancer anomaly female

