Temporal Trends and Geographic Variation in Cervical Cancer Cases (2005-2023): Insights from State Cancer Institute of Western India

Anand G Shah[1], Devanshi Raval[2], Hiral Dabhi[2], Bijal M Patel[3], Rohini Patel[4], Zankhana Modi[2], Janvi Pandya[2], Mohit N Makwana[5]

[1]Associate Professor, [2]Research Officer, [4]Medical Officer, [5]Assistant Professor, Department of Community Oncology, The Gujarat Cancer and Research Institute (GCRI), Ahmedabad, India

[3]Professor, Department of Gynecological Oncology, The Gujarat Cancer and Research Institute (GCRI), Ahmedabad, India

Correspondence: Dr. Mohit N. Makwana, Email: mohit.makwana@gcriindia.org

Abstract:

Introduction: Cervical cancer remains a significant global public health concern, with a disproportionate burden observed in low- and middle-income countries. **Objective:** To study epidemiological profile of the cervical cancer cases at the Gujarat Cancer & Research Institute (GCRI) over 19-year period (2005–2023). **Method:** This descriptive cross-sectional study utilized cancer registry data and electronic medical records from the GCRI. The study included all histologically confirmed (23,573) cervical cancer cases registered between January 2005 and December 2023. Annual trends in case registrations, age distribution, and geographic distribution (district level within Gujarat and state level across India) were analyzed. **Results:** Data shows annual registrations of cervical cancer peaks at 1,446 in 2014 before a marked decline to 614 in 2023 (APC= -4.94%). The mean age at diagnosis was 49.4±11.31 years, with the 40–49 age group representing the highest vulnerability (33.72%). While 27.92% of patients migrated from outside Gujarat- primarily from Rajasthan (15.88%) and Madhya Pradesh (9.22%) the intra-state burden was highest in the Ahmedabad district (19.43%). Significant geographic variance was observed, with registrations ranging from 7.00% in Sabarkantha to as low as 0.07% in the Dang district. **Conclusions:** This 19-year epidemiological analysis of cervical cancer cases at the GCRI reveals marked decline in hospital-based registrations since 2015. However, the persistent geographic inequities identified throughout the study period highlight critical need for targeted outreach and intensified screening in underserved regions. These longitudinal findings underscore the importance of strengthening preventive interventions to align with the World Health Organization's 2030 cervical cancer elimination targets.

Keywords: Cervical Cancer; Epidemiology; Geographic Distribution; India; Temporal Trends

Introduction:

Cervical cancer is a serious public health condition on an international scale, particularly in low- and middle-income nations where affordable preventive healthcare is not available. It was estimated that there were 661,044 new cases of cervical cancer diagnosed in the world in 2022, and approximately 348,186 deaths due to the disease, making it the fourth most frequent cancer and the fourth most common cause of cancer death among women globally, according to the

Quick Response Code	Access this article online	How to cite this article :
	Website : www.healthlinejournal.org	Shah A, Raval D, Dabhi H, Patel B, Patel R, Modi Z et al. Temporal Trends and Geographic Variation in Cervical Cancer Cases (2005-2023): Insights from State Cancer Institute of Western India. Healthline. 2026;17(1): 61-68
	DOI : 10.51957/Healthline_806_2026	

Received : 09-12-2025 **Accepted** : 10-03-2026 **Published :** 31-03-2026

International Agency for Research on Cancer (IARC).[1] An age-standardized incidence rate (ASIR) of 14.1 per 100,000 women and an age-standardized mortality rate (ASMR) of 7.1 per 100,000 women-years were reported.[1]

In India, cervical cancer remains a significant public health problem. The country reported 123,907 new cases and 77,348 deaths in 2022 and accounted for nearly one-fifth of global incidence and nearly one-fourth of global mortality.[1] It continues to be the second most prevalent cancer among Indian women, after breast cancer, with an ASIR of 18.0 and an ASMR of 11.4 per 100,000 females. The global Age-Standardized Incidence Rate (ASIR) was 18.11 per 100,000 population in 1990, showing a declining trend of 15% in incidence and 31% in mortality by 2021.[2] although there has been a declining trend. Over recent decades, the global decline in cervical cancer prevalence and mortality has been attributed to the introduction of HPV vaccination, widespread screening initiatives, and increased awareness.[1,3]

However, regional disparities persist, particularly in sub-Saharan Africa, Central America, and South-East Asia, including India, where screening coverage, vaccination rates, and access to treatment facilities remain uneven.[1] Bruni et al.[3] reported that, with state-led interventions in India, ASIR and ASMR declined by 21.3% and 32.3% respectively between 1990 and 2019.[4] Yet, this decline has not been uniform across all Indian states, and the national trend remains far from achieving the Sustainable Development Goal (SDG) of reducing premature mortality from cancer by one-third by 2030.[1,3]

The Gujarat Cancer & Research Institute (GCRI), located in Ahmedabad, has been functioning as a State Cancer Institute since its establishment in 1961. It is an apex cancer institute focused on providing evidence-based treatment, clinical research, and specialized education. As a tertiary referral facility, it manages complex cancer cases through a multidisciplinary approach and integrated patient care services and plays a pivotal role in India's healthcare system.[5]

The study aims to analyses temporal trends and geographic variation in cervical cancer cases registered at a State Cancer Institute in Western India from 2005 to 2023.

Methods:

Study Design and Setting: This descriptive cross-sectional study was conducted at The Gujarat Cancer & Research Institute (GCRI), Ahmedabad — It serves as a primary state cancer institute and is the designated center for oncological research in Gujarat. Established as a collaborative institution under the Government of Gujarat and the Gujarat Cancer Society, The GCRI serves as a tertiary care referral centre for oncology patients across the state and neighbouring regions. The institute provides comprehensive cancer care through its multidisciplinary departments, and maintains extensive, systematically archived patient records, facilitating robust long-term analyses of cancer incidence, trends, and geographic distribution.

Data Source: Data for this study were obtained from the hospital-based cancer registry and the electronic medical records system maintained by the GCRI. All cases of histopathology confirmed cervical cancer registered between January 2005 and December 2023 were identified and included for analysis.

Data Analysis: Data were compiled in Microsoft Excel and analyzed using descriptive statistical methods. Annual Percentage Change (APC) was calculated to quantify the relative increase or decrease in cervical cancer incidence trends over the study period (2005–2023). The APC was determined using the following formula: $\mathbf{APC = (V_{current} - V_{previous}/V_{previous}) * 100.}$ Where $V_{current}$ represents the number of cases in a given year and $V_{previous}$ represents the cases in the preceding year.[6] Annual Percentage Change trends were plotted graphically to identify longitudinal patterns. Age-wise, district-wise, and state-wise distributions were tabulated and visualized. Figures and graphs were generated to illustrate these trends across the defined time intervals.

Ethical Considerations: This study utilized de-identified secondary data extracted from hospital records and was conducted in accordance with established ethical standards and the principles of the Declaration of Helsinki (2013). Patient confidentiality and data privacy were rigorously maintained throughout the study.

Approval for this study was obtained from the Institutional Review Committee (IRC) [IRC/2025/P-97 granted on September 24, 2025]. Patient Consent was exempted by the Institutional Review Committee (IRC) as this study utilized de-identified secondary data extracted from hospital records.

Results:

Temporal Trends and Case Frequency

Between 2005 and 2023, The Gujarat Cancer & Research Institute (GCRI) recorded 23,573 histologically confirmed cases of cervical cancer. The data revealed a non-linear temporal trend: annual registrations rose from 1,204 in 2005 to a peak of 1,446 in 2014. Subsequently, a notable decline was observed, reaching 614 cases in 2023. The Annual Percentage Change (APC) indicated a downward trajectory of -4.94% per year over the last decade. A notable sharp decline occurred in 2020, where cases dropped to 724 - a 28.3% decrease from the 2019 baseline of 756.

The results present the temporal trends in annual incidence, along with demographic and geographic distributions analysed by age group, district, and state.

Age Metrics and Demographics:

The mean age at diagnosis was 49.4 years (SD ± 11.31), with cases spanning from 21 to over 60+ years. The 40–49 age group represented the highest vulnerability, accounting for 33.72% (n = 7,951) of cases, followed by the 50–59 cohort at 26.97% (n = 6,361). Nearly 16% of the total cases were identified in women under the age of 40.

Figure 1: Annual Percentage Change and Longitudinal Trends of Cervical Cancer cases registered at The GCRI (2005–2023)

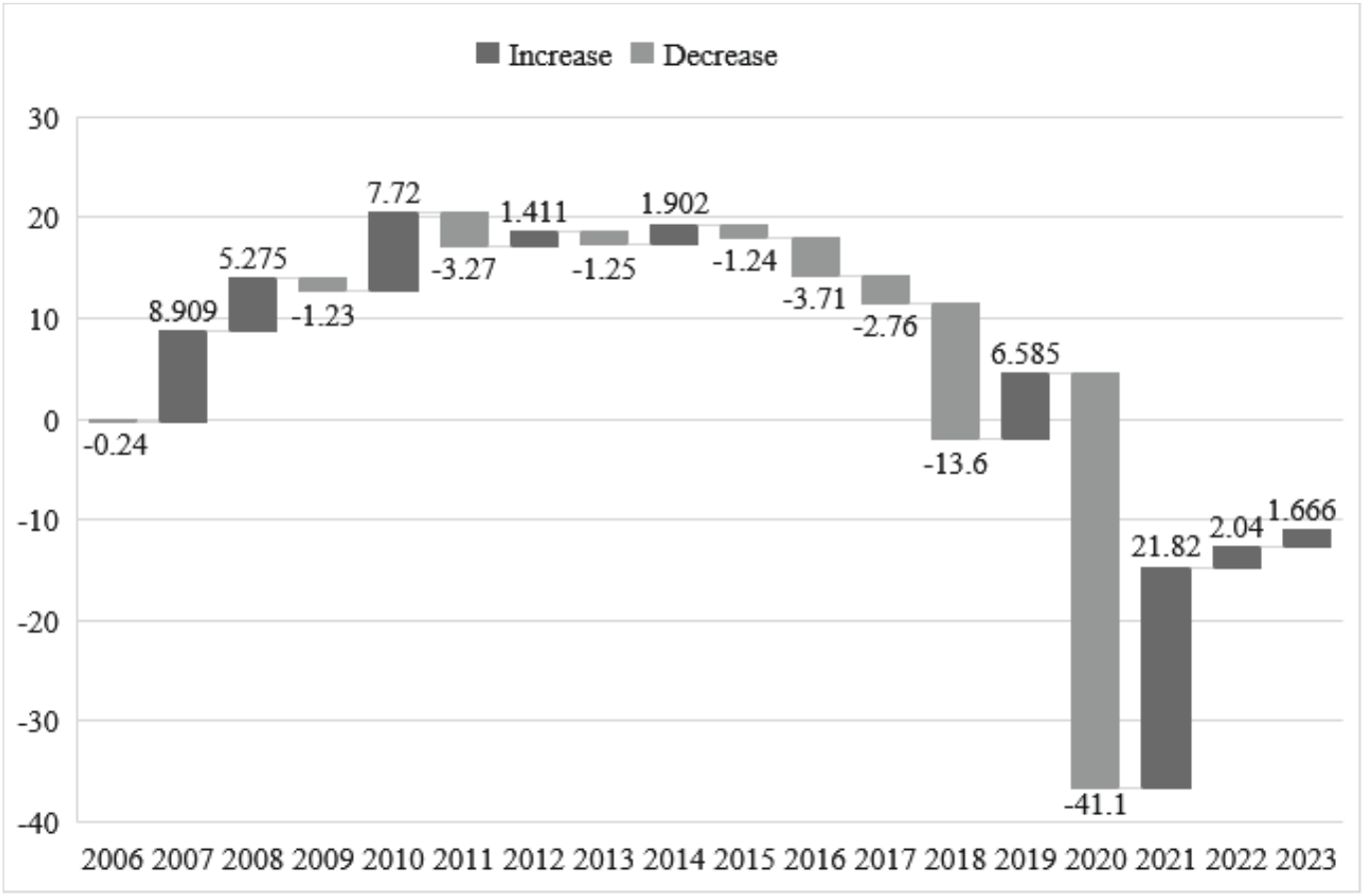
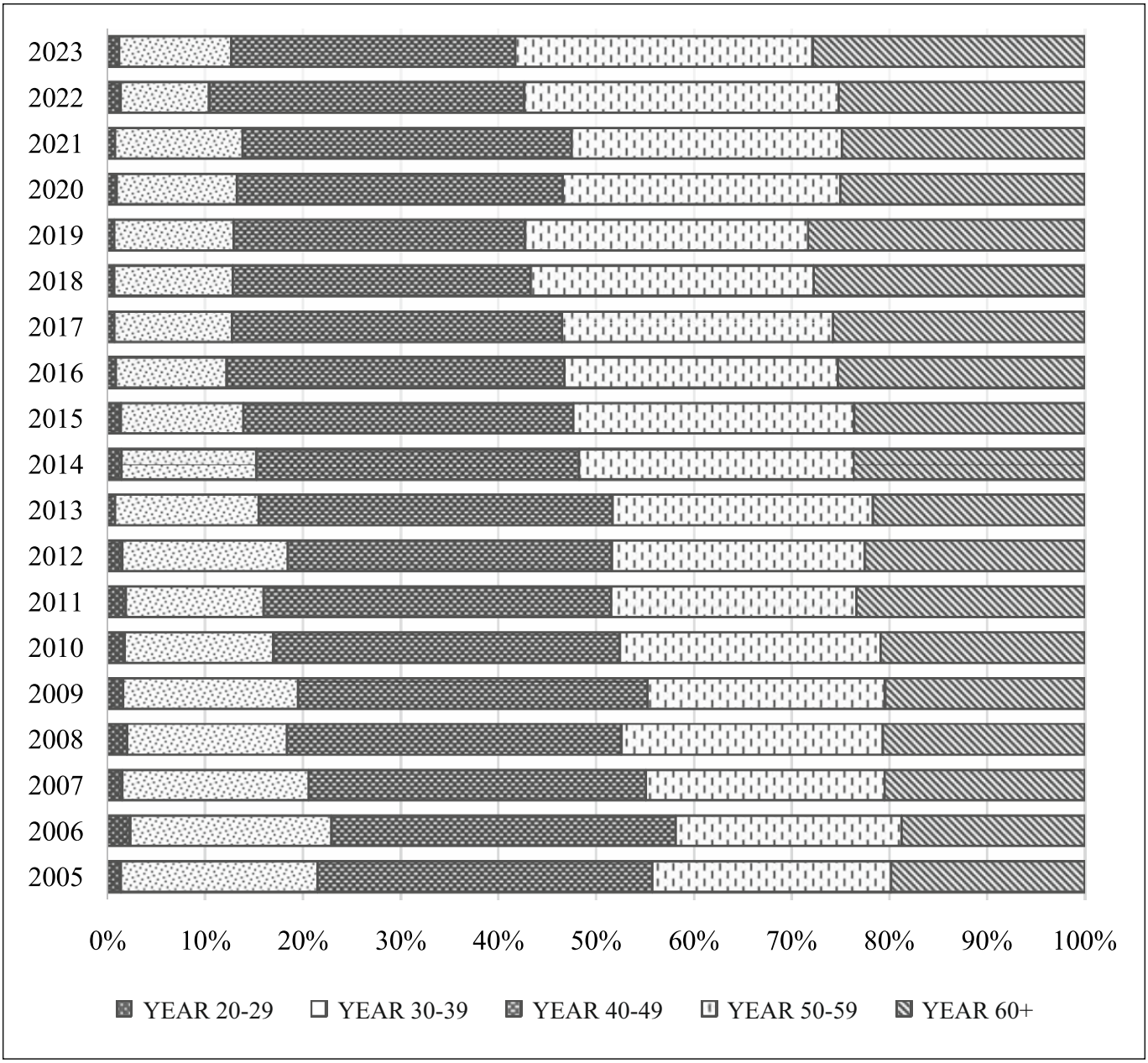


Figure 2: Proportional Age Distribution of Cervical Cancer Cases by Year (2005–2023) at The GCRI (2005–2023)



Geographic Distribution and Referral Patterns:

· **Inter-state Migration:**

A significant proportion of the study population, totalling 6,580 cases (27.92%), originated from outside the state of Gujarat, underscoring the institute's role as a primary tertiary referral center for Western and Central India. The highest inter-state contribution was observed from Rajasthan, which accounted for 3,746 cases (15.88%), followed by Madhya Pradesh with 2,176 cases (9.22%).

Beyond these primary contributing regions, a collective total of 658 cases (2.79%) were recorded from other Indian states. This merged cohort includes registrations from Uttar Pradesh (n=354; 1.50%), Maharashtra (n=125; 0.53%), and the remaining cases from various other states across the country.

Intra-state Migration:

Of the 15,944 total registered cases within Gujarat, the Ahmedabad district demonstrated the highest institutional burden, accounting for 19.43% (n = 4,277)

Figure 3: State-wise Distribution of Cervical Cancer Cases in India (2023)

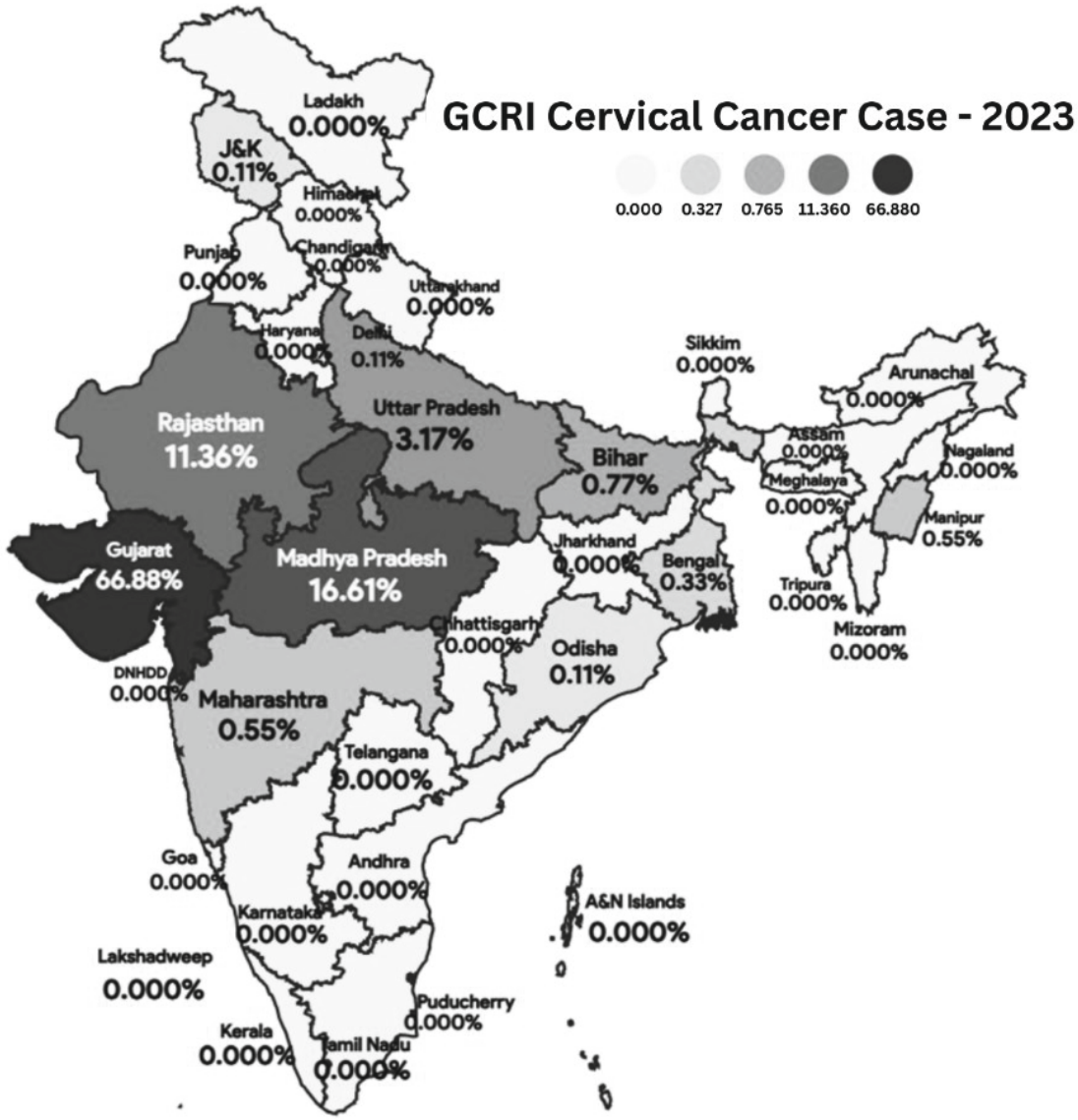


Figure 4: District-wise Distribution of Cervical Cancer Cases in Gujarat (2010 & 2015)

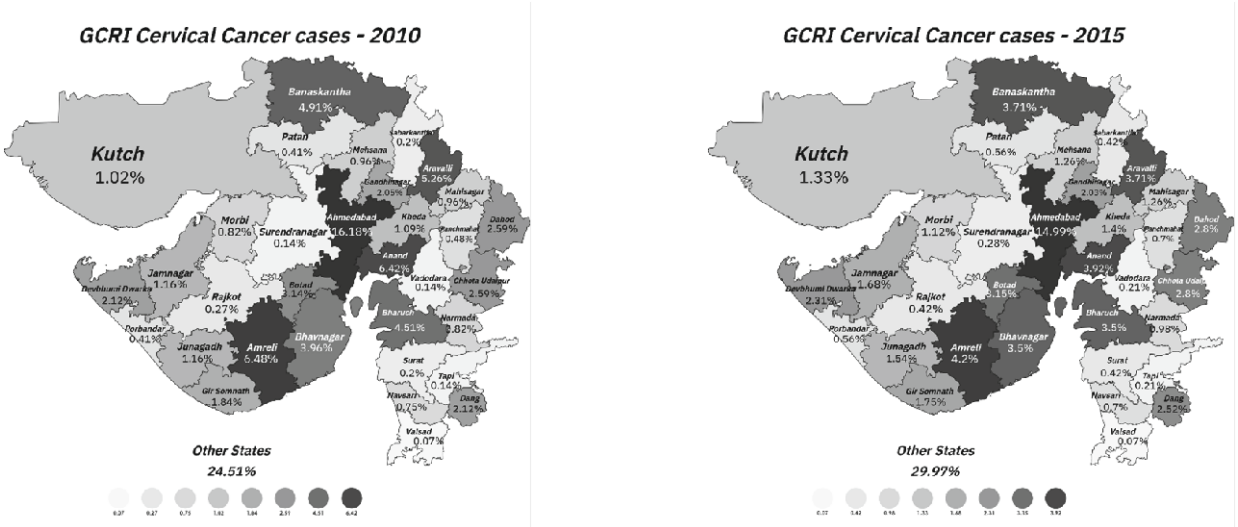
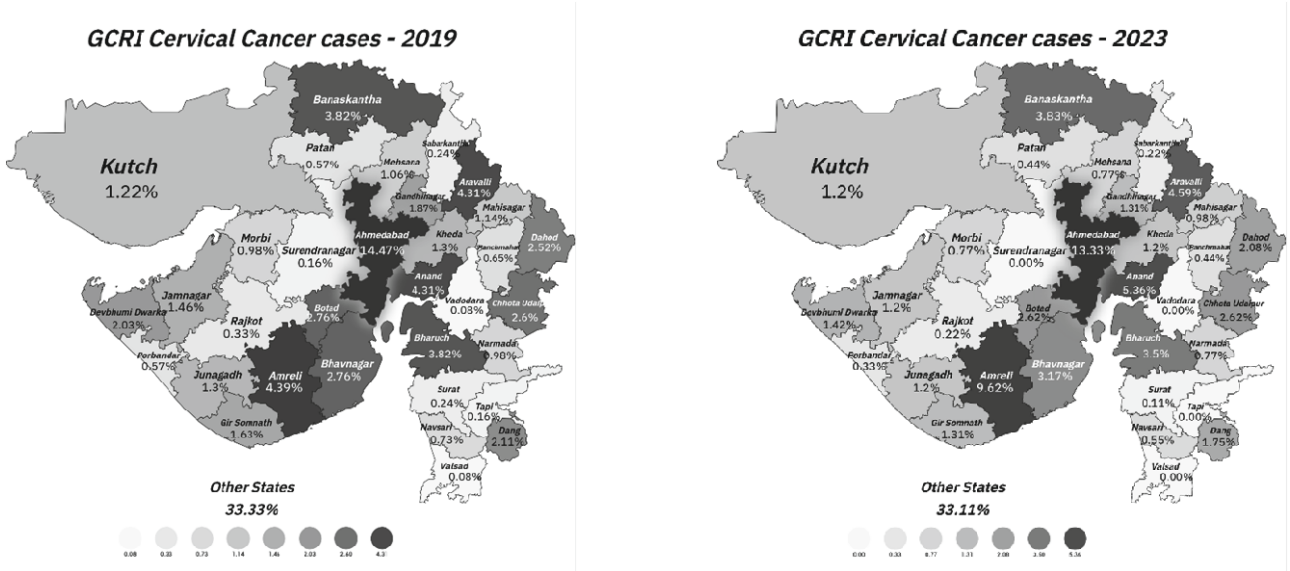


Figure 5: District-wise Distribution of Cervical Cancer Cases in Gujarat (2019 & 2023)



of the intra-state caseload. Other major contributors included Sabarkantha (7.00%), Panchmahal (6.33%), Kheda (6.04%), and Vadodara (5.44%). Substantial registrations were also recorded from Mehsana (4.92%), Dahod (4.69%), Gandhinagar (4.51%), Banaskantha (3.51%), and Anand (3.08%).

The remaining 23 districts—including Bhavnagar (2.48%), Junagadh (2.00%), and Surat (1.65%) among others—collectively accounted for 28.56% of the total registrations. This cohort includes the lowest reporting districts, specifically Tapi (0.10%; n = 21) and Dang (0.07%; n = 15), reflecting the geographic variance in patient presentation during the 2005–2023 study period.

Discussion:

This 19-year retrospective analysis of 23,573 histologically confirmed cervical cancer cases at the Gujarat Cancer & Research Institute (GCRI) provides a robust epidemiological portrait of the disease in Western India. Our primary finding reveals a non-linear temporal trend: a sharp increase in annual registrations from 1,204 cases in 2005 to a peak of 1,446 cases in 2014, followed by a significant stabilizing decline, reaching 614 cases in 2023.[7,8] The Annual Percentage Change (APC) indicates a successful downward trajectory in the last decade (–4.94% per year), potentially reflecting the impact of decentralized screening and early intervention programs across the state.

Comparative Analysis and Temporal Evolution

The initial surge in cases observed between 2005 and 2014 is likely not an indicator of rising biological incidence, but rather an improvement in diagnostic reach and referral infrastructure within Gujarat.[9] This trend mirrors findings in other Indian regions; for instance, hospital-based data from Chennai demonstrated that improved diagnostic methods and specialized infrastructure are critical drivers of registration volume.[9] However, the subsequent decline toward 2023 aligns with global reports of reduced cervical cancer burdens in regions with maturing screening initiatives.[8,10,11] Nationally, the National Cancer Registry Programme (NCRP) has noted a significant decrease in cervical cancer incidence rates across most Population-Based Cancer Registries (PBCRs), with the APC decreasing by –3.5% in Chennai, –3.0% in Delhi, –2.4% in Mumbai, and –1.9% in Bangalore.[7]

Interestingly, while regions like Bihar have seen a sharp 27% decline in cervical cancer registrations between 2015 and 2016, our data shows a more gradual, sustained stabilization.[12] A critical observation in our cohort is the significant decline in 2020 to 724 cases, representing a 28.3% drop from the 2019 baseline. This discordance with biological trends is a direct consequence of the COVID-19 pandemic's disruption of elective oncology screenings and transport barriers - a

finding concordant with international literature on the "diagnostic deficit.[7,11] Globally, while absolute annual deaths increased by 52% between 1990 and 2019 due to population growth, the Age-Standardized Death Rate (ASDR) fell from 8.48 to 6.51 per 100,000.[8]

Age Distribution and Peak Vulnerability

The demographic analysis shows a mean age at diagnosis of 49.4 years (SD ± 11.31), spanning 21 to 60+ years. This is strikingly consistent with data from North East India (median age 48) and Bihar (median age 50).[12,13] The most affected cohort in our study is the 40–49 age group (33.72%), followed by the 50–59 group (26.97%).

Mechanistically, this peak in the 40s suggests a long-term persistence of high-risk HPV infection, typically acquired in the second or third decade of life; HPV types 16 and 18 account for approximately 70% of total cases worldwide.[8,14] Notably, our findings contrast slightly with regions like Kerala and Mumbai, where the peak age group is often slightly older (52.6 years in Mumbai).[10] The presence of nearly 16% of cases in women under 40, alongside a noted increase in the 30–39 years cohort, lends weight to the hypothesis that early socio-cultural factors—such as early marriage and high parity—remain significant drivers of early-onset carcinoma.[12,15]

Geographic Reach and Regional Disparities

Our data highlights GCRI's role as a critical regional hub, with 27.92% of the total caseload originating from outside Gujarat. This "referral footprint" is dominated by Rajasthan (15.88%) and Madhya Pradesh (9.22%). This pattern suggests that tertiary centers in Gujarat fill a critical void for oncology services in the neighboring central and northern belts of India.[16] Within Gujarat, the caseload is heavily concentrated in Ahmedabad (18.13%), potentially indicating a "proximity bias," whereas the significantly lower numbers in tribal districts like Dang (0.06%) likely indicate under-reporting or geographic barriers to care.

Socioeconomic and Educational Barriers

Severe disparities exist across educational lines. A hospital-based study in North East India found that 43.5% of cervical cancer patients were illiterate, demonstrating that poor health literacy is a significant barrier to early diagnosis.[13] This is mirrored internationally in Brazil, where unknown tumor staging was 16% higher in public health system patients compared to those with private insurance.[11] Global data further supports this, showing that High Socio-Demographic Index (SDI) areas have significantly lower incidence rates (6.83 per 100,000) compared to low SDI areas (31.5 per 100,000).[8]

Limitations:

This hospital-based study may not fully reflect the true population burden of cervical cancer in Gujarat, as referral patterns and access to care can influence case registration. District-level disparities may also be affected by underdiagnosis and limited screening coverage in rural and tribal areas. Additionally, disruptions during the COVID-19 pandemic likely contributed to the sharp decline in cases in 2020–2021. Finally, changes in diagnostic and reporting practices over the years may have impacted temporal trends. Despite these limitations, the study provides important long-term insights into cervical cancer epidemiology in Western India.

Conclusion:

This 19-year analysis demonstrates a clear decline in cervical cancer cases registered at GCRI, particularly after 2015, indicating the positive impact of strengthened screening efforts and the introduction of HPV vaccination in Gujarat. The shift toward younger age groups and earlier-stage diagnoses further highlights improvements in awareness and access to care. However, persistent geographic disparities—especially in rural and tribal districts—underscore the need to enhance equitable screening coverage and outreach services. Strengthening primary-level preventive strategies, expanding HPV vaccination, and improving referral pathways will be essential to sustain progress and align with the WHO's 2030 cervical cancer elimination targets. Continued monitoring and research are crucial to address gaps and ensure that reductions in disease burden are achieved across all population groups.

Recommendation:

Based on the study findings, targeted interventions are required in districts with consistently low case reporting, particularly rural and tribal regions, to address probable underdiagnosis and limited access to screening. Continued reinforcement of HPV vaccination and screening efforts is essential to maintain the decline observed after 2015. Strengthening referral pathways from high-burden districts such as Ahmedabad, Surat, Rajkot, and Vadodara can further enhance timely diagnosis. Ongoing monitoring of geographic and age-specific trends should be prioritized to guide focused public health strategies.

Declaration

Funding: Nil

Conflict of Interest: Nil

Use of Artificial Intelligence: LLM were used only for improving grammar, language clarity, and formatting of the manuscript. All scientific content, data analysis, interpretations, and conclusions were conceptualized, validated, and approved by the authors.

References:

1. Filho AM, Laversanne M, Ferlay J, Colombet M, Piñeros M, Znaor A, et al. The GLOBOCAN 2022 cancer estimates: Data sources, methods, and a snapshot of the cancer burden worldwide. Int J Cancer. 2025 Apr 1;156(7):1336–46. doi:10.1002/ijc.35278 Pub Med PMID: 39688499.
2. Shao D, Wu P, Jiang H, Wang Z. Global trends and future projections of cervical cancer burden: an integrated analysis of GBD 2021, UN population and WHO HPV vaccination data. Front Public Health. 2026 Jan 26;14. doi:10.3389/fpubh.2026.1702186
3. Siegel RL, Kratzer TB, Giaquinto AN, Sung H, Jemal A. Cancer statistics, 2025. CA Cancer J Clin. 2025 Jan 16;75(1):10–45. doi:10.3322/caac.21871
4. Bruni L, Saura-Lázaro A, Montoliu A, Brotons M, Alemany L, Diallo MS, et al. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019. Prev Med (Baltim). 2021 Mar;144:106399. doi:10.1016/j.ypmed.2020.106399
5. The Gujarat Cancer & Research Institute [Internet]. [cited 2026 Feb 26]. Available from: https://www.gcriindia.org/profile.html
6. Fay MP, Tiwari RC, Feuer EJ, Zou Z. Estimating Average Annual Percent Change for Disease Rates without Assuming Constant Change. Biometrics. 2006 Sep 27;62(3):847–54. doi:10.1111/j.1541-0420.2006.00528.x
7. Ramamoorthy T, Sathishkumar K, Das P, Sudarshan KL, Mathur P. Epidemiology of human papillomavirus related cancers in India: findings from the National Cancer Registry Programme. Ecancermedicalscience. 2022;16. doi:10.3332/ecancer.2022.1444
8. Yao H, Yan C, Qiumin H, Li Z, Jiao A, Xin L, et al. Epidemiological Trends and Attributable Risk Burden of Cervical Cancer: An Observational Study from 1990 to 2019. Int J Clin Pract. 2022;2022. doi:10.1155/2022/3356431 PubMed PMID: 36263235.
9. Gopalakrishnan S, Umadevi R. An epidemiological analysis of cancer patients admitted to hospitals in Chennai, Tamil Nadu. Int J Community Med Public Health. 2015;2(1):3. doi:10.5455/2394-6040.ijcmph20150202
10. Aswin M, Catherin N, Racheal J, Vaz C. Trend analysis of cancers from a hospital-based cancer registry in Kerala, India. Int J Noncommun Dis. 2020;5(1):11–5. doi:10.4103/jncd.jncd_45_19
11. de Oliveira NPD, de Camargo Cancela M, Martins LFL, Meira KC, de Castro JL, de Souza DLB. Completeness of cervical cancer staging information in Brazil: A national hospital-based study. Cancer Epidemiol. 2022 Aug 1;79. doi:10.1016/j.canep.2022.102191 PubMed PMID: 35636001.
12. Pandey A, Raj S, Madhawi R, Devi S, Singh R. Cancer trends in Eastern India: Retrospective hospital-based cancer registry data analysis. South Asian J Cancer. 2019 Oct 1;8(4):215–7. doi:10.4103/sajc.sajc_321_18 PubMed PMID: 31807479.
13. Krishnatreya M, Kataki AC, Sharma JD, Nandy P, Talukdar A, Gogoi G, et al. Descriptive epidemiology of common female cancers in the North East India - A hospital based study. Asian Pacific Journal of Cancer Prevention. 2014;15(24):10735–8. doi:10.7314/APJCP.2014.15.24.10735 PubMed PMID: 25605167.
14. Sen U, Sankaranarayanan R, Mandal S, Ramanakumar A V., Parkin DM, Siddiqi M. Cancer patterns in Eastern India: The first report of the Kolkata Cancer Registry. Int J Cancer. 2002 Jul 1;100(1):86–91. doi:10.1002/ijc.10446 PubMed PMID: 12115592.
15. Qurieshi MA, Khan SMS, Masoodi MA, Qurieshi U, Ain Q, Jan Y, et al. Epidemiology of Cancers in Kashmir, India: An Analysis of Hospital Data. Adv Prev Med. 2016;2016:1–6. doi:10.1155/2016/1896761 PubMed PMID: 27478644.
16. Grewal GS, Gupta S, Sidhu MS, Brar G, Jain S, Dhall K, et al. Cancer Incidence and Epidemiological Trends in Punjab: A Population-Based Registry Analysis for State-Level Health Policy. Cureus. 2025 Jul 5. doi:10.7759/cureus.87339