Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 51-57

Disparities in Cervical Cancer Diagnosis, Treatment, and Outcomes: A Comparative Study Between Rural and Urban Populations in Tamil Nadu, India

Dr. J. Indhumathi[1], Dr. S. Jeeva[2], Dr. R.M. Arulmozhi[3], Dr. K.C. Jyothish[4]

[1] Senior Assistant Professor, Department of Radiation Oncology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu.
[2] Professor, Department of Radiation Oncology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu.
[3] Senior Resident, Department of Radiation Oncology, Karur Medical College, Karur, Tamil Nadu.
[4] Assistant Professor, Department of Radiation Oncology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu

Corresponding Author

Dr. K.C. Jyothish

Assistant Professor, Department of Radiation Oncology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu

Article Received: 15-01-2025

Article Accepted: 17-02-2025

Abstract

Aims and Objectives: This study aims to evaluate the disparities in the presentation, diagnosis, treatment initiation, and outcomes of cervical cancer among rural and urban populations in Tamil Nadu, India. The study also examines the impact of socioeconomic factors, health-seeking behavior, and access to healthcare facilities on treatment completion and prognosis.

Materials and Methods: A comparative observational study was conducted among cervical cancer patients from an institutional palliative care center in a rural headquarters hospital and an urban tertiary cancer center. Demographic data, disease presentation, histopathology, treatment modality, and compliance were analyzed. Statistical significance was assessed using appropriate tests ($p < 0.05$ considered significant).

Results: Rural patients had a longer delay in diagnosis (7 months vs. 3 months, $p < 0.04$) and treatment initiation (6.3 vs. 3.5 months, $p < 0.04$). Fewer rural patients completed chemoradiation and brachytherapy (12 vs. 19, $p < 0.03$). Advanced-stage presentation and poorly differentiated histology were more common in rural patients. Hematologic toxicities and anemia were significant prognostic factors affecting compliance.

Conclusion: Significant rural-urban disparities exist in cervical cancer management, influenced by access to healthcare, socioeconomic status, and treatment compliance. Strengthening screening programs, early referrals, and optimizing treatment accessibility can improve outcomes for rural patients.

KEYWORDS: Cervical Cancer, Rural Health, Urban Health, Healthcare Disparities, Chemoradiation, Treatment Compliance.

INTRODUCTION

Cervical cancer remains a significant public health challenge worldwide, particularly in low- and middle-income countries, where it ranks as the second most common malignancy among womenwith an annual incidence of 6,62,301 cases worldwide and 3,48,874 deaths. India bears a considerable burden of this diseasewith age standardized incidence and mortality rates of 22 and 12.4 per 1,00,000 women per year [1]. Despite advancements in screening programs, vaccination initiatives, and therapeutic interventions, disparities persist in the clinical presentation, access to healthcare, treatment outcomes, and overall prognosis between patients residing in rural and urban settings [1].

Cervical carcinoma primarily arises from persistent infection with high-risk strains of human papillomavirus (HPV). The disease has a well-defined natural history, beginning with pre-malignant lesions that progress over several years before developing into invasive cancer. With appropriate screening measures such as

Papanicolaou (Pap) smear testing and HPV DNA testing, early detection is feasible, significantly improving treatment outcomes. However, in rural areas, the uptake of screening programs remains suboptimal, leading to delayed diagnoses and a higher proportion of advanced-stage presentations. In contrast, urban and semi-urban populations often benefit from greater awareness, access to preventive measures, and early medical intervention, leading to improved clinical outcomes [2].

The management of cervical cancer encompasses a multidisciplinary approach, including surgery, radiotherapy, chemotherapy, and, in select cases, immunotherapy. The choice of treatment is largely dictated by the disease stage at presentation, patient comorbidities, and resource availability. Rural patients frequently encounter logistical and financial challenges that hinder timely treatment initiation and completion. Many are required to travel long distances to tertiary care centers, leading to increased dropout rates and suboptimal adherence to treatment protocols. Urban patients, however, are more likely to receive standardized care with greater compliance to treatment guidelines, thereby impacting survival outcomes [3].

Prognostic factors in cervical cancer include tumor stage, lymph node involvement, histological subtype, treatment response, and patient-related variables such as nutritional status and immune competence. In rural populations, additional social determinants of health, including socioeconomic status, educational background, and cultural beliefs, play a critical role in influencing disease outcomes. Malnutrition, anemia, and other comorbid conditions are more prevalent in these populations, further complicating the prognosis. In contrast, urban patients, with better access to supportive care and adjuvant therapies, often demonstrate improved survival rates and quality of life post-treatment [4].

While global and national data provide a broad understanding of the disease burden, there is a paucity of studies that specifically compare rural and urban patient cohorts. Understanding these differences is crucial for developing targeted interventions aimed at reducing disparities in cancer care and optimizing patient outcomes.This retrospective study aims to bridge this knowledge gap by systematically analyzing and comparing the clinical presentation, treatment modalities, outcomes, and prognosis of cervical cancer patients from rural and urban/semi-urban backgrounds within Tamil Nadu, India.

The findings of this study hold significant implications for healthcare policymakers, oncologists, and public health experts. If substantial disparities are identified, targeted initiatives can be developed to strengthen rural cancer care services, improve accessibility to early screening, and enhance patient adherence to treatment regimens. Moreover, the study can inform future interventions such as mobile screening units, telemedicine-based follow-up, and community-based education programs tailored to rural populations.

MATERIALS AND METHODS

Study Setting: This retrospective analysis was conducted using medical records retrieved from the Barnard Institute of Radiation Oncology, Madras Medical College (MMC), and the Government Headquarters Hospital, Pennagaram, Dharmapuri Health Unit District (HUD). The study period spanned from 2020 to 2023. The study was designed to compare the clinical presentation, treatment modalities, and prognosis of cervical cancer patients from rural and urban/semi-urban settings in Tamil Nadu. The two institutions were selected to ensure a balanced representation of patients from both demographic backgrounds.

Study Participants: Patients diagnosed with carcinoma cervix and treated at MMC and HQGH during the study period were included. Inclusion criteria encompassed patients with histopathologically confirmed cervical cancer, complete medical records detailing demographic and clinical characteristics, and those who had received definitive treatment (radiotherapy, chemotherapy, or surgery). Exclusion criteria included patients with incomplete records, recurrent or metastatic disease at presentation, prior history of pelvic malignancies, or those lost to follow-up immediately after diagnosis.

Sample Size and Sampling Technique: A total of 60 patients were included in the study, with 30 patients from MMC representing the urban/semi-urban cohort and 30 from HQGH representing the rural cohort. A purposive sampling technique was employed to ensure equal representation from both healthcare centers.

Patients meeting the inclusion criteria were selected based on availability of complete records in the hospital database.

Study Tools: The primary data collection tool was a structured data extraction sheet developed to capture relevant patient and treatment characteristics from medical records. The parameters analyzed included demographic details (age, marital age, parity, age at first childbirth, history of screening, and socioeconomic status), tumor characteristics (histology, tumor grade, stage of disease, and duration of symptoms), and treatment details (radiotherapy access, treatment policies, radiotherapy dosage and modality, chemotherapy regimens, brachytherapy modality and dosage, toxicity profiles, and follow-up data).

Study Methodology: Medical records were systematically reviewed, and relevant patient information was documented in Microsoft Excel (version 2003). Data extraction was performed by trained personnel to ensure consistency and accuracy. The study focused on evaluating variations in patient characteristics, disease presentation, and treatment patterns between rural and urban cohorts.

Ethical Issues: Institutional ethical approval was obtained prior to data collection, ensuring compliance with ethical research guidelines. Since the study was retrospective in nature, informed consent from patients was not required; however, patient confidentiality was strictly maintained. All extracted data were anonymized and stored securely, accessible only to authorized research personnel.

Statistical Analysis: Statistical analyses were conducted using SPSS version 25. Paired t-tests were used to compare patient and treatment characteristics between rural and urban cohorts. Descriptive statistics such as mean, standard deviation, and frequency distributions were used for demographic and clinical variables. Categorical variables were analyzed using chi-square tests, and continuous variables were compared using independent t-tests. Statistical significance was set at $p < 0.05$.

RESULTS:

The median age of rural patients was 54 years (IQR: 48–60), significantly higher than the median age of urban patients, which was 45 years (IQR: 41–48, *p = 0.051*). Symptom duration was notably longer in rural patients, with a median of 6 months (IQR: 4.50–6.75) compared to 3.63 months (IQR: 2.50–5.25) in urban patients (*p = 0.042*), suggesting a delay in seeking medical attention in rural settings. Age at marriage and parity were comparable between the groups, with no statistically significant differences (*p = 0.542* and *p = 0.201*, respectively) (Table 1).

Table 1. Demographic and Clinical Characteristics of Patients.

Characteristic	Rural Median (IQR)	Urban Median (IQR)	P Value
Age (years)	54 (48-60)	45 (41-48)	0.051
Symptom Duration(months)	6 (4.50-6.75)	3.63 (2.50-5.25)	0.042
Age at Marriage	18.20 (16.45-20.54)	19 (16.90-21.25)	0.542
Parity	3 (2.50-3.50)	3 (2.25-3.75)	0.201

The predominant histological type in both rural and urban patients was squamous cell carcinoma (90% in rural, 96.7% in urban), with a smaller proportion diagnosed with adenocarcinoma. There was no significant difference in histology between the two groups (*p = 0.512*). However, tumor grade distribution varied significantly, with poorly differentiated tumors more common in rural patients (53.3% vs. 30% in urban), while moderately and well-differentiated tumors were more frequent in urban patients (*p = 0.041*). HIV prevalence was slightly higher in rural patients (3 cases vs. 1 case in urban), though the difference was not statistically significant (*p = 0.428*) (Table 2).

Regarding disease stage at presentation, rural patients were more frequently diagnosed with advanced-stage disease (e.g., 43.3% with stage III C1 vs. 36.7% in urban patients). Urban patients had a slightly higher

proportion of earlier-stage diagnoses. However, the overall stage distribution did not show a statistically significant difference (*p = 0.810*), likely reflecting delayed detection across both groups (Table 2).

Table 2. Tumor and Disease Characteristics.

Characteristic	Rural	Urban	P Value
Histology	Sq Cell Ca - 27, Adeno Ca - 3	Sq Cell Ca - 29, Adeno Ca - 1	0.512
Tumor Grade	Poorly Diff - 16, Mod Diff - 8, Well Diff - 6	Poorly Diff - 9, Mod Diff - 13, Well Diff – 8	0.041
STD (HIV Cases)	3	1	0.428
Disease Stage	III C1 - 13, IV A - 1, II A1 - 5, II A2 - 7, II B – 4	III C1 - 11, IV A - 2, II B - 9, II A1 - 7, IV B – 1	0.810

Significant disparities were observed in treatment-related factors. Tumor board policy adherence was higher in urban patients (100%) than in rural patients (70%), with a significant difference (*p = 0.041*). Most rural patients (80%) received treatment at government institutions, whereas all urban patients were treated in tertiary care centers (*p = 0.052*). Radiation techniques differed significantly, with more rural patients receiving conventional 2D radiotherapy (10%) compared to none in the urban group, where intensity-modulated radiation therapy (IMRT) was more common (*p = 0.045*). The completion rate of concurrent chemoradiotherapy (CCRT) and brachytherapy was significantly lower in rural patients (40%) than in urban patients (63.3%, *p = 0.031*), highlighting a treatment adherence gap. Default rates were higher among rural patients for chemotherapy (26.7% vs. 20%) and brachytherapy (23.3% vs. 10%), but these differences were not statistically significant (*p = 0.451*) (Table 3).

Toxicity profiles were comparable, with slightly higher incidences of hematological toxicity in rural patients (26.7% vs. 20%) and cystitis in urban patients (3.3% vs. 0%). However, these differences did not reach statistical significance (*p = 0.064*). The rate of progressive disease was significantly higher in rural patients (36.7%) than in urban patients (20%, *p = 0.032*), suggesting poorer treatment outcomes in the rural cohort (Table 3).

Table 3. Treatment Characteristics.

Characteristic	Rural	Urban	P Value
Tumor Board Policy	21	30	0.041
Institute Type	Govt - 24, Pvt - 6	30	0.052
Radiation Technique	2D - 3, 3DCRT - 27	3DCRT - 21, IMRT - 9	0.045
CCRT + Brachytherapy (Completed)	12	19	0.031
Defaulted Treatment	EBRT - 3, Chemo - 8, Brachy - 7	EBRT - 2, Chemo - 6, Brachy - 3	0.451
Toxicity	Dermatitis - 6, Hematological - 8, Cystitis – 0	Dermatitis - 7, Hematological - 6, Cystitis - 1	0.064
Progressive Disease	11	6	0.032

DISCUSSION

Cervical cancer remains a major public health challenge, particularly in low- and middle-income countries (LMICs), where population-based cancer registries are limited. Inadequate follow-up mechanisms and restricted access to healthcare facilities hinder accurate survival rate estimations and treatment outcome assessments.

Despite improvements in healthcare infrastructure, cervical cancer awareness remains suboptimal. A study from North India reported that 71% of urban and 63% of rural women lacked awareness of the disease [5]. Our findings indicate that both rural and urban populations had general knowledge about cancers, largely attributed to social networks and media exposure. Interestingly, rural women exhibited greater awareness of cervical cancer screening compared to their urban counterparts, possibly due to their reliance on primary healthcare centers (PHCs), where screening services are more accessible.

Cervical cancer predominantly affects women in the reproductive age group, with peak incidence in the third and fourth decades of life. In our study, rural women presented at a significantly older age (mean: 54 years) compared to urban women (mean: 45 years), suggesting delayed diagnosis in rural settings. Histologically, poorly differentiated tumors were more prevalent among rural patients [6]. Although rural patients presented with more advanced disease stages, the difference was not statistically significant. These findings emphasize the need for earlier detection and intervention strategies.

Comorbid conditions, such as HIV infection, can significantly affect cervical cancer prognosis. In our study, three rural and one urban patient were HIV-positive. Women living with HIV (WLWH) face a higher risk of persistent human papillomavirus (HPV) infection, which predisposes them to cervical cancer. National guidelines recommend routine viral load monitoring and antiretroviral therapy (ART) initiation regardless of CD4 count. However, access to viral load monitoring remains inadequate [7].

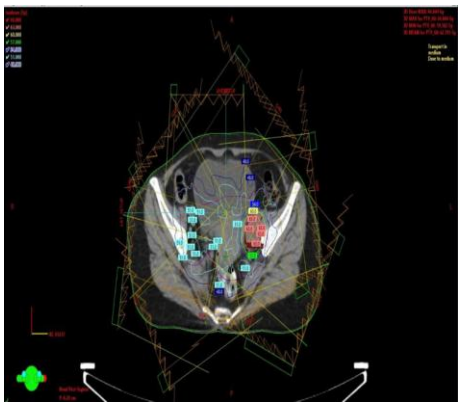

Fig .1.1 Isodose curves

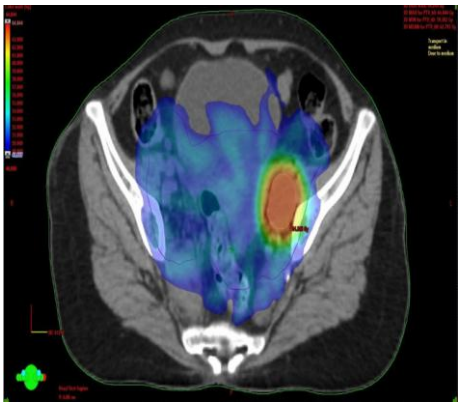

Fig 1.2: Dose colour wash

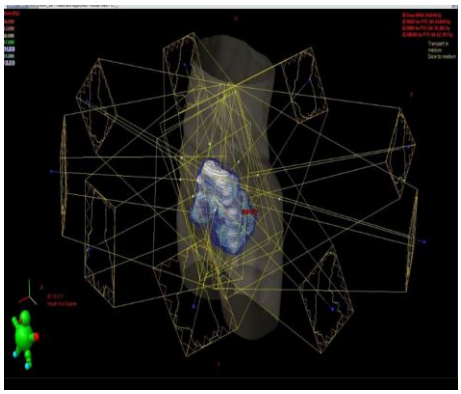

Fig 1.3: 9F IMRT external beam planning.

Fig 1.4: ca cervix IIIC1 contouring

Tumor board concurrence is crucial for cervical cancer management. All urban patients had documented tumor board decisions, whereas only 21 rural patients had such documentation, a statistically significant difference ($p<0.04$). Additionally, nine rural patients sought treatment in private hospitals due to accessibility issues, highlighting the need for decentralized cancer care facilities [8].

Regarding radiotherapy, significant disparities were observed in treatment modalities. Urban patients had access to advanced techniques such as intensity-modulated radiotherapy (IMRT) and simultaneous integrated boost (SIB) therapy, particularly those treated at the Barnard Institute of Radiation Oncology, MMC RGGGH Chennai. In contrast, rural patients predominantly received conventional cobalt-60 teletherapy, which lacks the precision of modern linear accelerators [9].

Treatment adherence significantly impacts cervical cancer prognosis. In our study, 19 urban patients completed concurrent chemoradiation therapy (CCRT) and brachytherapy compared to 12 rural patients ($p<0.03$). Rural patients also had a higher chemotherapy default rate (seven vs. three; $p<0.04$), primarily due to treatment-induced toxicities, including hematologic and renal complications. Neutropenia, lymphopenia, and thrombocytopenia were commonly observed, with anemia being a major determinant of treatment outcomes. Approximately 40-64% of cervical cancer patients present with anemia, which impairs radiotherapy efficacy due to tumor hypoxia. Rural patients had lower baseline hemoglobin levels (9.0 g/dL vs. 9.8 g/dL in urban patients), predisposing them to poor treatment outcomes [9].

Neutropenia is another critical prognostic factor in cervical cancer patients undergoing CCRT. Rural patients faced poorer outcomes due to limited availability of granulocyte colony-stimulating factors (G-CSF) and a lack of hematology consultations. The mortality rate associated with febrile neutropenia is reported to be as high as 30-50%, reinforcing the need for proactive management of hematologic toxicities in resource-limited settings. Prolonged treatment duration negatively affects progression-free survival (PFS) and overall survival (OS) in cervical cancer patients [8, 9].

CONCLUSION

This study highlights significant disparities in cervical cancer diagnosis, treatment, and outcomes between urban and rural populations. Rural patients experience greater delays in diagnosis and treatment initiation, higher non-compliance rates, and inferior access to advanced oncologic care. Addressing these disparities requires a multipronged approach including strengthening screening programs, enhancing treatment accessibility, improving awareness and health-seeking behavior, optimizing supportive care, andstreamlining treatment pathways.

REFERENCES

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, Jemal A. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2024 May-Jun;74(3):229-63. doi:10.3322/caac.21834.
2. Yu L, Sabatino SA, White MC. Rural-urban and racial/ethnic disparities in invasive cervical cancer incidence in the United States, 2010-2014. *Prev Chronic Dis.* 2019 Jun 6;16:E70. doi:10.5888/pcd16.180447.
3. Swaminathan R, Esmy PO, Selvakumaran R, Sampath P, Sankaranarayanan R. Assessment of registry-based surveillance statistics used for cancer control in the Dindigul District in South India. *J Registry Manag.* 2023 Spring;50(1):26-33.
4. Yadav R, Chauhan MB, Yadav C, Ranga S, Ahuja P, Tanwar M, Balhara N, Kadian L, Chauhan P, Tanwar N, Ahlawat C. Awareness data on cervical cancer among females of rural and urban areas of Haryana, India. *Data Brief.* 2024 Feb 7;53:110168. doi:10.1016/j.dib.2024.110168.
5. Chen X, Orom H, Hay JL, Waters EA, Schofield E, Li Y, Kiviniemi MT. Differences in rural and urban health information access and use. *J Rural Health.* 2019 Jun;35(3):405-17. doi:10.1111/jrh.12335.

6. Abraham AG, D'Souza G, Jing Y, Gange SJ, Sterling TR, Silverberg MJ, Saag MS, Rourke SB, Rachlis A, Napravnik S, Moore RD, Klein MB, Kitahata MM, Kirk GD, Hogg RS, Hessol NA, Goedert JJ, Gill MJ, Gebo KA, Eron JJ, Engels EA, Dubrow R, Crane HM, Brooks JT, Bosch RJ, Strickler HD; North American AIDS Cohort Collaboration on Research and Design of IeDEA. Invasive cervical cancer risk among HIV-infected women: a North American multicohort collaboration prospective study. *J Acquir Immune Defic Syndr.* 2013 Apr 1;62(4):405-13. doi:10.1097/QAI.0b013e31828177d7.
7. Jayatilakebanda I, Tsang YM, Hoskin P. High dose simultaneous integrated boost for node positive cervical cancer. *Radiat Oncol.* 2021;16(1):92. doi:10.1186/s13014-021-01818-1.
8. Frosch ZAK. Where have we been with rural-urban cancer care disparities and where are we headed? *JAMA Netw Open.* 2022 May 2;5(5):e2212255. doi:10.1001/jamanetworkopen.2022.12255.
9. Lin SM, Ku HY, Chang TC, Liu TW, Hong JH. The prognostic impact of overall treatment time on disease outcome in uterine cervical cancer patients treated primarily with concomitant chemo radiotherapy: a nationwide Taiwanese cohort study. *Oncotarget.* 2017 Jul 27; 8(49):85203-13. doi:10.18632/oncotarget.19617.