RESEARCH ARTICLE

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Intersecting Burdens: HIV Prevalence and Cervical Cancer Progression Among Women in the Eastern Cape, South Africa: A Retrospective Descriptive Study

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Abstract

Background: Cervical cancer remains a leading cause of cancer-related mortality in low- and middle-income countries, especially in sub-Saharan Africa, where the HIV epidemic further amplifies the disease burden. HIV-positive women are at greater risk for persistent HPV infection and accelerated cervical cancer progression. **Methods:** A cross-sectional analysis was conducted using secondary data from 606 women diagnosed with cervical cancer in the Eastern Cape, South Africa. Key variables included age, HIV status, antiretroviral therapy (ARV) usage, cancer stage, and referral modality. Descriptive statistics and multivariable regression analyses (STATA v16) were used to assess relationships between clinical and demographic variables. **Results:** HIV prevalence among cervical cancer patients was 60.23%. Most patients (68.48%) presented with stage III cancer, indicating delayed diagnosis. HIV-positive women were significantly older than their HIV-negative counterparts by 9.2 years on average ($\beta = 9.20$, $p < 0.001$). Age was positively associated with later cancer stages ($\beta = 1.91$, $p = 0.019$). ARV uptake was high (60.89%) and strongly predicted by HIV status ($\beta = 0.96$, $p < 0.001$). **Conclusion:** The findings emphasize a critical overlap between HIV and cervical cancer, particularly among older women. Despite robust ARV coverage, the high rate of late-stage presentation points to gaps in early detection and the integration of HIV and cancer services. Strengthening cervical cancer screening, especially for HIV-positive women, is essential to improving outcomes.

Keywords: Cervical cancer, HIV, Eastern Cape, cancer staging, antiretroviral therapy, integrated care, oncology

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Introduction

Cervical cancer remains a significant global public health concern, particularly in low- and middle-income countries (LMICs), which account for over 90% of cervical cancer-related deaths [1, 2]. Persistent infection with high-risk human papillomavirus (HPV) is the principal cause of cervical cancer, and immunosuppressed individuals especially women living with HIV face a markedly increased risk of HPV persistence and progression to malignancy. Globally, women living with HIV are six times more likely to develop cervical cancer compared to HIV-negative women [3, 4].

Worldwide, cervical cancer is the fourth most common cancer among women, with approximately 604,000 new cases and 342,000 deaths annually [1, 5]. Women with HIV constitute a disproportionately high-risk group; an estimated 5–10% of cervical cancer cases globally are attributable to HIV co-infection [3, 6].

In high-income countries such as the USA, Canada, Australia, and much of Europe, robust cervical cancer control strategies including widespread HPV vaccination, routine Pap testing, and early intervention have significantly reduced incidence and mortality [7–10]. However, women with HIV continue to experience disproportionate burdens, often due to fragmented care and lower screening coverage among marginalized groups [9, 11]. In Asia, cervical cancer screening remains inconsistent, with notable disparities in access for HIV-positive women, particularly in countries like India [12].

By contrast, sub-Saharan Africa bears the brunt of the global burden, with late-stage diagnoses and high HIV co-prevalence. South Africa, home to the world's largest HIV-positive population (>7.5 million), reports cervical cancer as the second most common cancer among women [13, 14]. The Eastern Cape Province, characterized by

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rural geography, poor infrastructure, and limited access to care, is a focal point of this dual epidemic. Despite national guidelines recommending annual or biennial Pap smears for HIV-positive women and three lifetime screenings for HIV-negative women, screening rates remain low, particularly in rural areas [14–16].

In South Africa, the implementation of cervical cancer screening programs faces significant challenges, particularly due to a shortage of trained healthcare personnel and high rates of loss to follow-up [15, 17]. These challenges are intensified by disparities between urban and rural healthcare access, high HIV prevalence, and limited public awareness, which contribute to women not returning for results or treatment after initial screening, thereby weakening the impact of early detection. These systemic gaps are especially evident in the Eastern Cape, where screening practices diverge from global guidelines recommended by the American Society of Clinical Oncology (ASCO) and the European Society for Medical Oncology (ESMO). These bodies advocate for evidence-based strategies such as HPV DNA testing as the primary screening method, integrated HIV-cancer care, timely colposcopy referrals, and multidisciplinary management of dysplasia approaches rarely implemented consistently in the province due to resource and training limitations [18–20]. Addressing these challenges requires innovative, context-specific solutions, including task-shifting to community health workers, mobile screening services, strengthened patient tracking systems, and culturally sensitive health education to improve screening uptake, follow-up, and continuity of care [21, 22].

Cervical cancer remains a major public health concern in the Eastern Cape Province, South Africa, where it is among the most prevalent HPV-associated malignancies affecting women [1, 23]. The region's high HIV prevalence significantly elevates the risk of persistent HPV infection and accelerates progression to invasive disease [1, 2, 4]. Studies in the Eastern Cape report HIV co-infection rates of approximately 60% among cervical cancer patients, often coupled with late-stage presentation that undermines treatment outcomes [2, 4, 14]. The immunosuppressive effects of HIV, together with inconsistent adherence to antiretroviral therapy, further exacerbate disease progression [4, 24]. Socioeconomic disparities, limited access to screening, and rural healthcare challenges contribute to delayed diagnosis and insufficient follow-up care [2, 3]. These factors underscore the urgent need for integrated HIV and cervical cancer prevention programs tailored to the province's resource-constrained context [1–4].

More broadly, cervical cancer imposes a disproportionate burden across low- and middle-income countries, particularly in sub-Saharan Africa, where gaps in vaccination, screening, and early treatment persist. WHO reports indicate uneven progress toward global cervical cancer elimination, with African countries facing persistent systemic barriers. In South Africa, which has the world's largest population of people living with HIV, co-infection dramatically increases risk of malignant progression and highlights the need for strengthened prevention and screening strategies. Recent evidence supports HPV-DNA–based screening and risk-stratified intervals for women living with HIV; however, rural provinces including the Eastern Cape face implementation challenges that limit population-level impact [1, 2, 4, 14].

The Eastern Cape exemplifies the systemic obstacles encountered nationally, including rural geography, shortages of trained healthcare providers, infrastructural limitations, and low follow-up rates. Evaluations of local screening programs reveal logistical barriers, fragmented integration of HIV and cervical cancer services, and weak patient tracking systems, contributing to late-stage presentation [2, 3, 15, 17]. Such constraints hinder adoption of global best practices recommended by ASCO, WHO, and related bodies, which include HPV DNA testing as the primary screening tool, intensified screening for women living with HIV, and coordinated referral pathways [18–20].

Given these challenges, region-specific research is essential to inform practical, context-appropriate policy interventions. Investigating the relationship between HIV prevalence and cervical cancer stage at diagnosis in the Eastern Cape provides insights into structural, operational, and community-level barriers that influence disease progression. Findings from such studies can guide the development of locally adapted screening programs, support patient-centered outreach strategies, and assist policymakers in aligning provincial practices with global evidence-based guidelines, ultimately improving outcomes for high-risk women [1–4, 18–20].

The Eastern Cape exemplifies challenges faced by under-resourced health systems managing co-morbid chronic diseases like HIV and cervical cancer. While policy exists nationally, provincial-level adaptation and implementation remain inconsistent and under-monitored. Given the significant proportion of HIV-positive women presenting with late-stage cervical cancer, urgent investigation into structural, operational, and community-level barriers is needed. Aligning provincial practice with global standards, such as ASCO and ESMO guidelines, could substantially improve outcomes for at-risk women. This study was conducted to examine the relationship between HIV prevalence and cervical cancer progression among women in the Eastern Cape, South Africa, by identifying key clinical and system-level factors contributing to late-stage diagnosis, to inform integrated care strategies and improve patient outcomes.

Materials and Methods

This study utilized a cross-sectional retrospective design, analysing data from 606 women diagnosed with cervical cancer registered in the UCT/SAMRC GYNAE-CANCER RESEARCH GROUP database, which is a hospital-based registry situated in Nelson Mandela Academic Hospital in Mthatha, Eastern Cape [1, 2]. Key variables collected included age, HIV status, antiretroviral (ARV) therapy usage, cancer stage at diagnosis, and referral modality [2, 23]. Data were extracted from the medical records of patients attending public health hospitals within the Eastern Cape province [14]. Descriptive statistics were employed to summarize

patient demographics and clinical characteristics. Logistic regression analysis was performed using STATA version 18 to identify associations between HIV status and cervical cancer presentation, controlling for relevant covariates [2, 4]. The study was conducted in collaboration with the Walter Sisulu University Faculty of Health Sciences as a secondary data analysis, with a waiver of informed consent. It was supported by the Eastern Cape Provincial Department of Health [1].

Data Analysis and Management

Data were securely extracted from hospital records and the provincial cancer registry, anonymized, and entered into a password-protected database [14, 23]. Descriptive analyses characterized the study population, while multivariable logistic regression models examined predictors of advanced cancer stage at diagnosis, with a focus on HIV status and ARV use [2]. Data management adhered to strict confidentiality protocols as mandated by institutional policies and national health regulations [1]. Missing data were addressed through sensitivity analyses to ensure robustness of findings [4].

Ethical Considerations

Ethical approval was granted by the Walter Sisulu University Faculty of Health Sciences Research Ethics Committee (Reference number: 001/2021) and the Eastern Cape Provincial Department of Health Ethics Review Board [2]. Given the retrospective nature of the study and use of de-identified secondary data, a waiver of informed consent was obtained in line with ethical guidelines [1, 4]. Data confidentiality and participant anonymity were strictly maintained throughout the study per the Declaration of Helsinki and local regulatory requirements [1].

Table 1. Clinical and Treatment Characteristics of Cervical Cancer Patients in Eastern Cape (N = 606)

Variable	Category	Frequency (n)	Percent (%)
Age Category	25–34 years	35	5.78
	35–44 years	154	25.41
	45–54 years	89	14.69
	55+ years	328	54.13
HIV Status	Positive	365	60.23
	Negative	180	29.70
	Unknown	61	10.07
ARV Status	On ARVs	369	60.89
	Not on ARVs	176	29.04
	Unknown	61	10.07
Cancer Stage	Stage 0–1	9	1.49
	Stage 2	122	20.13
	Stage 3	415	68.48
	Stage 4–6	54	8.91
Type of Therapy	Radiotherapy (RT) only	508	83.83
	Chemotherapy only	60	9.90
	Surgery + RT/CT/Hormone	11	1.82
	Hormone Therapy (HRT) only	3	0.50
	RT + HRT	2	0.33
	Supportive Care only	2	0.33
	Surgery only	2	0.33
	Total Patients	606	100

Results

Descriptive Characteristics of the Study Population

The study included 606 women with histologically confirmed cervical cancer. Over half (54.13%) were aged 55 and above, while 25.41% were aged 35–44. HIV prevalence was 60.23%, with 60.89% of all participants on ARV therapy. Notably, 68.48% of patients presented at stage 3 of cancer, indicating late detection. Radiotherapy was the primary treatment modality for 83.83% of patients. Table 1 provides clinical and Treatment Characteristics of Cervical Cancer Patients in the Eastern Cape

Regression Analysis

Regression models examined the relationship between patient characteristics and HIV status, age, and cancer stage. The analysis revealed that HIV-positive women were significantly older than their HIV-negative counterparts ($\beta = 9.1993$, $p < 0.001$). Older age was also significantly associated with advanced cancer stage ($\beta = 1.9118$, $p = 0.019$). ARV usage was strongly linked to HIV status ($\beta = 0.9636$, $p < 0.001$), while referral modality showed a borderline association with age ($\beta = 0.1424$, $p = 0.076$). Table 2 provides a regression Analysis of Factors Associated with HIV Status and Cervical Cancer Stage.

Discussion

This study revealed a high prevalence of HIV (60.23%) among women diagnosed with cervical cancer in Eastern Cape, South Africa, with the majority presenting at stage 3 (68.48%) [1, 2]. HIV-positive patients were, on average, 9.2 years older than their HIV-negative counterparts, and older age was associated with more advanced cancer stages [2, 4]. Despite relatively high ARV coverage (60.89%), late-stage presentation remained prevalent, highlighting significant delays in early detection and integrated care delivery [4].

In contrast to high-income countries such as the United States, Canada, Australia, and parts of Europe where cervical cancer incidence has dramatically declined due to effective HPV vaccination, routine Pap smears, and timely intervention [7–10] the Eastern Cape continues

Table 2. Regression Analysis of Factors Associated with HIV Status and Cervical Cancer Stage

Variable	Coefficient (β)	Std. Error	p value	95% CI
Referral Modality	0.1424	0.08	0.076	[-0.0148, 0.2995]
HIV Status	9.1993	0.7511	<0.001	[7.7241, 10.6744]
Cancer Stage	1.9118	0.8123	0.019	[0.3164, 3.5071]
Age	0.0017	0.0005	<0.001	[0.0008, 0.0025]
ARV Status	0.9636	0.0094	<0.001	[0.9452, 0.9820]

to experience delayed diagnosis and limited screening coverage [14, 23]. In these countries, targeted outreach to HIV-positive populations and implementation of HPV DNA testing have improved early detection, whereas the Eastern Cape still relies primarily on opportunistic cytology-based screening, often initiated at symptomatic stages [14, 18].

Furthermore, while ASCO and ESMO advocate for integrated cervical cancer and HIV management, including immediate colposcopy after positive HPV DNA results [18–20], such practices remain inconsistently implemented in rural provinces like the Eastern Cape due to resource limitations, workforce shortages, and systemic fragmentation [14, 22]. Cervical cancer trends in the Eastern Cape align closely with patterns observed across sub-Saharan Africa, where late-stage presentation is common, and HIV prevalence among cancer patients is disproportionately high [2, 9, 15]. For example, countries such as Zambia, Malawi, and Zimbabwe report similarly high co-infection rates and inadequate screening infrastructure [9, 15]. In contrast, some North African countries (e.g., Tunisia, Morocco) have made modest gains in HPV vaccination and screening coverage through donor-supported public health programs [13].

In Asia, particularly in India and parts of Southeast Asia, disparities remain in cervical cancer screening, though some countries have introduced pilot HPV DNA testing programs [6, 12]. However, few regions show the compounded dual burden of HIV and cervical cancer observed in Southern Africa [2, 9].

This study contributes significantly to the global and African understanding of the intersection between HIV and cervical cancer by providing real-world clinical insights from a high-burden region [1, 2]. Drawing on a large, regionally representative sample of 606 women treated at public hospitals in the Eastern Cape, South Africa, it highlights patterns of late-stage cervical cancer presentation in a setting where HIV prevalence is among the highest globally [1, 4]. The use of routine clinical data offers practical relevance, capturing the realities of public sector service delivery, which is often underrepresented in international research [1, 2]. By employing multivariable regression analysis, the study also controls for key confounders such as age and referral pathways, enhancing the robustness of its findings [2].

Within the African and South African context, the study's strength lies in its regional specificity and potential to inform targeted interventions in similar resource-limited settings [1, 4, 14]. Its findings provide a foundation for policy and clinical practice improvements, especially concerning the integration of HIV and oncology services [18, 22]. However, limitations inherent to its cross-sectional design restrict the ability to draw causal conclusions or establish temporal relationships between HIV status and cervical cancer progression [4]. Additionally, reliance on secondary data introduces risks of incomplete or inconsistent clinical documentation, which may affect staging accuracy and treatment records [2].

Approximately 10% of participants had unknown HIV or antiretroviral therapy (ARV) status, limiting the completeness of some analyses and potentially underestimating the impact of HIV on cancer progression [2]. Despite these limitations, the study addresses a critical gap in the literature and contributes valuable evidence to the growing body of research advocating for integrated, equity-focused cervical cancer care models in high HIV-prevalence settings across the Global South [1, 4].

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In addition to highlighting the high burden of HIV co-infection and late-stage cervical cancer in the Eastern Cape, the discussion has been expanded to emphasize context-specific policy recommendations tailored to rural health systems. The province's rural geography, workforce shortages, and fragmented healthcare infrastructure create barriers to timely screening and follow-up. Integrating cervical cancer screening into existing HIV care platforms, utilizing task-shifting with community health workers, and implementing mobile outreach programs could improve early detection, reduce loss to follow-up, and optimize resource use. These strategies align with WHO, ASCO, and ESMO guidelines advocating for coordinated, risk-based cervical cancer prevention and management [14, 18–20, 22].

While ARV uptake was high among study participants, measuring adherence would provide additional insight into

its influence on cervical cancer progression. Suboptimal adherence can exacerbate immunosuppression, increasing susceptibility to persistent HPV infection and accelerating progression to invasive disease. Although the current dataset did not capture adherence, we have discussed its potential implications and highlighted the importance of longitudinal monitoring in future studies to more accurately assess protective effects of effective ARV therapy [4, 24]. Similarly, HPV vaccination status an essential preventive measure was not available in the dataset, but its inclusion in future research would allow risk stratification and more targeted interventions, particularly among HIV-positive women at elevated risk for persistent HPV infection [1, 18–20].

Finally, the regression analyses, while methodologically standard, provide robust, region-specific evidence of associations between HIV status, age, referral pathways, and cervical cancer stage in a high HIV-prevalence, resource-limited context. Although these analyses do not introduce novel statistical frameworks, their value lies in capturing real-world patterns and informing operational strategies for integrated HIV–cancer care. By contextualizing these findings within provincial challenges, they support improvements in policy and clinical practice aimed at reducing late-stage presentation and improving outcomes for high-risk women in the Eastern Cape and comparable settings across sub-Saharan Africa [2, 4, 14].

Strengths

This study offers several notable strengths. First, it utilizes a large, regionally representative sample of 606 women from the Eastern Cape, providing valuable insights into cervical cancer staging and HIV co-burden in a high-prevalence, resource-limited setting [1, 2, 4]. Second, the use of routine clinical and registry data ensures real-world relevance, capturing the realities of public sector service delivery that are often underrepresented in research [2, 15]. Third, multivariable regression analyses allowed for adjustment of key confounders such as age and referral pathways, enhancing the validity of the observed associations between HIV status and advanced cervical cancer presentation [2]. Finally, the study contextualizes findings within local healthcare infrastructure and aligns them with international guidelines from WHO, ASCO, and ESMO, strengthening the translational relevance for policy and clinical practice [18–20, 22].

Limitations

Several limitations should be acknowledged. The cross-sectional design precludes causal inference, limiting conclusions about the temporal relationship between HIV infection, ARV use, and cervical cancer progression [2, 4]. Approximately 10% of participants had unknown HIV or ARV status, which may introduce bias and underestimation of the impact of HIV on disease severity [2]. Key variables, including ARV adherence and HPV vaccination status, were not captured, reducing the ability to evaluate their protective effects or inform targeted prevention strategies [1, 4, 18–20]. Additionally, reliance on secondary data may result in incomplete or inconsistent clinical documentation, affecting staging accuracy and the reliability of follow-up information [2]. Finally, findings from the Eastern Cape, with its unique rural and resource-limited context, may not be fully generalizable to other South African provinces or LMICs with different healthcare infrastructure and population dynamics [14].

Clinical Implications

Despite these limitations, the study has important clinical and public health implications. It underscores the urgent need for integrated HIV–cervical cancer care models, particularly in rural and resource-constrained settings, where delayed diagnosis remains prevalent [1, 14, 22]. Embedding cervical cancer screening into routine HIV care, leveraging community health workers, and adopting mobile outreach strategies could improve early detection and reduce loss to follow-up [18–20]. Monitoring ARV adherence and incorporating HPV vaccination tracking into routine care may allow for risk stratification and targeted interventions among the most vulnerable populations [4, 18, 23-24]. The findings also provide evidence to guide provincial and national policymakers in aligning local practice with global standards, ultimately aiming to reduce late-stage presentation and improve survival outcomes for high-risk women in the Eastern Cape and similar sub-Saharan African contexts [1, 2, 14, 22].

In conclusion, the study confirms a critical intersection between HIV infection and late-stage cervical cancer presentation in the Eastern Cape. HIV-positive women, despite relatively high ARV coverage, face significant delays in cervical cancer diagnosis, possibly due to poor screening access, inadequate integration of HIV and oncology services, and systemic weaknesses in care coordination. Addressing these gaps will require provincial adaptation of global oncology guidelines, scaling up HPV DNA testing, and intensifying community-level outreach, especially for older women. Integrating cervical cancer screening into HIV care platforms could represent a practical and impactful intervention.

Author Contribution Statement

MJP conceived and designed the study, coordinated data collection, performed data analysis and interpretation, and drafted the manuscript. NG contributed to study design, clinical data acquisition, and critical revision of the manuscript. ZJ and NN were involved in data collection, patient record review, and manuscript editing. CB contributed to statistical analysis, data interpretation, and critical manuscript review. DA provided pathology and laboratory data interpretation, contributed to methodological rigor, and critically reviewed the manuscript for important intellectual content.

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Ethical Approval and Consent to Participate

Ethical approval was granted by the Walter Sisulu University Faculty of Health Sciences Research Ethics Committee and the Eastern Cape Provincial Department of Health Ethics Review Board. Given the retrospective nature of the study and the use of de-identified secondary data, a waiver of informed consent was obtained following institutional and national ethical guidelines.

Availability of Data and Materials

The data that support the findings of this study are available from the Eastern Cape Department of Health, but restrictions apply to their availability. Data are available from the corresponding author upon reasonable request and with permission from the provincial authority.

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Competing Interests

The authors declare that they have no competing interests.

List of Abbreviations

Abbreviation Meaning
HIV: Human Immunodeficiency Virus
HPV: Human Papillomavirus
ARV: Antiretroviral Therapy
ASCO: American Society of Clinical Oncology
ESMO: European Society for Medical Oncology
RT: Radiotherapy
CT: Chemotherapy
HRT: Hormone Replacement Therapy
LMICs: Low- and Middle-Income Countries
WHO: World Health Organization

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