ORIGINAL RESEARCH ARTICLE

Diagnostic accuracy of visual inspection with acetic acid versus Papanicolaou smear in cervical cancer screening among HIV-positive women in rural Nigeria

DOI: 10.29063/ajrh2026/v30i11.3

Akhere E. Oshodin[1], Eustace E. Ehikioya[2], Okelue E. Okobi[3], Anthonia I. Njoku[4], Felix O. Okogbo[4], Stella Ehi Egege[4], Olamma A. Dike[5], Ifunanya C. Modebelu[6] and Omowunmi Adewara[7]*

Obstetrics and Gynaecology Department, Edo specialist hospital, Benin City, Nigeria[1]; Obstetrics and Gynaecology Department, Irrua Specialist Teaching Hospital, Irrua, Nigeria[2]; Larkin Community Hospital, Miami, Department of Family Medicine, Florida, USA[3]; International University of the Health Sciences, Calgary, Canada[4]; Department of Family Medicine, Abia State University Teaching Hospital, Abia, Nigeria[5]; University of Nigeria Teaching Hospital, Nsukka, Nigeria[6]; Obstetrics and Gynaecology, Newham University Hospital, London, United Kingdom[7]

[*]**For Correspondence:** Email: *drokelue.e.okobi@gmail.com;* Phone: +1 (240) 360-8444

Abstract

Cervical cancer remains a significant reproductive and public health concern, particularly among women living with Human Immunodeficiency Virus (HIV) in low-resource settings like Irrua community in Edo State Nigeria. This study aimed to compare the sensitivity and specificity of visual inspection with acetic acid (VIA) and the Papanicolaou smear (Pap smear) as screening methods for premalignant and malignant cervical lesions in HIV-positive women. A comparative cross-sectional design was employed, involving 136 HIV-positive women who met the inclusion criteria. Suspicious or well-defined aceto-white areas observed during VIA were biopsied and subjected to histopathological examination. The sensitivity of VIA was higher than that of the Pap smear (94.1% vs. 73.5%), whereas its specificity was lower (25% vs. 79.5%). When both methods were combined, the screening performance improved, yielding higher sensitivity, specificity, positive predictive value, and negative predictive value (92.3%, 87.5%, 92.3%, and 87.5%, respectively) than either test alone. These findings indicate that VIA demonstrates higher sensitivity than the Pap smear, while using both methods in combination enhances overall diagnostic accuracy. We recommend that VIA can therefore serve as an effective complementary screening tool to the Pap smear for the early detection of cervical cancer, particularly in resource-constrained healthcare settings. Keywords: Cervical cancer, HIV-positive women, Pap smear, Visual Inspection with Acetic Acid (VIA), Screening methods, Sensitivity and specificity, Low-resource settings, Premalignant lesions, Histopathology, Comparative cross-sectional study. *(Afr J Reprod Health 2026; 30 [11]: 28-37).*

Keywords: Cervical Cancer, acetic-acid, Hiv-positive, Papanicolaou smear (Pap smear),rural women

Résumé

Le cancer du col de l'utérus demeure un problème majeur de santé reproductive et publique, en particulier chez les femmes vivant avec le VIH dans des contextes à faibles ressources comme la communauté d'Irrua, dans l'État d'Edo, au Nigéria. Cette étude visait à comparer la sensibilité et la spécificité de l'inspection visuelle à l'acide acétique (IVA) et du test de Papanicolaou (frottis cervico-vaginal) comme méthodes de dépistage des lésions cervicales précancéreuses et cancéreuses chez les femmes séropositives. Une étude transversale comparative a été menée auprès de 136 femmes séropositives répondant aux critères d'inclusion. Les zones blanchâtres suspectes ou bien délimitées observées lors de l'IVA ont fait l'objet d'une biopsie et d'un examen histopathologique. La sensibilité de l'IVA était supérieure à celle du frottis cervico-vaginal (94,1 % contre 73,5 %), tandis que sa spécificité était inférieure (25 % contre 79,5 %). L'association des deux méthodes a permis d'améliorer les performances du dépistage, avec une sensibilité, une spécificité, une valeur prédictive positive et une valeur prédictive négative supérieures (respectivement 92,3 %, 87,5 %, 92,3 % et 87,5 %) à celles obtenues avec chaque test pris isolément. Ces résultats indiquent que l'IVA présente une sensibilité plus élevée que le frottis cervico-vaginal, tandis que l'utilisation combinée des deux méthodes améliore la précision diagnostique globale. Nous recommandons donc l'IVA comme outil de dépistage complémentaire efficace au frottis cervico-vaginal pour la détection précoce du cancer du col de l'utérus, notamment dans les contextes de soins de santé aux ressources limitées. Mots-clés : Cancer du col de l'utérus, femmes séropositives, frottis cervico-vaginal, inspection visuelle à l'acide acétique (IVA), méthodes de dépistage, sensibilité et spécificité, contextes à faibles ressources, lésions précancéreuses, histopathologie, étude transversale comparative..*(Afr J Reprod Health 2026; 30 [11]: 28-37).*

Mots-clés : Cancer du col de l'utérus, acide acétique, VIH positif, frottis de Papanicolaou (test Pap), femmes rurale

Introduction

Cervical cancer is a major public health concern and remains a leading cause of cancer-related deaths among women in developing countries, including Nigeria. It is the fourth most common cancer affecting women globally, with the vast majority of cases occurring in low- and middle-income countries.[1–3] Approximately 83% of the 530,000 to 604,000 new cases diagnosed annually occur in developing nations, with Nigeria contributing about 10% of the global burden. Between 270,000 and 342,000 women die of cervical cancer each year, and 85% of these deaths occur in resource-limited regions.[3–4] Even in industrialized countries where organized screening programs have led to significant reductions in incidence, mortality remains substantial in areas with poor access to healthcare, screening, and early treatment.[3–7]

The impact of cervical cancer is further compounded by the high prevalence of HIV/AIDS among women in sub-Saharan Africa. Women living with HIV are approximately six times more likely to develop cervical cancer than their HIV-negative counterparts.[8] The immunosuppression associated with HIV increases susceptibility to persistent infection with oncogenic strains of Human Papillomavirus (HPV), thereby accelerating the progression from precancerous lesions to invasive cancer. Both conditions often coexist within the same vulnerable populations, where poverty and limited health literacy exacerbate disease outcomes.[8–10] Moreover, the course of cervical cancer tends to be more aggressive and less responsive to treatment among HIV-infected women.

Cervical cancer has a well-recognized premalignant phase lasting 10–20 years, during which screening and appropriate management can prevent disease progression.[11] Early detection of these premalignant changes therefore offers a crucial opportunity for effective intervention.[12]

The introduction of the Papanicolaou smear (Pap smear) by George Papanicolaou and Aurel Babeș in the 1940s revolutionized cervical cancer prevention, enabling early diagnosis and reducing morbidity and mortality, particularly in developed nations where screening coverage exceeds 80%.[11] However, unlike developed countries, most developing nations struggle to implement effective screening programs. Barriers such as weak health infrastructure, limited laboratory capacity, low screening coverage (<5%), insufficient skilled personnel, weak political commitment, poverty, and lack of public awareness limit screening effectiveness.[11]

A 2019 World Health Organization (WHO) survey reported that, although 65% of 194 member countries had national cervical cancer screening programs, most achieved only 10–50% population coverage due to limited infrastructure and resources.[11] These constraints underscore the need for inexpensive, readily available, and effective screening alternatives suitable for low-resource environments.[2]

Visual Inspection with Acetic Acid (VIA) has been recommended by the WHO as a practical, low-cost, and feasible alternative to cytology and colposcopy for cervical cancer screening, particularly in resource-constrained settings.[3,6,13] VIA requires minimal equipment and training yet provides immediate results, allowing for a "screen-and-treat" approach that improves follow-up rates. Studies conducted in Nigeria and other low-resource countries have demonstrated that VIA achieves diagnostic accuracy comparable to Pap smear in identifying premalignant lesions among women, including those living with HIV.[13–15] This makes VIA a valuable primary or complementary screening tool in resource-limited healthcare contexts, especially where cytological services are unavailable or unsustainable.[13,14]

It is therefore imperative to assess the performance of VIA as a screening method within local populations of HIV-positive women, in order to determine its validity, feasibility, and potential for integration into broader cervical cancer prevention programs in Nigeria and similar settings.

Aim and objectives

This study aims to compare the diagnostic performance of Visual Inspection with Acetic Acid (VIA) and the Papanicolaou (Pap) smear in detecting preinvasive cervical lesions among HIV-positive women in a low-resource setting in Nigeria.

Specifically, it seeks to determine and compare the sensitivity, specificity, positive predictive value, and negative predictive value of both screening methods, individually and in combination, using histopathology as the gold standard.Although the diagnostic accuracy of VIA and Pap smear has been well established globally, limited evidence exists on their comparative performance among HIV-positive women in sub-Saharan Africa. HIV-related immunosuppression may alter the cytological characteristics and visibility of cervical lesions, potentially influencing test sensitivity and specificity. Moreover, structural barriers such as inadequate laboratory facilities, shortage of skilled personnel, and poor follow-up rates often limit the effectiveness of cytology-based screening in low-resource environments.

This study provides locally relevant data on the diagnostic accuracy and feasibility of VIA relative to the Pap smear among high-risk women, thereby contributing to evidence-based strategies for sustainable cervical cancer prevention in resource-limited, high-HIV-prevalence settings.

Methods

Study area

The study was conducted at the Irrua Specialist Teaching Hospital (ISTH), Edo State, Nigeria. ISTH is a federal tertiary referral center located in Irrua, the administrative headquarters of Esan Central Local Government Area, approximately 90 kilometers north-east of Benin City. The hospital serves as a major referral institution for Edo and neighboring states in southern Nigeria. It offers a wide range of specialist services, including obstetrics and gynecology, internal medicine, family medicine, pathology, and laboratory sciences. The hospital runs an established HIV care and treatment clinic under the Department of Internal Medicine, which provides comprehensive care to over 1,000 clients. On average, about 45 women are seen weekly in the HIV clinic, providing an ideal setting to access HIV-positive women for this study.

Study design

This was a comparative cross-sectional study designed to evaluate and compare the diagnostic performance of Visual Inspection with Acetic Acid (VIA) and the Papanicolaou (Pap) smear in detecting preinvasive and invasive cervical cancer among HIV-positive women.

Study population

Participants were HIV-positive women aged 25–65 years who attended the gynecology, family planning, postnatal, HIV, and other specialist clinics at ISTH during the study period and met the inclusion criteria. Recruitment occurred after obtaining informed written consent from eligible participants.

Inclusion and exclusion criteria

Women were included if they were HIV-positive, aged between 25 and 65 years, not pregnant, and more than six weeks postpartum, with a fully visible transformation zone. Excluded were women with visible cervical masses or lesions, current pregnancy or less than six weeks postpartum, a history of total hysterectomy, or an obscured transformation zone on examination.

Sample size

The formula for calculating the minimum sample size when comparing proportions between two independent populations or groups was employed in the determination of the sample size per group in this study.

Sample size per VIA or Pap smear screening method.

$n = 2\,\acute{p}\,(1 - \acute{p})\,(Z_{\alpha/2} + Z_{\beta})^2 / (p_1 - p_2)^2$ [14, 15, 16]

n= the smallest sample size required for each screening method.

p_1= proportion of VIA users

p_2= proportion of Pap smear users

$\acute{p} = (p_1 + p_2)/2$

$Z_{\alpha/2}$ = standard normal deviate corresponding to confidence level. At a confidence level of 95%, where α is set at 0.05, $Z_{\alpha/2}=1.96$

Z_{β}= standard normal deviate corresponding to (1-power). At a power of 80%, $Z_{\beta}=0.84$ in this case, p_1= proportion (within 10% of error margin) in the use of VIA = 69.6% [17]

p_2 = proportion (within 10% of error margin) in the use of Pap smear = 52.5% [17]
$\acute{p} = (p_1 + p_2)/2 = (0.696+0.525)/2 = 0.6105$
Therefore,
$n = 2 \times 0.6105\ (1–0.6105)\ (1.96+0.84)^2 / (0.696–0.525)^2 = 127$.
An additional 7.5% will be added to account for possible attrition, and this would amount to 127+9=136.
Thus, a minimum sample size of one hundred and thirty-six participants was used for the study and screened sequentially with VIA and Pap smear for pre-malignant cervical lesions and cervical cancer to make a meaningful conclusion.

Sampling technique

Participants were selected using simple random sampling from HIV-positive women attending the ISTH HIV clinic. Recruitment occurred over three months, with approximately 12 participants enrolled weekly until the target sample size was achieved. A randomized computer-generated list was used weekly to select participants, ensuring unbiased inclusion.

Sample collection

All procedures were performed by the principal investigator, assisted by a trained female nurse-midwife. To minimize bias, Pap smear cytology and VIA interpretation were performed independently, and laboratory scientists analyzing Pap smears were blinded to the VIA findings and vice versa. The pathologists evaluating histopathology specimens were also blinded to both Pap and VIA results.
Participants were placed in the lithotomy position under adequate lighting. The vulva was examined for ulcers, warts, or infection. A sterile, disposable bivalve speculum was then inserted for visualization of the cervix.

Papanicolaou (Pap) smear procedure

Using an Ayre's spatula, the ectocervix and transformation zone were gently scraped circumferentially. The cellular material was smeared onto a clean glass slide, immediately fixed in 95% ethanol, and sent to the ISTH Department of Anatomic Pathology for cytological assessment. Smears were classified according to the 2014 Bethesda System as:
1.Negative for intraepithelial lesion or malignancy (NILM)
2.Atypical squamous cells of undetermined significance (ASC-US)
3.Low-grade squamous intraepithelial lesion (LSIL)
4.High-grade squamous intraepithelial lesion (HSIL)
5.Malignant cells
Results showing LSIL, HSIL, or malignant cells were recorded as positive.

Visual inspection with acetic acid (VIA) procedure

Immediately after taking the Pap smear, the cervix was painted with cotton wool soaked in 5% acetic acid and examined one minute later under bright illumination. A VIA-positive result was defined as the presence of distinct, well-demarcated, dense aceto-white areas with or without raised margins in or close to the transformation zone. The absence of aceto-white change was recorded as VIA-negative. Suspicious aceto-white lesions were biopsied under colposcopic guidance. Women with positive Pap smear results were recalled for colposcopy-directed biopsy. When colposcopy findings were normal, but Pap smear abnormal, repeat cytology was scheduled as per standard protocol.

Colposcopy and histopathology

During colposcopy, the cervix was first cleaned with 0.9% normal saline. Surface and vascular patterns were examined, using a green filter to visualize abnormal vessels. After applying 5% acetic acid, abnormal findings such as dense aceto-white epithelium, coarse punctuation, mosaic patterns, or atypical vessels were considered suggestive of cervical intraepithelial neoplasia (CIN). Guided punch biopsies were taken from abnormal areas and preserved in 10% formalin for histopathological analysis.
The histopathological diagnoses were classified as:
1.CIN 1 (mild dysplasia / LSIL)
2.CIN 2–3 (moderate to severe dysplasia / HSIL)

3.Squamous cell carcinoma

Biopsy results served as the gold standard for evaluating test performance. Patients diagnosed with preinvasive or invasive lesions were counseled and referred to the gynecology clinic for continuation of care.

Statistical analysis

Data were analyzed using SPSS version 27 and WinPepi statistical software. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of Pap smear and VIA were calculated, using biopsy-confirmed histopathology as the reference. Differences in diagnostic accuracy between the two methods were assessed using the Chi-square test, with statistical significance set at $p < 0.05$.

Ethical considerations

Ethical approval for this study was granted by the Ethics and Research Committee of Ambrose Alli University, Ekpoma, Edo State, Nigeria (Approval No. NHREC/12/06/2013; renewed from 26 May 2024 to 25 May 2025). Written informed consent was obtained from all participants prior to enrollment. Each participant was informed of the purpose, procedures, potential benefits, and minimal risks of the study and assured of the right to withdraw at any stage without any negative consequence to their ongoing medical care.

All research activities were conducted in strict adherence to the ethical principles governing research involving human participants—respect for persons, beneficence, non-maleficence, and justice—as articulated in the Declaration of Helsinki and consistent with the National Health Research Ethics Code of Nigeria.[18-19]

Participant confidentiality and data security were ensured through anonymization of all records and restricted access to identifiable information. Individual results were shared privately with each participant. Those diagnosed with premalignant or malignant cervical lesions were referred promptly to the gynecology clinic of Irrua Specialist Teaching Hospital for appropriate management, counseling, and follow-up in line with institutional treatment protocols.

Results

During the three-month study period, 136 HIV-positive women were screened sequentially with a Pap smear and Visual Inspection with Acetic Acid (VIA). Participants with positive VIA findings received appropriate treatment and follow-up; The correlation between histopathological findings and screening test results is presented in Table 3.

Table 1: Pap smear results (n = 136)

Result	Frequency (n)	Percentage (%)
Unsatisfactory	20	14.7
Negative for intraepithelial lesion or malignancy (NILM)	43	31.6
Chronic cervicitis / NILM	32	23.5
ASC-US	7	5.2
Subtotal Negative	82	60.3
Low-grade squamous intraepithelial lesion (LSIL)	11	8.1
High-grade squamous intraepithelial lesion (HSIL)	17	12.5
Squamous cell carcinoma (SCC)	6	4.4
Subtotal Positive	34	25.0
Total	136	100

ASC-US: Atypical squamous cells of undetermined significance; LSIL: Low-grade squamous intraepithelial lesion; HSIL: High-grade squamous intraepithelial lesion; SCC: Squamous cell carcinoma.

Table 2: VIA Results (n = 136)

Result	Frequency (n)	Percentage (%)
Positive	65	47.8
Negative	71	52.2
Total	136	100

VIA: Visual Inspection with Acetic Acid.

Twenty (14.7%) Pap smears were initially inadequate for cytological assessment per the Bethesda criteria and were repeated; all subsequent results were negative. Eighty-two (60.3%) smears were negative for intraepithelial lesion or malignancy (NILM), including normal smears,

Table 3: Histopathological findings and screening test results

Histopathology Diagnosis	VIA +ve	VIA –ve	Pap +ve	Pap –ve
Normal (n = 44)	33 (FP)	11 (TN)	9 (FP)	35 (TN)
CIN I (n = 10)	8	2 (FN)	7	3 (FN)
CIN II (n = 7)	7	–	5	2 (FN)
CIN III (n = 9)	9	–	7	2 (FN)
Micro-invasive carcinoma (n = 8)	8	–	6	2 (FN)

VIA detected more positive cases (higher sensitivity), while Pap smear detected more normal cases (higherspecificity). CIN: Cervical intraepithelial neoplasia; FP: False positive; FN: False negative; TN: True negative

Table 4: Comparison of diagnostic performance of VIA and pap smear

Measure	**VIA**	**Pap Smear**	**χ^2 / P-value**
False Positive (FP)	33	9	–
False Negative (FN)	2	9	–
True Positive (TP)	32	25	–
True Negative (TN)	11	35	–
Sensitivity (%)	94.1	73.	$p = 0.004^{\chi}$
Specificity (%)	25.0%	79.5	20.84 / $p = 0.001$
Positive Predictive Value (PPV%)	37.1	73.5	11.07 / $p = 0.001$
Negative Predictive Value (NPV%)	84.6	79.5	$p = 0.001^{\chi}$
False Positive Rate (FPR%)	50.8	26.5	–
False Negative Rate (FNR%)	15.4	20.4	–
Accuracy(%)	55.1	76.9	8.45 / $p = 0.001$

$^{\chi}$ *Fisher's exact two-tailed p-value. Significant differences observed in sensitivity, specificity, PPV, NPV, and overall accuracy.*

Table 5: Comparison of VIA, Pap Smear, and Combined Method

Measure	**VIA**	**Pap Smear**	**Combined (VIA + Pap)**
False Positive (FP)	33	9	1
False Negative (FN)	2	9	1
True Positive (TP)	32	25	12
True Negative (TN)	11	35	7
Sensitivity(%)	94.1	73.5	92.3
Specificity(%)	25.0	79.5	87.5
PPV(%)	37.1	73.5	92.3
NPV(%)	84.6	79.5	87.5
FPR(%)	50.8	26.5	7.6
FNR(%)	15.4	20.4	12.5
Accuracy(%)	55.1	76.9	90.5

chronic cervicitis, and a typical squamous cells of undetermined significance (ASC-US). Thirty-four (25%) smears were positive for epithelial abnormalities (LSIL, HSIL, or SCC). Detailed Pap smear findings are presented in Table 1. Table 1 summarizes the Pap smear findings among the HIV-positive women screened in this study.Most participants had negative cytological findings, while a smaller proportion demonstrated epithelial abnormalities ranging from low-grade to high-grade squamous intraepithelial lesions and squamous cell carcinoma. Unsatisfactory smears were repeated according to standard cytological protocols. Overall, the findings demonstrate the presence of premalignant and malignant cervical lesions within the study population.The distribution of VIA screening results is summarized in Table 2. Table 2 presents the VIA screening results among the study participants. Nearly half of the women screened demonstrated positive VIA findings, while slightly more than half had negative VIA results. These findings reflect the significant burden of cervical abnormalities among HIV-positive women in this setting and highlight the potential utility of VIA as a screening approach in resource-limited environments.

A comparison of the diagnostic performance characteristics of VIA and Pap smear is shown in Table 4. Table 4 compares the diagnostic performance of VIA and Pap smear using histopathology as the reference standard. VIA demonstrated higher sensitivity for detecting

cervical lesions, whereas Pap smear showed better specificity and overall diagnostic precision. Both screening methods showed distinct strengths in lesion detection and exclusion of disease, supporting their complementary roles in cervical cancer screening among HIV-positive women.

The comparative diagnostic performance of VIA alone, Pap smear alone and combined screening approach is summarized in table 5 below. Table 5 compares the performance of VIA alone, Pap smear alone, and the combined use of both screening methods. The combined screening approach demonstrated improved overall diagnostic performance compared with either method used independently. These findings suggest that combining VIA with Pap smear may enhance the detection and evaluation of premalignant and malignant cervical lesions, particularly in low-resource settings where optimizing screening effectiveness is essential.

Discussion

The purpose of this study was to compare the diagnostic accuracy of Visual Inspection with Acetic Acid (VIA) and the Papanicolaou (Pap) smear in detecting pre-invasive and invasive cervical cancer among HIV-positive women attending the Irrua Specialist Teaching Hospital (ISTH), Edo State, Nigeria. The VIA positivity rate (47.8%) was nearly double that of Pap smear (25%). These values are higher than those reported in earlier studies, where VIA positivity rates ranged between 3% and 28%.[20,21] This discrepancy could be attributed to differences in screening criteria, the absence of standardized thresholds for VIA positivity, variations in study populations, and operator dependency. The significant difference in positivity rates between VIA and Pap smear ($\chi^2 = 8.453$; $p < 0.001$) indicates genuine performance differences rather than random variation.

Muwonge *et al*.[22] in Angola and Were *et al*.[23] in Kenya reported VIA positivity rates of 6.6% and 13.9%, respectively, while Odafe *et al*.[10] and Ogunbowale *et al*.[24] in Nigeria observed rates of 16–16.2%. Their lower positivity rates were linked to stricter criteria—only distinct aceto-white areas were recorded as positive. In contrast, Ekalaksananan et al.[25] in Thailand found a 38.1% VIA positivity rate when all grades of aceto-white lesions were included. The broader inclusion criteria and the high-risk profile of HIV-positive participants in this study likely contributed to the higher VIA detection rate.

In the present study, VIA demonstrated higher sensitivity (94.1%) but lower specificity (25%) compared with Pap smear (sensitivity 73.5%, specificity 79.5%). The positive predictive value (PPV) was lower for VIA (37.1%) than for Pap smear (73.5%), while the negative predictive value (NPV) was slightly higher for VIA (84.6% versus 79.5%). Because both tests were performed sequentially on the same participants, selection bias was minimized. These results are consistent with other comparative studies, which have shown that VIA tends to have better sensitivity but lower specificity than Pap smear.[20-23,25]

The lower specificity of VIA in this study might be explained by the high prevalence of cervicitis among participants (23.5%), since inflammatory changes can mimic aceto-white reactions with acetic acid.[31] Previous literature notes that cervicitis is common in resource-limited settings due to poor infection control, contributing to false-positive VIA results.[27,28] Repeat VIA after infection treatment could improve specificity and reduce unnecessary referrals.

While VIA's higher sensitivity and lower PPV suggest a risk of over-diagnosis and possible overtreatment, particularly in "see-and-treat" programs, this must be balanced against the challenges of cytology-based screening—delayed results, high attrition, and late presentations with advanced disease. The immediate feedback from VIA improves patient adherence and allows same-day treatment when indicated, which is particularly valuable for HIV-positive women who may have reduced access to continuing care.

The finding that combining VIA and Pap smear improved overall test performance—yielding sensitivity and specificity of 92.3% and 87.5%, respectively—supports the view that both methods are complementary rather than mutually exclusive. VIA offers a rapid, low-cost, high-sensitivity tool suitable for primary screening, while Pap smear provides higher specificity and diagnostic confirmation.

Age-specific patterns observed in this study are consistent with known epidemiologic trends. VIA positivity was most common among women aged 35–44 years, whereas Pap smear positivity peaked among women aged 45–54 years. This variation may reflect differences in the squamocolumnar junction morphology with age and hormonal changes. Low-grade lesions (LSIL) predominated in younger women, while high-grade lesions (HSIL) and invasive squamous cell carcinoma were common in older age groups, supporting the well-established 10–20-year progression timeline from premalignant to malignant disease.[27,31,32]

Overall, the high VIA sensitivity and its ability to detect all cases of CIN II, CIN III, and microinvasive carcinoma underscore its value as an initial screening method, particularly for HIV-positive women who have accelerated disease progression. The relatively low specificity emphasizes the need for adequate training, standardization of positivity criteria, and possibly adjunct approaches such as repeat testing or HPV triage.

Implications for policy and practice

This study provides locally relevant evidence supporting VIA as a feasible and effective cervical cancer screening method in resource-limited, high-HIV-burden settings. Policymakers should consider integrating VIA into primary healthcare and HIV programs to expand screening coverage. Establishing community-based "screen-and-treat" clinics—linked to referral hospitals for cytology or histology confirmation—would improve early detection and reduce cervical cancer mortality. Training mid-level providers in VIA, ensuring continuous quality assurance, and integrating screening services into existing maternal and HIV health programs would enhance sustainability.

Moreover, national cervical cancer prevention policy should adopt a tiered approach—using VIA for initial screening and Pap smear or HPV testing for confirmation where feasible. Such integration aligns with WHO recommendations for low-resource countries and supports Nigeria's strategic drive toward eliminating cervical cancer as a public health threat.

Strengths and limitations

This study created an important opportunity for women living with HIV in a low-income community to access cervical cancer screening within their routine clinic visits. By integrating screening into the HIV care structure, the study demonstrated the feasibility of using Visual Inspection with Acetic Acid (VIA)—a low-cost, simple, and widely accessible method—in a real-world, resource-constrained setting. It also provided local evidence to support the implementation of comprehensive cervical cancer prevention programs tailored for high-risk populations.

A major strength of this study lies in its focus on HIV-positive women—an underserved population particularly vulnerable to cervical cancer—and the direct comparison of VIA and Pap smear within the same participants using histopathology as the reference standard. This design reduced selection bias and improved internal validity.

However, the study had some limitations. The single-center design and relatively small sample size may limit generalizability to broader populations. VIA performance is subject to intra- and inter-observer variability due to the absence of universally standardized criteria for positivity, making results operator-dependent. Similarly, Pap smear sensitivity can be affected by errors in slide preparation and interpretation, which may contribute to false-negative results. Not all participants with negative test results underwent biopsy confirmation due to financial constraints, which may have introduced verification bias.

Sociodemographic characteristics such as participants' ethnic homogeneity (predominantly Esan), universal male partner circumcision, and limited data on sexual history may have reduced the ability to explore associations between behavioral factors and abnormal cervical findings.

Despite these limitations, the study's findings—that VIA is more sensitive than Pap smear in detecting premalignant lesions among HIV-positive women—have important implications for clinical practice and health policy. They support the adoption of VIA as a primary screening tool in resource-limited, high-HIV-prevalence settings,

provided rigorous training, quality assurance, and supportive policy frameworks are established. Implementing such measures can enhance early detection, reduce cervical cancer morbidity, and promote equity in access to women's health services across similar low-resource environments.

Conclusion

Cervical cancer remains a largely preventable disease, yet prevention efforts in Nigeria and other low-resource settings are hindered by inadequate screening programs, limited laboratory capacity, and weak policy commitment. This study showed that Visual Inspection with Acetic Acid (VIA) is a feasible and effective alternative to the Pap smear for detecting premalignant and malignant cervical lesions among HIV-positive women, demonstrating higher sensitivity and negative predictive value despite lower specificity. VIA's low cost, simplicity, and immediate results make it particularly suitable for "see-and-treat" approaches in resource-constrained environments. Integrating VIA into existing HIV and reproductive health services—as a primary or complementary screening tool—would strengthen early detection, reduce cervical cancer burden, and improve access to preventive care. Achieving this requires strong political will, community education, and the establishment of national cervical cancer screening guidelines tailored to the realities of low-income settings.

Acknowledgements

The authors express their sincere appreciation to the management and staff of Irrua Specialist Teaching Hospital (ISTH), Edo State, Nigeria, particularly the Departments of Gynaecology, HIV Clinic, and Anatomic Pathology, for their collaboration and technical assistance during the study. We also acknowledge the commitment of the nursing and laboratory staff who supported participant recruitment, data collection, and sample processing. Our deepest gratitude goes to all the women who participated in this study for their trust and cooperation. Their contribution has advanced understanding of cervical cancer screening among women living with HIV in resource-limited settings. The authors also appreciate the academic support and constructive feedback received from colleagues in the Faculty of Clinical Medicine, Ambrose Alli University, Ekpoma.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. All study activities were self-supported by the investigators.

Conflict of interest

The authors declare no conflict of interest related to this study, its authorship, or publication.

Data availability

The datasets generated and analyzed during this study are available from the corresponding author on reasonable request. Data are anonymized to protect participant confidentiality.

References

1. Oche MO, Kaoje AU, Gana G, and Ango JT. Cancer of the cervix and cervical screening: Current knowledge, attitude and practices of female health workers in Sokoto, Nigeria. Int J Med Med Sci 2013; 5(4): 184-90.
2. Vum, Yuj, Awoiude OA, and Chuangl L. Cervical cancer worldwide. Current Problems in Cancer 2018; 42(5): 457-65.
3. World Health Organization. Comprehensive Cervical Cancer Control: A Guide to Essential Practice. 2nd ed. Geneva: WHO; 2014.
4. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, and Bray F. Global Cancer statistics 2020; GLOBOCAN estimate of incidence and mortality worldwide for 36 cancer in 185 countries. CA: A Cancer Journal for Clinicians 2021; 71(3): 209-49.
5. Cuzick J, Arbyn M, Sankaranarayanan R, Tsu V, Ronco G, Mayrand MH, Dillner J, and Meijer CJ. Overview of human papillomavirus based and other novel options for cervical cancer screening in developed and developing countries. Vaccine 2008; 26(10): K29–K41.
6. Oluwole EO, Mohammed AS, Akinyinka MR, and Salako O. Cervical cancer awareness and screening uptake among rural women in Lagos, Nigeria. Journal of Community Medicine and Primary Health Care 2017; 29(10): 81-8.
7. Durowade KA, Osagbemi GK, Salawudeen AG, Musa OI, Akande TM, and Babatunde OA. Prevalence and risk factors of cervical cancer among women in an urban community of Kwara State, North central Nigeria. J Prev Hyg 2012; 53: 213-19.

8. Burki T. UNAIDS and IAEA join forces on HIV and cervical cancer. The Lancet 2020; 395(10223): 484.
9. Bassey G, Jeremiah I, Ikimalo JI, Fiebai PO, and Athanasius BP. Abnormal cervical cytology among HIV-positive women in Nigeria. Int J Gynaecol Obstet 2014; 1252: 103-106.
10. Odafe S, Torpey K, Khamofu H, Oladele E, Adedokun O, Chabikuli O, Mukaddas H, Usman Y, Aiyenigba B, and Okoye M. Integrating cervical cancer screening with HIV care in a district hospital in Abuja, Nigeria. Niger Med J 2013; 54: 176-84.
11. World Health Organization. Assessing national capacity for the prevention and control of noncommunicable diseases: report of the 2019 global survey.
12. Owoeye IOG and Ibrahim IA. Knowledge and attitude towards cervical cancer screening among female students and staff in a tertiary institution in the Niger Delta. IJMBR 2013; 2(1).
13. World Health Organization (WHO). Prevention of cervical cancer through screening using visual inspection with acetic acid (VIA) and treatment with cryotherapy. Nigeria: WHO; 2012 p. 1-33.
14. Ibrahim T. Research Methodology and Dissertation Writing for Health and Allied Health Professionals. Abuja. Cress Global Link Limited 2009.58.
15. Israel G. D, 2012. Determining sample size. University of Florida, institute for Food and Agricultural Sciences. 2012
16. Araoye MO. Subjects Selectionin Research Methodology with statistics for Health and Social sciences. Ilorin. Nathadex publishers, 2003: 115-129.
17. Mabeya H, Khozaim K, Liu T, Orango O, Chumba D, Pisharodi L, Carter J, and Cu-Uvin S. Comparison of conventional cervical cytology versus visual inspection with acetic acid among human immunodeficiency virus infected women in Western Kenya. J Low Genit Tract Dis 2012; 16(2): 92–7.
18. Council for International Organisations of Medical Sciences (CIOMS) International Ethical Guidelines for Biomedical Research Involving Human Subjects. 2002.
19. World Health Organisation Standards and Operational Guidance for Ethics Review of Health- Related Research with Human Participants. 2011.
20. Perkins RB, Langrish S, Stern LJ, Figueroa J, and Simon CJ. Visual inspection with acetic acid is more cost-effective than Pap smears for cervical cancer screening in Honduras. Doctoral Dissertation 2007.
21. Ahmed I, Arja R, and Vibeke R. Cervical cancer screening in primary health care setting in Sudan :a comparative study of VIA and Pap smear. Int J Women's Health 2012; 4: 67-73.
22. Muwonge R, Manuel MG, Filipe AP, Dumas JB, Frank MR, and Sankaranarayanan R. Visual screening for early detection of cervical neoplasia in Angola. Journal of Gynaecology and Obstetrics 2010; 111: 68-72.
23. Were E, Nyaberi Z, and Buziba N. Integrating cervical cancer and genital tract infection screening into mother, child health and family planning clinics in Eldoret, Kenya. African Health Sciences 2010; 10: 58-65.
24. Ogunbowale T and Lawoyin TO. Cervical cancer risk factor and predictors of cervical dysplasia among women in southwest Nigeria. Aust J Rural Healthy 2008; 16: 338-42.
25. Ekalaksananan T, Pientong C, Thinkhamrop J, Kongyingyoes B, Evans MF, and Chaiwongkot A. Cervical cancer screening in north east Thailand using the visual inspection with aceti cacid(VIA) test and its relationship to high-risk human papilloma virus(HR-HPV) status. Journal of Obstetrics and Gynecological Research 2010; 36: 1037-43.
26. Doh AS, Nkele NN, Achu P, Essimbi F, Essame O, and Nkegoum B. Visual inspection with Acetic acid and cytology as screening method for cervical lesion in Cameroon, International Journal of Gynecology and Obstetrics 2015; 89: 167-73.
27. Akinola OI, Fabamwo AO, Oshodi YA,Banjo AA, Odusanyo O, Gbadagesin A, and Tayo A. Efficacy of visual inspection using acetic acid in cervical cancer screening: A comparison with cervical cytology. J Obstet Gynaecol. 2007; 27: 703-5.
28. Ogunbowale T and Lawoyin TO. Cervical cancer risk factor and predictors of cervical dysplasia among women in southwest Nigeria. Aust J Rural Healthy 2008; 16: 338-42.
29. Samuels F, Blake C, Akinrimisi B. HIV vulnerabilities and the potential for strengthening social protection responses in the context of HIV in Nigeria. London: ODI. 2012 Feb 21.
30. Odukogbe AA, Awolude OA, Oluwasola AOT, Adewole FI, and Omigbodun AO. Guidelines and Standard of Care Manual for Managing Gynaecological Cancers In Gynaecological Oncology Unit, Dept of Obstet and Gynaecol, college of med, Univ of Ibadan/UCH, Ibadan.1st edition, Ibadan: Ibadan University Press 2014. p. 1.
31. Omole-Ohonsi A. Risk factors for cervical dysplasia in Aminu Kano Teaching Hospital. Ibom Med J 2014; 634-9.
32. Ononogbu U, Almujtaba M, Modibbo F, Lawal I, Offiong R, Olaniyan O, Dakum P, Spiegelman D, Blattner W, and Adebamowo C. Cervical cancer risk factor among HIV infected Nigerian women. BMC public health 2013; 13(1): 1-10.