

Evaluating Visual Inspection with Acetic Acid and Human Papilloma Virus Tests for Cervical Cancer Screening in Ndola District, Zambia: A Focus on Positive Predictive Value

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Abstract

Background: Visual Inspection with Acetic Acid (VIA) and Human Papilloma virus (HPV) tests are crucial methods for early detection of premalignant lesions, especially in resource-limited environment. No study has been conducted on the accuracy of VIA and HPV tests in detecting premalignant cervical lesions in Ndola district. This study explored the effectiveness of VIA and HPV tests in detecting premalignant cervical lesions in Ndola district, focusing on their Positive Predictive Value (PPV) as a crucial factor in evaluating their clinical utility.

Methods and Materials: A prospective cross-sectional study selected 172 female participants, with 49 testing positive for both VIA and HPV using purposeful sampling. The study recruited women aged 18 years or old who attended cervical cancer clinic at Ndola Teaching Hospital from January 2024 to November 2024, had loop electrosurgical excision procedure (LEEP) done and histopathology results obtained. They all voluntarily consented to participate in the study. Using SPSS version 20 software, descriptive statistics were performed. Positive predictive values and their confidence intervals for both VIA and HPV tests in detecting premalignant were evaluated and recorded in both frequencies and percentages.

Results: The PPV of positive VIA and HPV tests histopathology-confirmed premalignancy or malignant cervical lesions were 58.1% and 71.4% respectively.

Conclusion and Recommendation: HPV has high PPV than VIA in Ndola district. To minimize false positives in detecting cervical lesions, national policymakers should scale up HPV test as primary screening test while VIA test should be reserved for identifying lesion margins during LEEP provision.

Keywords: VIA, HPV, Positive Predictive Value, Cervical Cancer, Screening

1. INTRODUCTION

Globally, cervical cancer is still a major health problem, especially in areas with few resources. In 2022, around 660,000 new cases and 350,000 deaths were recorded and it was the fourth most frequent cancer in women globally¹.

Persistent infection with high-risk HPV-16 and HPV-18 is the main cause of cervical intraepithelial neoplasia (CIN) and cervical cancer². Both Visual Inspection with Acetic Acid (VIA) and Human Papilloma virus (HPV) tests

have been increasingly adopted worldwide either alone or as dual tests. This is because over 99% of cervical cancers are linked to persistent infection with high-risk HPV types and account for approximately 70% of cervical cancer cases^{2,3}. Due to social and economic inequalities as well as restricted access to national HPV vaccination, screening and treatment facilities, low-income countries have high incidence and death rates of cervical cancer¹. Women with HIV are six times more likely than those without the virus to get cervical cancer, and while it takes 15

to 20 years for abnormal cells to turn into cancer, it can happen more quickly in women with weakened immune systems, taking 5 to 10 years⁴. Even though cervical cancer is preventable and curable, Zambia had the third highest incidence of the disease in 2020, with 65.5 cases per 100,000 women and 43.4 deaths⁵.

Premalignant lesions screening along with receiving a preventative HPV vaccine, are cost effective methods for preventing cervical cancer¹. If cervical cancer is detected and treated early, it is curable¹. The gold standard for cervical cancer screening has been the traditional cytology (Pap smear), however, due to logistical and economical limitations, its use is limited in many poor nations^{6,7}. World Health Organisation now recommends HPV testing as the preferred method for cervical cancer screening, especially in settings where resources allow. However, VIA is still a viable alternative in situations where HPV testing is not yet practical^{2,8}. VIA is the primary cervical cancer screening modality used in the majority of the districts on the Copperbelt province, including Ndola district. Some studies have shown the accuracy of VIA and HPV tests in the screening of cervical premalignancy and malignancy to be 10% and 37.5% respectively^{9,10}.

The goal of the global effort is to eradicate cervical cancer by 2030. To achieve this goal, it requires that 90% of girls receive the HPV vaccine by the age of 15 years, 70% of women between the ages of 35 and 45 years receive high quality screening and 90% of all women with cervical cancer receive treatment¹. It is therefore essential to assess the PPV of VIA and HPV tests as the two widely used cervical cancer screening tests and locally available in Ndola district.

As far as we are aware, there has been no research conducted on the PPV of HPV and VIA tests in detecting premalignant cervical lesions in Ndola district. This study explores the effectiveness of VIA and HPV tests in detecting premalignant and or malignant cervical lesions in Ndola district, focusing on their Positive Predictive Value (PPV) as a crucial factor in evaluating their clinical utility.

2. MATERIALS AND METHODS

2.1. Study Participants

Participants comprised of all women aged 18 years and old who sought and received cervical cancer screening services at Ndola teaching hospital (NTH). They tested positive to HPV

infection on either VIA or HPV test according to WHO and MoH guidelines^{2,8}. A written consent was obtained from women before being given a written pretested self-administered questionnaire. Those with cervical lesions less than 75% and not extending into cervical canal, those who did not have a LEEP or who had visible lesions requiring a biopsy to be taken but no VIA or HPV test was done, were excluded from the study. Finally, only those with histopathology results were included in the study.

2.2. Study Site

This study was conducted at Ndola Teaching Hospital in Ndola district, Copperbelt province of Zambia. Ndola Teaching Hospital is a tertiary teaching hospital. It is also a training site for both under graduate and post graduate students in different health disciplines.

2.3. Study Design

This was a prospective cross section survey. Data was collected over 11 months, from January to November, 2024.

2.4. Sample and Sampling Methods

Purposeful sampling was utilized in this study. The sample size was 172 participants. Sample size was determined using a formula by Yamane after catering for a 10% non-response rate¹¹.

2.5. Data Collection

Trained and certified competent nurses with 5 years or more experience in cervical cancer screening screened all women with both VIA and HPV tests. Nurses collected specimen for HPV test from women who sought cervical cancer screening services at NTH and placed it in transport media before being taken to histopathology laboratory for analysis and examination. Trained and certified medical doctors in surgical cervical cancer screening and treatment performed LEEP surgery. The LEEP specimens were placed in formalin and equally transported to the laboratory where a trained pathologist processed and examined them.

2.6. Data Analysis

Data was initially entered in Excel computer software by a trained data entry clerk, cleaned it before being exported to IBM SPSS version 20 software for analysis. Descriptive statistics were performed. "Positive predictive values, the mean and their confidence intervals for both VIA and HPV tests in detecting premalignant/malignant were evaluated and recorded".

2.7. Ethical Clearance

Ethics clearance was sought and granted from Tropical Diseases Research Centre Ethics Committee reference number TDREC/18/06/24 and National Health Research Authority. Permission to conduct the research was obtained from the Copperbelt Provincial Health Office.

3. RESULTS

A total of 172 participants tested VIA positive, and of these, 49 of them also tested positive for HPV. Table 3.1 summarises the characteristics of study participants. The majority (65.7%) and 61.2% of the participants who tested positive for

VIA and HPV were aged 35 years or old respectively. Of these participants, 29.1% and 22.4 % who tested positive for VIA and HPV, respectively, had unprotected sexual debuts when they were below 16 years old.

Eighty-two point six per cent (82.6%) who tested positive for VIA and 85.7% for HPV had attained either secondary or tertiary education. The majority (70.9%) of VIA and 91.1% of HPV-positive participants had unprotected vaginal sex with 3 or more male sex partners, while 95.3 % and 93.9%, respectively, admitted to drinking alcohol. Nearly half (48.1%) of the participants were HIV positive.

Table 3.1. Characteristics of women with positive VIA/HPV tests who attended cervical cancer clinic in Ndola district

Characteristic	VIA – n = 172 (%)	HPV – n = 49 (%)
Educational level		
Primary level	30 (17.4)	7 (14.3)
Secondary/Tertiary	142 (82.6)	42 (85.7)
Marital		
Single	62 (36.0)	19 (38.8)
Married/Divorced	110 (64.0)	30 (61.2)
Male sex partners' circumcision status		
Circumcised	117 (68.0)	36 (73.5)
Not circumcised	55 (32.0)	13 (26.5)
Parity		
3 and less	116 (67.4)	36 (73.5)
4 and more	56 (32.6)	13 (26.5)
Cigarette smoking/Tobacco sniffing		
Yes	53 (30.8)	15 (30.6)
No	119 (69.2)	34 (69.4)
Participants' diabetes mellitus status		
Diabetic	60 (34.9)	21 (42.9)
Non diabetic	112 (65.1)	28 (57.1)
History of pelvic inflammatory disease treatment		
Yes	102 (59.3)	30 (61.2)
No	70 (40.7)	19 (38.8)
Participants' BMI		
24.9 or less	43 (25.0)	10 (20.4)
25.0 and above	129 (75.0)	39 (79.6)

NB: HIV- Human immunodeficiency virus; BMI-Body mass index

The positive predictive values for VIA and HPV tests in detecting Premalignancy/malignant cervical lesions were 58.1% and 71.4% with their

confidence intervals respectively as shown in table 3.2.

Table 3.2: Positive predictive values of VIA and HPV tests in detecting Premalignancy/malignant cervical lesions

Factor	n	PPV (%)	95% CI
VIA test positives (N=172)			
Premalignancy/malignancy	100	58.1	(43.7 – 72.6)
No malignancy	72	41.9	
HPV test positives (N=49)			
Premalignancy/malignancy	35	71.4	(46.6 – 96.2)
No malignancy	14	28.6	

NB: CI = Confidence interval

4. DISCUSSION

Positive Predictive Value (PPV) is a crucial metric for assessing the efficacy of both VIA and HPV cervical cancer screening tests. The clinical value of a screening tool is determined by the probability that those with a positive test result actually have the condition and this is determined by their PPV. A higher PPV indicates a higher likelihood of a genuine positive test result for doctors to make informed decisions on additional diagnostic tests and treatment. Additionally, high PPV tests can optimise healthcare resource utilization in resource-limited settings by prioritizing patients who are more likely to benefit from immediate treatment¹². This is particularly important in low-resource nations, where VIA is frequently utilised than HPV DNA testing¹³.

Our research showed that although the majority (172) tested positive for VIA, only 58.1% had PPV (95% CI: 43.7 – 72.6). In contrast, the minority (49) who tested positive to HPV test had PPV of 71.4% (95% CI: 46.6 – 96.2) for premalignancy/malignant lesions.

This study has shown that PPVs for both tests were much higher than those of some comparable studies conducted within SADC countries like 14.6% for VIA and 59.7% for HPV in South Africa and 45% for VIA and 70% for HPV in Zimbabwe^{14,15}. Equally, our study has demonstrated a similar higher PPV for HPV like what was found in Botswana at 73% despite their study having low VIA PPV at 53%¹⁵. This study could have found a high PPV for HPV due to competent staff at NTH. Self-testing increases accessibility and participation in screening programs, and ensures timely treatment. NTH's well-trained staff ensures accurate procedures and better yields. These findings are consistent with what was also found in a South African study^{14,15}. The high PPV for HPV test could also be attributed to it being a laboratory based test with more objectivity and reduced variability in results. To the contrary, VIA test is subjective as it is based on individual competency, a finding similar to what was found in Lusaka by Tayhavi and others¹⁷.

5. CONCLUSION AND RECOMMENDATION

HPV has high PPV than VIA in Ndola district. To minimize false positives in detecting cervical lesions, national policymakers should scale up HPV test as primary screening while VIA test

should be reserved for identifying lesion margins during LEEP provision.

6. CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

7. ACKNOWLEDGEMENT

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REFERENCES

- [1] World Health Organisation [WHO]. (2024a). *Cervical cancer fact sheet*. <https://www.who.int/news-room/fact-sheets/detail/cervical-cancer/>?. Accessed on line: 10/04/2024.
- [2] World Health Organization (2021). *WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention*, 2nd edition. <https://www.who.int/publications/i/item/9789240030824>.
- [3] Walboomers JM, Jacobs MV, Manos MM, et al. (1999). *Human papillomavirus is a necessary cause of invasive cervical cancer worldwide*. *Journal of Pathology*, 189(1), 12–19. [https://doi.org/10.1002/\(SICI\)1096-9896\(199909\)189:1<12::AID-PATH431>3.0.CO;2-F](https://doi.org/10.1002/(SICI)1096-9896(199909)189:1<12::AID-PATH431>3.0.CO;2-F)
- [4] International Agency for Research on Cancer [IARC]. (2025). *Cervical cancer*. Accessed online on: 1May, 2025. <https://www.iarc.who.int/cancer-type/cervical-cancer?>.
- [5] World Health Organisation [WHO]. (2024b). Zambia steps up cervical cancer screening with HPV testing. <https://www.afro.who.int/countries/zambia/news/zambia-steps-cervical-cancer-screening-hpv-testing?>. Accessed on line 20/02/2024.
- [6] Goldie SJ, Kuhn L, Denny L et al. (2001). *Policy Analysis of Cervical Cancer Screening Strategies in Low-Resource Settings Clinical Benefits and Cost-effectiveness*. *JAMA*. 2001; 285 (24):3107-3115. doi:10.1001/jama.285.24.3107.
- [7] Denny L & Wright T. (2009). *Strategies for Overcoming the Barriers to Cervical Cancer Screening in Low-Resource Settings*. <https://www.glowm.com/section-view/item/22>. *Glob. libr. women's med.*, (ISSN: 1756-2228) 2009; DOI 10.3843/GLOWM.1002. <https://jamanetwork.com/journals/jama/fullarticle>.
- [8] Ministry of Health [MoH]. (2023). *Zambia National Guidelines for cervical cancer Screening*. Lusaka.
- [9] Denny L, Herrero R, Levin C et al. (2013). *Cervical cancer*. Disease control priorities. 3rd edition. Pg 69-82.

- [10] Partha B, Srabani M, Dipanwita B et al. (2015). *Diagnostic accuracy of VIA and HPV detection as primary and sequential screening tests in a cervical cancer screening demonstration project in India*. *Int J Cancer*. 2015 Aug 15; 137(4):859-67. doi: 10.1002/ijc.29458. Epub 2015 Feb 12.
- [11] Israel G.D. (1992). *Determining Sample Size*. University of Florida, Gainesville 3261.
- [12] Arbyn M, Sankaranarayanan R, Muwonge R et al. 2008. *Pooled analysis of the accuracy of five cervical cancer screening tests assessed in eleven studies in Africa and India*. *International journal of cancer* (2008) vol 123: 153- 160. <https://doi.org/10.1002/ijc.23489>
- [13] Denny L, Kuhn L, Pollack A et al. (2005). *Direct visual inspection for cervical cancer screening: an analysis of factors influencing test performance*. *Cancer*, 103(3), 519–523. <https://doi.org/10.1002/cncr.20829>.
- [14] Kelly AH, Chikandiwa A, Sawadogo B et al. (2021). *Diagnostic accuracy of cervical cancer screening and screening–triage strategies among women living with HIV-1 in Burkina Faso and South Africa: A cohort study*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7971880>. *PLoS Med*. 2021 Mar 4; 18 (3):e1003528. doi: 10.1371/journal.pmed.1003528.
- [15] Gichangi E. (2019). *HPV Testing for Cervical Cancer Screening in Botswana: Diagnostic Performance and Clinical Outcomes*
- [16] El-Zein M, Bouten S, Louvanto K, et al. (2019). *Predictive Value of HPV Testing in Self-collected and Clinician-Collected Samples Compared with Cytology in Detecting High-grade Cervical Lesions*. *Cancer Epidemiol Biomarkers Prev* (2019) 28 (7): 1134–1140. <https://aacrjournals.org/cebpa/article-abstract/28/7/1134/72066/Predictive-Value-of-HPV-Testing-in-Self-collected?redirectedFrom=fulltext>.
- [17] Tarhavi K, Moono M, Mwanahamuntu M et al. (2024). Accuracy of screening tests for cervical pre-cancer in women living with HIV in low resource settings: a paired prospective study in Lusaka, Zambia. *MedRxiv*.bmjoncol.2024 Feb10; 3(1):e0001111.doi:10.1136/BMJONC-2023-000111.PMID37398043; PMCID: PMV10312869.

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