



## A Comparative Study Evaluating the Effectiveness of Visual Inspection with Acetic Acid, Pap Smear, and Colposcopy in Cervical Cancer Screening

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### ABSTRACT

**Background:** Cervical cancer ranks as the fourth most common cancer in women worldwide, with approximately 570,000 new cases reported in 2018, accounting for 7.5% of all female cancer deaths. India alone contributes one-fourth of global cervical cancer deaths, reporting 60,078 deaths and 96,922 new cases in 2018. The objective of this study was to compare the effectiveness of three different cervical cancer screening methods: Visual Inspection with Acetic Acid (VIA), Pap smear, and colposcopy.

**Methods:** A prospective study was conducted with 150 sexually active and non-pregnant women aged 20 to 70 years. Participants with no prior history of cervical cancer or pre-invasive lesions were included. The three screening methods were performed, and sensitivity, specificity, positive predictive value, and negative predictive value were calculated. Statistical analyses were conducted using descriptive indices.

**Results:** Colposcopy showed the highest sensitivity (90.48%) and specificity (95.65%) among the three methods. VIA had a sensitivity of 71.43% and specificity of 78.26%, while the Pap smear had a sensitivity of 76.19% and specificity of 26.09%. Colposcopy demonstrated significantly superior diagnostic accuracy compared to the other methods.

**Conclusion:** Colposcopy was found to be the most effective screening method for detecting cervical cancer, outperforming VIA and the Pap smear. However, VIA and Pap smear can still play complementary roles in cervical cancer screening, especially in resource-constrained settings. Implementing colposcopy as the primary diagnostic tool in cervical cancer screening programs could significantly contribute to early detection and prevention of cervical cancer-related deaths in developing countries.

**Keywords:** cervical cancer, Visual Inspection with Acetic Acid (VIA), Pap smear, colposcopy, screening methods.

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### INTRODUCTION

Cervical cancer ranks as the fourth most common cancer in women worldwide, with approximately 570,000 new cases reported in 2018, accounting for 7.5% of all female cancer deaths. India alone contributes one-fourth of global cervical cancer deaths, reporting 60,078 deaths and 96,922 new cases in 2018. It is the second leading cause of cancer-related deaths among Indian women, despite being largely preventable. The causes of cervical cancer are multifactorial and include human papillomavirus infections, multiple sexual partners, sexual intercourse, multiparity, long-term use of oral contraceptives, tobacco smoking, low

economic status, Chlamydia trachomatis infection, and deficiencies in micronutrients and a diet lacking in vegetables and fruits.<sup>1</sup>

In developing countries, nearly 80% of cervical cancer cases are detected at an advanced stage due to inadequate access to healthcare facilities. Therefore, there is a need for a cost-effective approach that can be implemented on a mass scale to facilitate effective cervical cancer screening programs.<sup>2</sup> Traditionally, the Pap smear test has been a key tool in cervical cancer prevention programs globally. However, in resource-constrained settings like developing countries, Visual Inspection with Acetic Acid (VIA) and Pap smear are the main methods used for screening.<sup>3</sup> Screening aids in the detection of precancerous lesions, thereby preventing the development of invasive cervical cancer. Several screening and assessment tools, including colposcopy, the Pap smear, and VIA, have been developed to enhance the efficacy of cervical cancer screening. Hence, this study aims to compare the effectiveness of these screening methods in detecting cervical cancer.<sup>4</sup>

### **AIM AND OBJECTIVES**

The main goal of this study is to assess and compare the effectiveness of three different screening methods, namely visual inspection with acetic acid (VIA), Pap smear, and colposcopy, for detecting cervical cancer. The specific objectives are to determine which screening method yields the most reliable and accurate results in identifying cervical cancer, and ultimately, to identify the optimal screening approach among the three methods.

### **MATERIALS AND METHODS**

In this prospective study, a total of 100 sexually active and non-pregnant women between the ages of 20 to 70 years were recruited from the gynecology department. Patients with no active disease of the cervix, no history of cervical conization, cryo or other invasive cervical cancer treatment, no history of pre-invasive lesions, and no prior diagnosis of cervical cancer were included in the study. Patients with unsatisfactory Pap smear results were excluded.

After obtaining written and informed consent, the participants underwent three screening methods: Pap smear, visual inspection with acetic acid (VIA), and colposcopy. The sensitivity, specificity, positive predictive value, and negative predictive value for each method were calculated using descriptive indices. The results showed that colposcopy had a sensitivity of 90.48% and specificity of 95.65%. The sensitivity of Pap smear was 76.19%, while the specificity was 26.09%. Visual inspection with acetic acid had a sensitivity of 71.43% and specificity of 78.26%.

Based on the findings, colposcopy was determined to be the most sensitive and specific among the three screening procedures, outperforming the Pap smear and visual inspection with acetic acid methods.

### **RESULTS**

**Table 1: Age distribution of participants**

<b>Age Range (Years)</b>	<b>Number of Participants</b>
20-30	12
30-40	56
40-50	54
50-60	25
60-70	3

The study involved a total of 150 participants, and their ages were distributed across various age ranges. The majority of the participants, 56 individuals, fell within the age range of 30-40 years. The second most represented age group was 40-50 years, comprising 54 participants. Additionally, 25 participants were in the age range of 50-60 years. A smaller group of 12

participants were aged between 20-30 years. Lastly, there were only 3 participants who were between 60-70 years old.

**Table 2: Comparison between Visual Inspection with Acetic Acid (VIA) and Biopsy results among the study participants.**

		Biopsy		Total	Kappa statistics	p-value
		Abnormal	Normal			
VIA	Abnormal	22	8	30	0.522	0.001
	Normal	9	27	36		
	Total	31	35	66		

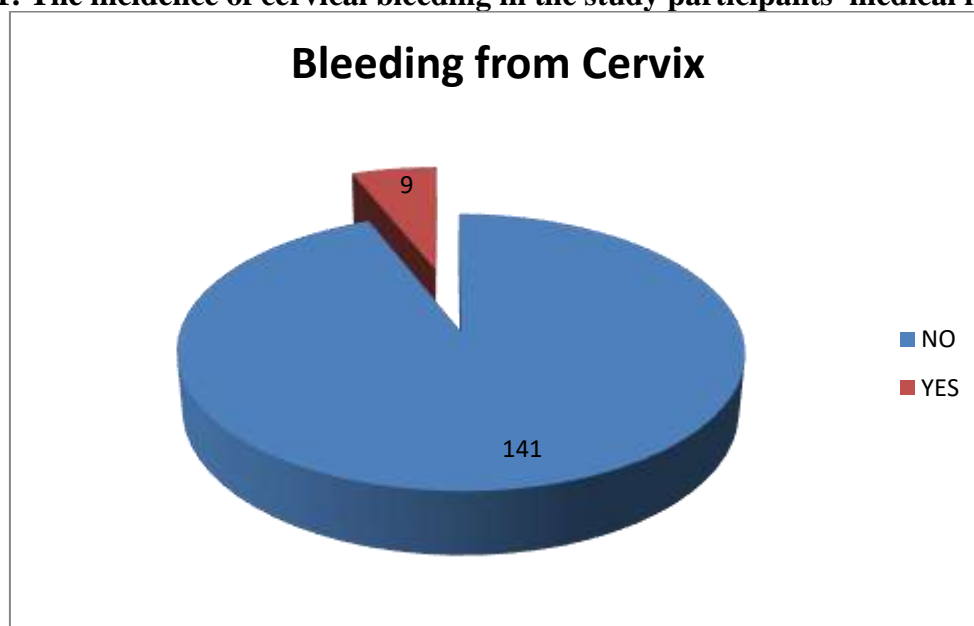
The study involved conducting biopsies on a total of 66 participants to determine their biopsy results. Out of these participants, 31 were diagnosed with abnormal biopsy results, and 35 were diagnosed with normal biopsy results. VIA Screening Shows a Kappa Value of 0.522 and p-value of 0.001 for Abnormal vs. Normal Cases in a Total of 66 Participants

**Table 3: Pap smear vs Biopsy of specimen among participants**

		Biopsy		Total	Kappa statistics	p-value
		Abnormal	Normal			
Pap smear	Abnormal	24	25	48	0.032	0.712
	Normal	8	9	17		
	Total	32	34	66		

The study compared the results of Biopsy and Pap smear tests in a total of 66 participants. Among the participants, 32 individuals were diagnosed with abnormal biopsy results, while 34 had normal biopsy results. Regarding the Pap smear test, 48 participants were identified with abnormal results, and 17 participants had normal results out of the total 66 participants. The study calculated the Kappa statistic to measure the agreement between the Biopsy and Pap smear results, which resulted in a Kappa value of 0.032. The p-value, which assesses the significance of the agreement, was found to be 0.712.

**Figure 1: The incidence of cervical bleeding in the study participants' medical history.**



Among the study participants, 141 individuals reported no history of bleeding from the cervix, while 9 participants indicated a positive history of cervical bleeding.

**Table 4: A comparative analysis among the study participants for VIA (Visual Inspection with Acetic Acid), Pap smear, and Colposcopy.**

Statistic	VIA		Pap smear		Colposcopy	
	Value	95% CI	Value	95% CI	Value	95% CI
Sensitivity	71.43%	47.82% - 88.72%	76.19%	52.83% - 91.78%	90.48%	69.62% - 98.83%
Specificity	78.26%	56.30% - 92.54%	26.09%	10.23% - 48.41%	95.65%	78.05% - 99.89%
Positive Likelihood Ratio	3.29%	1.45%- 7.47%	1.03%	0.73%- 1.45%	20.81%	3.04%- 142.22%
Negative Likelihood Ratio	0.37%	0.18%- 0.74%	0.91%	0.33%- 2.55%	0.1%	0.03%- 0.37%
Positive Predictive Value	75.00%	56.89% - 87.21%	48.48%	40.10% - 56.96%	95.00%	73.55% - 99.24%
Negative Predictive Value	75.00%	59.60% - 85.92%	54.55%	30.02% - 77.05%	91.67%	74.59% - 97.63%
Accuracy	75.00%	59.66% - 86.81%	50.00%	34.56% - 65.44%	93.18%	81.34% - 98.57%

The table presents a comparative analysis of three diagnostic methods, namely VIA (Visual Inspection with Acetic Acid), Pap smear, and Colposcopy, with respect to their sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, positive predictive value, negative predictive value, and overall accuracy. For VIA, the sensitivity was found to be 71.43%, indicating the proportion of true positive results. Its specificity was 78.26%, representing the proportion of true negative results. The positive likelihood ratio was 3.29, while the negative likelihood ratio was 0.37. For Pap smear; the sensitivity was slightly higher at 76.19%, with a specificity of 26.09%. The positive likelihood ratio was 1.03, and the negative likelihood ratio was 0.91. For Colposcopy, the sensitivity was the highest among the three methods at 90.48%, and its specificity was 95.65%. The positive likelihood ratio for Colposcopy was 20.81, and the negative likelihood ratio was 0.1. In terms of predictive values, VIA had a positive predictive value of 75.00% and a negative predictive value of 75.00%. For Pap smear, the positive predictive value was 48.48%, and the negative predictive value was 54.55%. Colposcopy showed the highest positive predictive value at 95.00% and a negative predictive value of 91.67%. Regarding overall accuracy, VIA had an accuracy of 75.00%, Pap smear had 50.00% accuracy, and Colposcopy had the highest accuracy at 93.18%.

## DISCUSSION

In a developing country like India, cervical cancer remains a significant cause of cancer-related deaths among women. Studies, such as the one conducted by Manju Talathi et al., have compared the efficacy of different screening methods like Pap smear, VIA, and colposcopy for detecting precancerous and cancerous lesions of the cervix. Similar to their findings, our study also observed higher sensitivity for colposcopy (90.48%) compared to Pap smear (76.19%). However, VIA's sensitivity in our study was closer to that of Pap smear, with VIA at 71.43% and Pap smear at 76.19%. This suggests that while colposcopy is

considered the most accurate tool among the three methods, VIA can still assist in identifying pre-malignant and malignant cervical lesions.<sup>5-7</sup>

Another study by Singh et al. reported higher sensitivity for colposcopy (95%) and lower sensitivity for Pap smear (20%), which aligns with our study's results. However, their specificity for Pap smear was higher (91.25%) compared to colposcopy, while our study found higher specificity for colposcopy (95.65%) and lower for Pap smear (26.09%).<sup>8-9</sup>

Ashmita et al.'s study also found better sensitivity for colposcopy (90.24%) compared to Pap smear (19.5%), which supports our findings. Additionally, Jyothi Gandavaram et al. demonstrated that Pap smear had lower sensitivity (28%) and higher specificity (99.32%) than colposcopy (sensitivity of 80.2% and specificity of 82.14%). Our study's accuracy for colposcopy (93.18%) and Pap smear (50%) is consistent with their findings, further highlighting the advantage of colposcopy in diagnosing cervical lesions.<sup>10-12</sup>

Furthermore, Dipali et al. reported sensitivity and specificity of 91.7% and 45.45% for Pap smear, respectively, compared to our study's results of 90.48% sensitivity and 76.19% specificity for colposcopy. These studies collectively support colposcopy's superiority in accurately diagnosing precancerous and cancerous lesions of the cervix.<sup>13-14</sup>

## **CONCLUSION**

In conclusion, our study compared the efficacy of three different screening methods, namely Visual Inspection with Acetic Acid (VIA), Pap smear, and colposcopy, in detecting cervical cancer among 150 participants. Colposcopy demonstrated the highest sensitivity (90.48%) and specificity (95.65%) among the three methods, making it the most accurate diagnostic tool for identifying precancerous and cancerous lesions of the cervix.

While VIA and Pap smear showed lower sensitivity compared to colposcopy, they can still play a role in aiding the screening process, especially in resource-constrained settings. VIA, in particular, can be considered as an adjuvant to colposcopy in detecting and diagnosing pre-malignant and malignant cervical conditions.

Our findings align with previous studies that have also supported colposcopy as the most sensitive and specific screening method for cervical cancer. In countries like India, where cervical cancer is a major health concern, implementing effective screening programs using colposcopy as the primary diagnostic tool can significantly contribute to early detection and prevention of cervical cancer-related deaths.

Overall, our study highlights the importance of utilizing colposcopy in cervical cancer screening efforts, and further research should be conducted to improve accessibility and affordability of this valuable diagnostic method in developing countries to enhance women's healthcare outcomes.

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