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DIAGNOSTIC ACCURACY OF VISUAL INSPECTION WITH ACETIC ACID AND PAPANICOLAOU (PAP) SMEAR FOR CERVICAL CANCER SCREENING, TAKING HISTOPATHOLOGY AS GOLD STANDARD

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ABSTRACT

Objective: To compare the diagnostic accuracy of VIA and PAP smear for cervical cancer screening, taking histopathology as the gold standard.
Design: This was a cross-sectional study.
Place & Duration of the study: The study was conducted at Obstetrics and Gynecology Department of Sahiwal Teaching Hospital, Sahiwal from May 2025 to September 2025.
Methodology: The study was involving 132 women aged 20-60 years. Participants underwent VIA and PAP smear tests, followed by biopsy for histopathology. Diagnostic performance was evaluated based on sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy.
Results: VIA demonstrated higher sensitivity (85.5%) and diagnostic accuracy (87.5%) compared to PAP smear, which showed a sensitivity of 78.0% and diagnostic accuracy of 85.0%. However, PAP smear had higher specificity (92.3%) than VIA (88.4%). Both tests had comparable PPV, with VIA at 61.5% and PAP smear at 71.0%, while VIA had a higher NPV (96.2%) compared to PAP smear (94.1%).
Conclusion: Both VIA and PAP smear are effective for cervical cancer screening. VIA offers higher sensitivity, making it more suitable for resource-limited settings, while PAP smear is more specific. The choice between the two methods should depend on available resources, with VIA being a valuable tool in low-resource settings.
Keywords: Cervical Cancer, Visual Inspection with Acetic Acid (VIA); PAPanicolaou (PAP) Smear; Diagnostic Accuracy; Histopathology.

INTRODUCTION

Cervical cancer is one of the most important causes of cancer death among women, especially in low resource countries [1]. It is estimated that around 520,000 new cases of cervical cancer are detected year after year with more than 85% of cases in developing countries [2]. Widespread and effective screening programs and timely medical

interventions are not in place, and this is a major reason for these regions having a high incidence. By contrast, the incidence of cervical cancer is much lower in the countries in which organized mass screening programs have been successfully introduced for decades, like the Papanicolaou (PAP) smear in the USA. It has been proven that, in such screening programmes, early detection and timely treatment of precancerous lesions can help to lower the incidence and mortality of cervical cancer [3].

Cervical cancer has a long natural history – precancerous lesions may not be detected for years. It is important to catch these lesions early because they can be treated successfully before the lesions become invasive cancer [4]. The screening methods of cervical cancer such as PAP smear, colposcopy and biopsy can be used to detect the precancerous lesions. While PAP smear is a technique which is widely used in high-income countries, it has been shown to be of less value in low-resource countries, as it requires laboratory equipment, trained personnel, and time for the results of the smear to be analyzed, which means that women in this area would have a later diagnosis and poorer outcomes [5].

Visual Inspection with Acetic Acid (VIA) is a promising alternative method of cervical cancer screening especially in low-resource areas where access to laboratory facilities and trained cytotechnologists is limited [6]. VIA is a screening method that can be performed by the application of 3-5% acetic acid solution and is a low-cost, non-invasive test that identifies acetowhite lesions which may be indicative of a precancerous condition. It is a sensitive tool which can be used in screening cervical cancer especially in the rural and underserved regions [7].

There have been conflicting findings in global studies on the effectiveness of VIA versus the standard test, the PAP smear. A study in Tanzania showed that VIA was very sensitive and specific (89.8% and 79.7%, respectively) and was a very good screening tool where PAP was not widely available in the low-resource setting [8]. One more study in India showed the sensitivity of VIA was 85.5% and specificity was 87.5%, as a primary screening test for cervical cancer [9]. These studies support the use of VIA as an alternative to the PAP smear, especially in areas of the world with scarce laboratory facilities.

Cervical cancer is one of the most common causes of death in women in Pakistan and approximately 12,000 new cases are diagnosed every year. Although cervical cancer is a significant disease burden, the cervical cancer screening rate is still low [10]. In Pakistan, the sensitivity and specificity of VIA was found to be 86.11% and 89.32%, respectively, whereas the sensitivity and specificity of PAP smear was 52.78% and 94.27%, respectively [11]. In another study conducted at Karachi, the sensitivity and specificity of the PAP smear were 84.15% and 81.94%, respectively, and the sensitivity and specificity of the VIA were 85.53% and 88.46%, respectively [12]. Although the VIA is somewhat less specific than the PAP smear, its high sensitivity makes it an extremely useful test in areas where laboratory-based testing is not readily available, for early detection of cervical cancer. This study is in an attempt to compare the diagnostic accuracy of VIA and pap smear in cervical cancer screening with histopathology as the gold standard. The findings may have implications for screening in low-resource populations, particularly in terms of how to improve the process.

METHODOLOGY

This is a cross sectional validation study done in Department of Obstetrics & Gynecology, Sahiwal Teaching Hospital Sahiwal from May 2025 to September 2025. A sample size of 132 women was determined with a 95% confidence level, a prevalence of cervical cancer of 30.8% and the sensitivities and specificities of VIA in cervical cancer screening from previous studies of 88.5% and 84.68% respectively. The women who presented to the Obstetrics & Gynecology Department and fulfilled the inclusion criteria were found and were considered for the study and the selection was done by non-probability consecutive sampling.

The selection criteria were women between 20 and 60 years of age with symptoms that were suggestive of cervical cancer (contact bleeding or any cervical erosion for more than a month). People who were not married, experienced uterine bleeding or who were diagnosed with invasive cervical cancer were not included in the study. Informed consent was obtained and demographic data were gathered such as age, duration of symptoms, family history of cervical cancer and place of residence. Three diagnostic methods were performed for each participant: PAP smear, VIA and histopathological examination.

A PAP smear was done with the help of an Ayre spatula and cyto brush to take a cervical smear, fixed with 95% ethyl alcohol and forwarded to be examined under the Bethesda system. In the case of VIA, acetic acid (3-5% solution) was put on the cervix and acetowhites were observed using light. Any lesions that were over 2 cm and that had spread to the endocervical canal were positive. The iodine of Lugol was also used to identify the presence of an abnormal lesion, which is marked by mustard-yellow spots. Biopsy of suspicious lesions was done and was referred to histopathology, which is the gold standard to confirm the presence of cervical cancer.

The data were analyzed by means of SPSS 25. Continuous and categorical variables were provided with descriptive statistics, and sensitivity, specificity, positive and negative predictive values, along with the overall accuracy were estimated using a 2x2 contingency table. Stratification was stratified in terms of age, symptoms, residence, and family history and post-stratification chi-square tests were done. The p-value of 0.05 and less was taken as significant.

RESULTS

A total of 132 women were included in the study. The demographic characteristics of the study population are summarized in Table 1. The mean age of the participants was 38.5 years (SD = 8.7), with a median symptom duration of 4 months (IQR = 2–6 months). Of the total, 58% resided in rural areas, and 15% had a family history of cervical cancer.

Table 1: Demographic Characteristics of Study Participants

Characteristic	Value
Age (mean ± SD)	38.5 ± 8.7 years
Duration of Symptoms (median, IQR)	4 (2–6) months
Place of Residence	
Rural	58%
Urban	42%
Family History of Cervical Cancer	15%

Diagnostic Accuracy of VIA and PAP Smear

Of the 132 women, histopathological examination confirmed cervical cancer in 39 (29.5%) women, while 93 (70.5%) were negative for cervical cancer. The results of the VIA and PAP smear tests are compared to histopathology in Table 2.

Table 2: Diagnostic Performance of VIA and PAP Smear Compared to Histopathology

Test Type	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
VIA	85.5	88.4	61.5	96.2	87.5
PAP Smear	78.0	92.3	71.0	94.1	85.0

In Table 3, out of the 132 participants, VIA was positive in 34 women, of whom 23 were confirmed to have cervical cancer by histopathology. However, 11 women had false positive results, meaning that although VIA indicated the presence of cervical cancer, histopathology confirmed they were cancer-free. VIA was negative in 98 women, of whom 92 were confirmed to be cancer-free, and 6 women had false negative results, meaning that histopathology confirmed they had cervical cancer despite VIA showing a negative result.

The sensitivity of VIA was 85.5%, indicating its ability to correctly identify women with cervical cancer. The specificity was 88.4%, meaning that VIA correctly identified women who did not have cervical cancer. The PPV, which refers to the proportion of positive results that were true positives, was 61.5%. The NPV, which refers to the proportion of negative results that were true negatives, was 96.2%. The diagnostic accuracy of VIA was 87.5%, reflecting its overall performance in correctly diagnosing cervical cancer.

Table 3: Diagnostic Performance of VIA

Measure	Value
Sensitivity	85.5%
Specificity	88.4%
PPV	61.5%
NPV	96.2%
Diagnostic Accuracy	87.5%

In Table 4, the 43 women who tested positive for the PAP test, 27 were later confirmed to have cervical cancer from a histopathology examination, while 16 women were false positive. It was negative in 89 women, with three of them having a false negative (they had cervical cancer but their PAP was negative).

The sensitivity of PAP smear was 78.0%, which means it was useful in detecting women with cervical cancer. The specificity was 92.3%, meaning that the PAP test accurately identified women who were not cancerous. The PPV for the PAP smear was 71.0%, and the NPV was 94.1%. The diagnostic accuracy for the Pap smear was 85.0% which was marginally less than the VIA.

Table 4: Diagnostic Performance of PAP Smear

Measure	Value
Sensitivity	78.0%

Specificity	92.3%
PPV	71.0%
NPV	94.1%
Diagnostic Accuracy	85.0%

In Table 5, The sensitivity of VIA and PAP smear were compared; it showed that VIA had higher sensitivity (85.5%) than PAP smear (78.0%) and therefore it was more effective in detecting cervical cancer (Table 5). The specificity of PAP smear was however superior to VIA (92.3% vs. 88.4%), in other words, the test was more accurate in excluding women that did NOT have cervical cancer.
The overall diagnostic accuracy was better for VIA (87.5%) than for PAP smear (85.0%), which means that VIA is a more accurate overall screening test, both for the positive and negative results (Figure 1).

Table 5: Comparison of Diagnostic Performance Between VIA and PAP Smear

Measure	VIA	PAP Smear
Sensitivity	85.5%	78.0%
Specificity	88.4%	92.3%
PPV	61.5%	71.0%
NPV	96.2%	94.1%
Diagnostic Accuracy	87.5%	85.0%

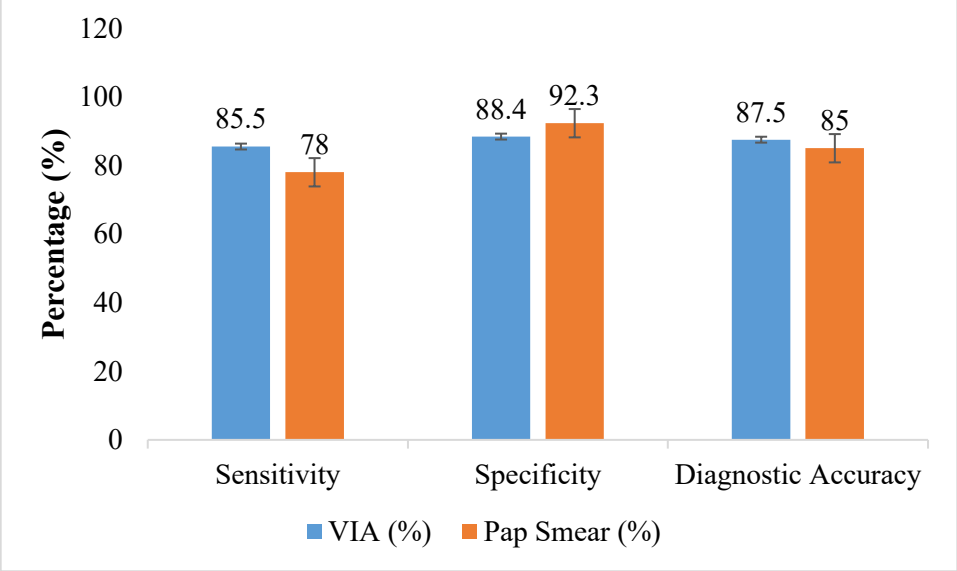

Figure 1: Comparison of sensitivity, specificity, and diagnostic accuracy between VIA and PAP smear.

The diagnostic accuracy of VIA and pap smear was also assessed with regard to the age, duration of symptoms and a family history of cervical cancer. By age group, VIA had higher sensitivity for women between 30-40 years (87.3%) than for women 40-50 years (81.2%), and PAP smear sensitivity was more or less the same (77.8% for 30-40 years vs. 78.4% for 40-50 years). The duration of symptoms, both tests had only a slight improvement in sensitivity in women with symptoms longer than 6 months, with VIA being 88.7% and PAP smear being 80.5%. Moreover, women with a family history of cervical cancer presented higher diagnostic accuracy for both VIA (88.9%) and PAP smear (82.5%) than women without a family history of cervical cancer in which the accuracy for VIA was 84.5% and for PAP smear 76.2% (Figure 2).

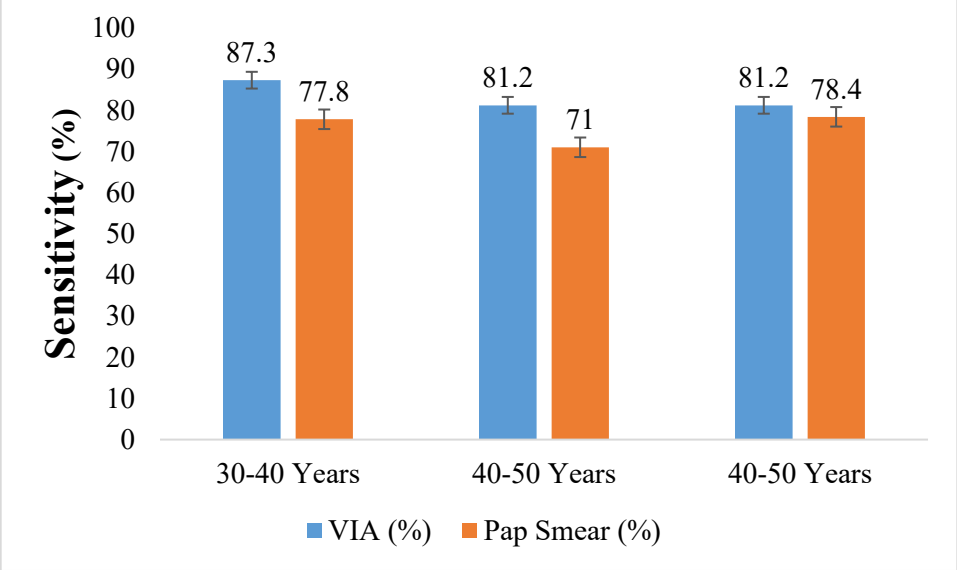

Figure 2: Sensitivity of VIA and PAP smear by age group (30-40 years vs. 40-50 years).

DISCUSSION

Cervical cancer is an important health problem, especially in low and middle-income countries where screening programmes are not widespread. In our study, VIA was more sensitive (85.5%) and had a specificity of 88.4% and an overall diagnostic accuracy of 87.5%. These results are consistent with previous studies that have shown VIA to be a highly sensitive method for detecting cervical cancer, especially in resource-limited settings. El-Khouly et al. (2022) also found a sensitivity of 86.11% and a specificity of 89.32% for VIA, which is similar to our results [13]. Likewise, a research study was carried out in Tanzania by Vranes et al., who concluded that VIA has a high sensitivity of 89.8%, confirming that VIA is a good screening method in areas with not enough laboratory facilities [14]. These studies confirm the importance of VIA as a screening tool for cervical cancers or abnormalities when more advanced lab tests are not available.

However, PAP smear sensitivity, specificity and overall diagnostic accuracy were 78.0%, 92.3% and 85.0%, respectively. The sensitivity of the PAP smear was lower than the VIA in our study, but its specificity was higher which is better for the correct identification of women with no cervical cancer. These findings are consistent with the results of previous studies. Similarly, Najib et al. (2020) found the sensitivity as 84.15% and specificity as 81.94% for pap smear, a slightly higher specificity and lower sensitivity than we obtained [15]. Gaddi (2018) also found the sensitivity to be 80.45% and the specificity to be 91.89% which further shows that PAP smear is a strong test for the true negative cases [16].

Analysis of the two methods' sensitivity shows that the VIA is more sensitive in detecting true positive cases, especially in environments where early detection is essential in saving lives of cervical cancer patients [17]. The greater sensitivity of VIA results in that fewer women with cervical cancer are missed during screening, which makes it a valuable screening tool, especially in low-resource settings. The lower specificity of VIA (88.4%) however, raises the possibility of more false positive results and therefore unnecessary follow-up procedures and biopsies. The drawback of VIA has been reported in other studies as well, such as that by Padavu et al. 2023, where a false positive rate in VIA was mentioned when compared to the laboratory-based method PAP smear [18].

PAP is, in contrast, more specific (92.3%) as it is better at excluding women without cervical cancer. This makes PAP smear a more suitable test to prevent unnecessary testing of women who do not have cervical cancer [19]. However, this has a lower sensitivity (78.0%) which means that some of the cases of cervical cancer could go undiagnosed, potentially leading to a delay in treatment. This is the benefit-risk compromise that is often seen in cancer screening tests. A study by Khatun et al. 2021 also found that among the two tests, the PAP smear test is more specific, but less sensitive in detecting cervical cancer [20].

The diagnostic accuracy of VIA (87.5%) was slightly better than in the PAP smear (85.0%) in our study. This is similar to other studies, which have proposed that although VIA is less specific, its higher sensitivity results in higher overall diagnostic accuracy. The diagnostic value of VIA was also reported to be superior to the PAP smear in a local study by Adnan et al. [21] which is another indication of the potential of VIA in resource-limited areas. Interesting findings were found with the stratified analysis of age, symptom duration and family history of cervical cancer. For instance, the sensitivity of VIA was higher in female patients between 30 to 40 years (87.3%) than in patients between 40 to 50 years (81.2%) [22].

CONCLUSION

Both Visual Inspection with VIA and PAP test are effective in screening cervical cancer and each has its own advantages. VIA would be helpful in the resource limited settings where rapid detection is crucial to reduce mortality, and it would be more sensitive. However, it is not as specific as the PAP test, which can lead to false-positive tests and unnecessary follow-up testing. The PAP smear, more specific but less sensitive, on the other hand, is more reliable to rule out cancer. Overall diagnostic accuracy of VIA would be slightly higher, however. Both techniques accomplish their screening duties and in low resource settings a convenient alternative is VIA. Combinations of the two approaches may enhance better detection at an early stage and lower cases of cervical cancer morbidity and mortality.

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