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ACCURACY OF VISUAL INSPECTION WITH ACETIC ACID FOR CERVICAL LESIONS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstrak

Latar Belakang: Inspeksi visual dengan asam asetat (IVA) masih широко digunakan sebagai metode skrining kanker serviks di negara berpenghasilan rendah dan menengah, meskipun akurasi diagnostiknya masih diperdebatkan. Studi ini bertujuan mengevaluasi akurasi IVA dalam mendeteksi lesi serviks derajat tinggi (CIN2+) dibandingkan histopatologi. Pencarian sistematis dilakukan pada PubMed, Scopus, dan ScienceDirect (2015–Oktober 2025). Studi yang memenuhi kriteria menyajikan data untuk tabel 2×2 dan dinilai menggunakan QUADAS-2. Analisis menggunakan model bivariat efek acak dan HSROC. Sebanyak 13 studi diinklusi dan 5 dianalisis secara kuantitatif. Sensitivitas berkisar 0,25–0,92 dan spesifisitas 0,49–0,97, dengan heterogenitas yang tinggi. Risiko bias umumnya rendah hingga sedang, terutama pada seleksi pasien serta alur dan waktu pemeriksaan. IVA menunjukkan akurasi sedang dengan variasi antar populasi. Meskipun kurang sensitif dibanding skrining HPV, IVA tetap menjadi alternatif pragmatis di setting terbatas, khususnya dalam strategi screen-and-treat, dengan kebutuhan peningkatan pelatihan dan jaminan mutu.

Kata Kunci: IVA Tes, Kanker Serviks, Lesi Serviks, Diagnostik

Abstract

Visual inspection with acetic acid (VIA) remains widely used for cervical cancer screening in low- and middle-income countries, despite ongoing concerns regarding its diagnostic accuracy. This study aimed to evaluate the diagnostic performance of VIA for detecting high-grade cervical lesions (CIN2+) compared with histopathology. A systematic search was conducted in PubMed, Scopus, and ScienceDirect (2015–October 2025). Eligible studies provided sufficient data to construct 2×2 tables and were assessed using QUADAS-2. A bivariate random-effects model and HSROC analysis were applied. Thirteen studies were included, with five eligible for quantitative synthesis. Sensitivity ranged from 0.25 to 0.92 and specificity from 0.49 to 0.97, indicating substantial heterogeneity. Risk of bias was generally low to moderate, mainly in patient selection and flow and timing domains. VIA demonstrates moderate accuracy with variability across populations. Although less sensitive than HPV-based screening, VIA remains a pragmatic option in resource-limited settings, particularly within screen-and-treat strategies, with strengthened training and quality assurance required.

Keywords: *VIA Test, Cervical Cancer, Cervical Lesion, Diagnostic*

INTRODUCTION

Cervical cancer remains a leading cause of premature death among women worldwide, especially in low- and middle-income countries. According to the 2019 Global Burden of Disease (GBD) analysis, there were 565,541 new cases and 280,479 deaths, with age-standardized incidence and mortality rates of 13.35 and 6.51 per 100,000 women, respectively (Momenimovahed et al., 2023). The burden is disproportionately higher in countries with low sociodemographic indices, which experience greater incidence, mortality, and disability-adjusted life years (DALYs) compared to high-income countries. Data from 2020 to 2022 highlight the urgency, as cervical cancer is the fourth most common cancer and the leading cause of cancer death in women (Pimple & Mishra, 2022).

High mortality from cervical cancer is closely linked to limited access to quality, organized, and sustainable screening programs, as well as delays in early detection. As a result, most cases are identified at advanced stages. Persistent infection with high-risk human papillomavirus (hrHPV) is the primary cause of cervical carcinogenesis, leading to the progression of cervical intraepithelial neoplasia (CIN) to invasive cancer. Recent cohort studies in high-burden settings, such as Kenya, show that about 35% of women with persistent hrHPV infection over 18 months develop CIN2+ lesions, highlighting the significant risk in low- and middle-income countries. While some CIN lesions, especially in young women, may regress spontaneously by up to 50–60% within two years (Zhang et al., 2025), others progress to high-grade lesions (CIN2+), which are clinically significant and a key focus for secondary prevention. Given the complexity of cervical cancer risk and progression, heterogeneity exists among screened populations, particularly by HIV status, age, and lesion prevalence. To address this, our study assessed the diagnostic performance of VIA in key subgroups, including HIV-positive and HIV-negative women, to better account for variability and enhance the relevance of our findings.

Due to resource constraints in many developing countries, visual inspection with acetic acid (VIA) has been widely adopted as a low-tech screening method in primary healthcare settings, supporting a single-visit “screen-and-treat” approach. VIA offers a practical alternative where laboratory infrastructure is limited. However, recent evidence indicates that VIA's sensitivity for detecting clinically significant precancerous lesions (CIN2+) is only about 51.5% (Nguyen et al., 2022). This low sensitivity increases the risk of false-negative results, which may delay diagnosis and allow lesions to progress to invasive cancer. These limitations can reduce the effectiveness of secondary prevention and hinder progress toward global cervical cancer elimination targets.

In line with the World Health Organization's recommendations regarding cervical cancer elimination strategies through HPV-based screening approaches, the role of VIA has shifted from a primary screening method to a triage test for women with HPV-positive results (Lobin et al., 2024). This paradigm shift requires re-evaluation of VIA's diagnostic performance in the context of new screening algorithms. Furthermore, the variation in VIA performance reported across studies is influenced by operator-dependent factors, inconsistent standards for interpreting acetowhite lesions, differences in population characteristics (e.g., HIV status, age, and lesion prevalence), and verification bias because not all participants underwent histopathological confirmation. These

factors contribute to substantial heterogeneity across studies and create uncertainty about the generalizability of results to real-world clinical practice.

Previous reviews have struggled to provide robust pooled estimates due to incomplete diagnostic data, inconsistent focus on clinically meaningful endpoints (CIN2+), and insufficient consideration of VIA's use as primary screening or triage in the context of HPV-based screening. These methodological gaps limit the accuracy of VIA sensitivity and specificity estimates relevant to current screening practices, especially in low- and middle-income countries. In contrast, this study focused on detecting high-grade cervical lesions (CIN2+) as the primary outcome, included only studies with complete diagnostic data for 2×2 table construction, and used a hierarchical summary receiver operating characteristic (HSROC) meta-analysis to obtain precise estimates and address inter-study heterogeneity. The HSROC model allows for a rigorous synthesis of diagnostic accuracy by accounting for study-level variability and threshold effects. This systematic review and meta-analysis aimed to comprehensively evaluate the diagnostic accuracy of VIA compared to histopathology. By linking pooled sensitivity and specificity estimates to the World Health Organization's 2030 cervical cancer elimination targets, this study provides essential evidence to guide policy and implementation. Aligning our findings with these global benchmarks underscores the practical significance and urgency of this work, highlighting VIA's potential role in achieving elimination goals where it remains the primary screening method.

METHOD

Data sources and search strategy

The articles in this review were search online through three sources which are Pubmed, Scopus, ScienceDirect using the search string ("visual inspection with acetic acid" OR "VIA test" OR "IVA test") AND ("cervical cancer" OR "cervical intraepithelial neoplasia" OR "CIN") AND ("sensitivity" OR "specificity" OR "diagnostic accuracy"). Time-lapse considered for the search was from 2015 until October 2025.

Eligibility criteria

Eligibility criteria were predefined and an accordant agreement was reached by all authors. Inclusion criteria for this review such as used the visual inspection with acetic acid (VIA) for the interventions of study, comparison with the gold standard histology. Disease was understood as the presence of CIN 2 or more advanced lesions, assessed the true positive (TP), true negative (TN), false positive (FP), and false negative (FN). Types of articles other than original research such as book chapters, reviews, letters, or editorials were excluded in this review.

Selection and data extraction

The authors independently assessed the search results. We screened the research results based on the titles and abstracts to excluded irrelevant studies. We then searched for the full text of studies that appeared to be relevant and read them thoroughly to determine whether they met the inclusion criteria for this study. Data extraction was designed using the excel with the following entries first authors name, year of study publication, country, age range of the study population, whether

the women were asymptomatic or had gynecologic signs at the time of screening, place of screening, study design, screener, disease threshold, gold standard for confirmatory testing, recipients of a confirmatory test and diagnosis, and the results of TP, TN, FP, FN for each study.

Quality assessment of included study

The quality assessment of included study was assessed based on the criteria outlined in the quality assessment oof diagnostic accuracy studies (QUADAS-2) tool. Quality assessment and risk of bias assessment were performed by two reviewers and any disagreements were resolved by discussion.

Statistical analysis

Meta-analysis in this study will be performed to quantitatively synthesize the diagnostic accuracy data from the eligible studies. Based on the available data, the primary analysis will focus on the detection of cervical lesions or CIN. For each study included in the meta-analysis, the raw data from 2x2 contingency table consisting of TP, TN, FP, and FN were extracted. From this data, the following key diagnostic accuracy metrics were calculated for each individual study: sensitivity and specificity. All statistical analysis will be performed using a dedicated meta-analysis software metaDTA.

RESULT

Study Selection

The total number of records identified from the literature search was 1,296, obtained from various sources such as Scopus (635), PubMed (276), and ScienceDirect (385). After the removal of 57 duplicate records from the database, the titles and abstracts of the remaining 1,239 records were used for screening. In the initial screening phase, a total of 1,196 publications were excluded for not meeting the inclusion criteria, while 43 publications were qualified for further analysis in the full-text phase. All publications considered for full-text analysis were successfully retrieved (reports not retrieved = 0). Of these, 43 full-text articles were assessed for their inclusion criteria. A total of 28 studies were excluded following these reasons: irrelevant interventions (n = 4), inappropriate outcome measures (n = 10), irrelevant comparators (n = 11), and inappropriate study designs (n = 3). In the end, only 13 studies met the inclusion criteria, and their results were used to inform the systematic review. Out of those, five studies were identified as having suitable data to create 2×2 tables, thus making them useful in the meta-analysis of diagnostic accuracy.

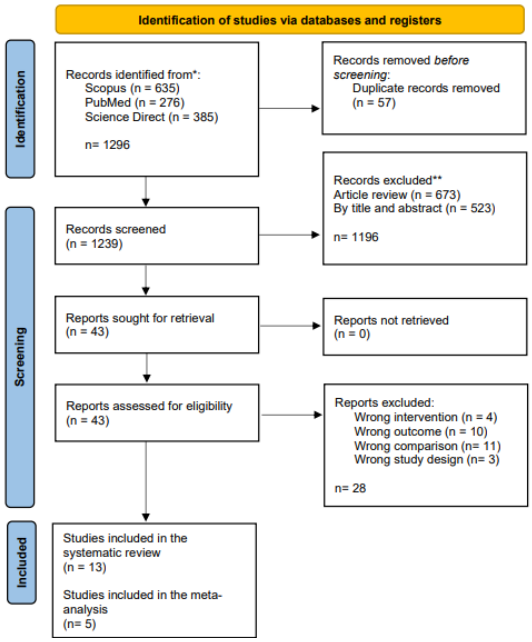

Figure 1. PRISMA Flow Diagram

Table 1. Characteristics of Included Studies

Author	Year	Country	Study Design	Population	Index Test	Reference Standard	Target Lesion
(Awolude et al., 2021)	2021	Nigeria	Prospective cohort	Women living with HIV	VIA	Histopathology	CIN2+
(Batool et al., 2019)	2019	Pakistan	Cross-sectional validation	Women 20–60 years	VIA	Histopathology	CIN
(Harshitha et al., 2023)	2023	India	Cross-sectional observational	HPV-positive women ≥30 years	VIA	Histopathology	CIN2+
(Jayabalan et al., 2023)	2023	India	Crossover randomized trial	VIA+ / abnormal cytology women	VIA (triage)	Histopathology	CIN2+
(Lertcharernrit et al., 2016)	2016	Thailand	Prospective study	Pregnant women	VIA	Histopathology	Low-grade lesions
(Luckett et al., 2019)	2019	Botswana	Prospective cohort	WLHIV, hrHPV-positive	VIA (triage)	Histopathology	CIN2+
(Luckett et al., 2024)	2024	Botswana	Prospective cohort	HPV-positive (WLHIV & non-HIV)	VIA (triage)	Histopathology	CIN2+
(Mekuria et al., 2024)	2024	Ethiopia	Randomized controlled trial	HPV-positive women	VIA	Histopathology	CIN2+
(Mohamad et al., 2016).	2016	Egypt	Cross-sectional study	Women 20–50 years	VIA	Histopathology	CIN I–III & cancer
(Rajpar et al., n.d.)	2021	Pakistan	Interventional study	Married women 15–60 years	VIA	Histopathology	Precancer & cancer
(Shrestha et al., 2020)	2020	Nepal	Cross-sectional comparative	Gynecology outpatients	VIA	Histopathology	CIN I–III & cancer
(Tebeu et al., 2015)	2015	Cameroon	Cross-sectional	Women 30-60 years	VIA	Histopathology	CIN2+
(Tonui et al., 2025)	2025	Kenya	Cross-sectional analytical	Women living with HIV	VIA	Histopathology	CIN2+

Characteristics of Included Studies

The studies included in this systematic The studies included in this systematic review totaled 13, with publication years from 2015 to 2025, representing a range of study designs, such as cross-sectional studies, prospective cohort studies, interventional studies, and randomized controlled trials. They were conducted in several countries of Africa and Asia, predominantly in the low- and middle-income countries represented in the studies by Tebeu et al. of Cameroon(Tebeu et al., 2015), Jamal and Batool of Pakistan (Batool et al., 2019), and Luckett et al. of Botswana (Luckett et al., 2019, 2024).

There was significant heterogeneity amongst the study populations, which included women of reproductive age from the general population, women living with HIV, pregnant women, and women with positive HPV screening results. For example, Awolude et al. and Luckett et al. exclusively investigated the performance of VIA amongst women living with HIV (Awolude et al., 2021; Luckett et al., 2019, 2024), while Lertcharernrit et al. studied the use of VIA in pregnant women attending antenatal clinics (Lertcharernrit et al., 2016). The study settings were similarly diverse, ranging from facility-based screening clinics and HIV clinics to tertiary referral hospitals and community-based screening campaigns.

The index test across all studies was visual inspection with acetic acid, as either a primary screening modality or as a triage test following HPV screening, according to the reports of Mekuria et al. and Luckett et al. within the framework of HPV-based screening strategies (Luckett et al., 2024; Mekuria et al., 2024). All the studies included cervical histopathology as the reference standard-obtained by colposcopy-directed biopsy or systematic cervical biopsy with or without endocervical curettage. The target lesions assessed were not quite similar in all studies. Most studies report on the diagnostic accuracy of VIA for high-grade cervical lesions, CIN2+, such as those by Tebeu et al., Luckett et al., and Mekuria et al (Luckett et al., 2024; Mekuria et al., 2024; Tebeu et al., 2015). However, a number of studies evaluated low-grade precancerous lesions or combined precancerous lesions and invasive cervical cancer as outcomes, such as those by Mohamad et al. and Shrestha et al (Mohamad et al., 2016; Shrestha et al., 2020). This means that out of all the studies included, only some studies were found to have sufficient data that enabled constructing a 2×2 contingency table, qualifying them for a quantitative meta-analysis regarding diagnostic accuracy. In contrast, all studies are subject to a qualitative synthesis but used separately because of inadequate reporting of data, partial verification of studies, application of Bayesian correction, or because VIA was not used as the index test.

Forest Plot and HSROC Analysis

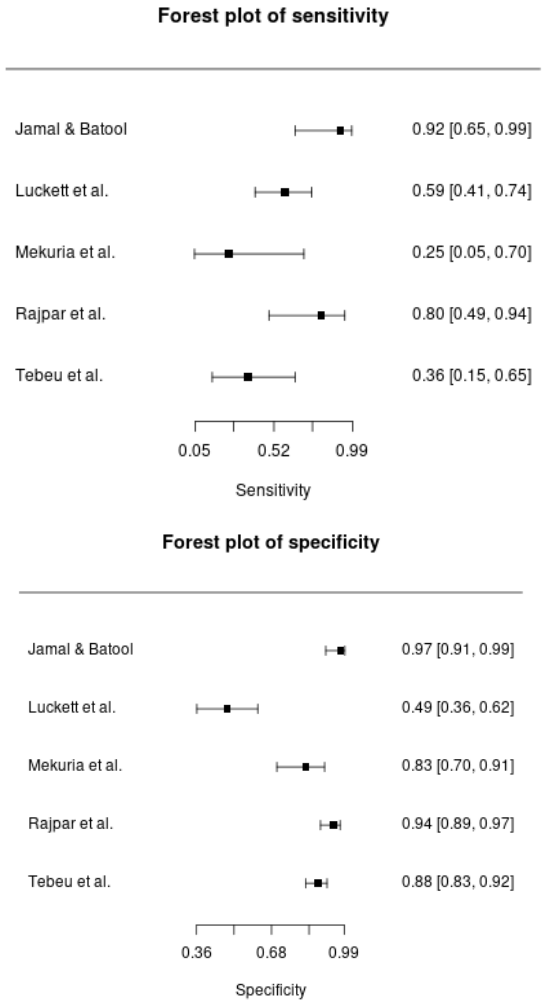

Figure 2. Forest Plot of Sensitivity and Specificity

Forest plots indicated significant variability in sensitivity and specificity of VIA between studies (Figure 2). For sensitivity, individual study data varied from low to high. The lowest sensitivity was observed in the study by Mekuria et al. (0.25; 95% CI 0.05–0.70) and another by

Tebeu et al. (0.36; 95% CI 0.15–0.65). On the other hand, the highest sensitivities were observed in the study by Jamal and Batool (0.92; 95% CI 0.65–0.99) and another by Rajpar et al. (0.80, 95% CI 0.49–0.94). On the other hand, the specificity of VIA was seen to be more consistent and higher in most studies. The highest specificity for VIA was observed by Jamal and Batool, which was 0.97 (95% CI 0.91-0.99), and by Rajpar et al. of 0.94 (95% CI 0.89-0.97), while Luckett et al. reported a lower specificity for VIA of 0.49 (95% CI 0.36-0.62). The study by Mekuria et al. and Tebeu et al. reported moderate to high specificity.

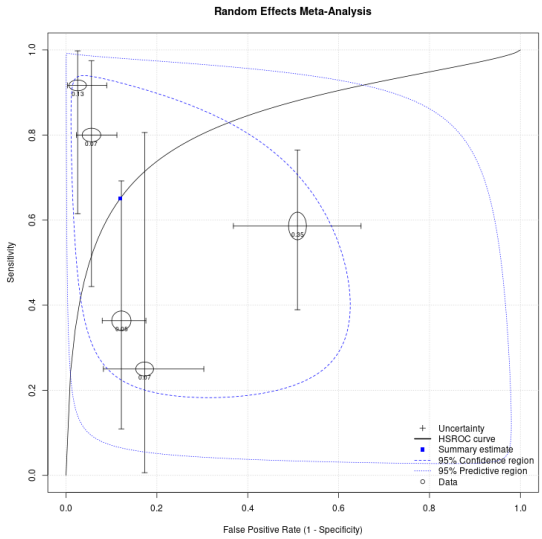

Figure 3. HSROC Analysis

The HSROC curve showed a clear trade-off between sensitivity and specificity; however, the location of the pooled estimate was within a region of moderate sensitivity and a high rate of false positives. It was also seen that the region for the pooled estimates being narrower suggested stability in the average performance, while the wider region for predictions showed heterogeneity in the results. These findings suggest that overall diagnostic accuracy of VIA is moderate. Moreover, variability in the performance of VIA is found to be influenced by differences in populations studied, in settings of screening performed, and whether the test is used as a primary or a triage test.

Risk of Bias Assessment

Bias risk assessment using the QUADAS-2 tool revealed that most studies included had a low to moderate risk of bias for the majority of domains. Variability has been noted mainly for the items covering patient selection and flow, and timing (Figure 4 and Figure 5).

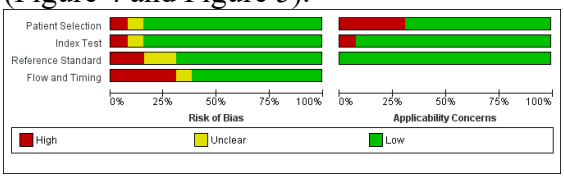

Figure 4. Risk of Bias Graph

Of all the studies under Patient Selection, the majority of them were seen to experience a low level of bias. Looking at the studies carried out by Mohamad and Rajpar (Mohamad et al., 2016; Rajpar et al., n.d.), they were seen to experience a potential bias. The basis of the potential bias in these two studies in relation to Patient Selection lies in the fact that histopathological examination was primarily carried out in subsets of people who were selected to undergo biopsies, unlike studies carried out by Tebeu.

Most of the included studies under the Index Test Domain, such as those by Jamal and Batool, Luckett et al., and Tebeu et al. (Batool et al., 2019; Luckett et al., 2024; Tebeu et al., 2015), were considered to have a low risk of bias because of the relative consistency with which VIA was applied. However, some studies such as those by Mohamad et al. and Tonui et al. were recorded as having an unclear risk of

bias due to inadequate information on blinding or standardization of interpretation of VIA results (Mohamad et al., 2016; Tonui et al., 2025).

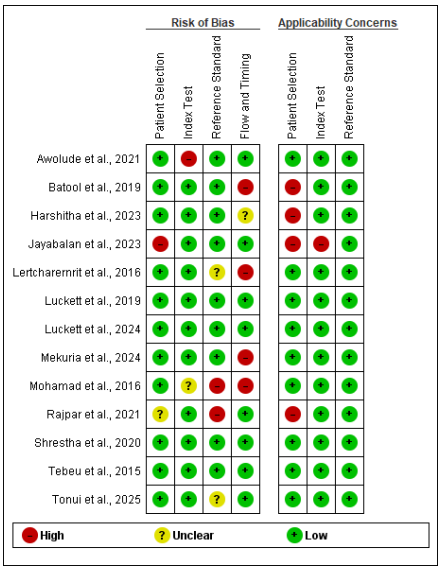

Figure 5. Risk of Bias Summary

Within the Reference Standard domain, it was observed that the majority of studies showed a low risk of bias due to the histopathology method adopted as the reference standard. However, studies with selective verification methods, like those conducted by Mohamad et al. and another one conducted by Rajpar et al. (Mohamad et al., 2016; Rajpar et al., n.d.), had a high risk of bias due to insufficient information being provided on histopathological examination procedures.

The Flow and Timing domain had the highest variability in risk of bias results. Some of the included studies, like Mohamad et al. and Mekuria et al. (Mekuria et al., 2024; Mohamad et al., 2016), had high risk of bias, particularly due to partial verification or the difference in the time interval from the index test to the reference standard. Conversely, those studies which demonstrated clear and prospective pathways in their diagnostic process, like Tebeu et al., Luckett et al., and Shrestha et al., had a low risk of bias outcome in the Flow and Timing domain (Luckett et al., 2024; Shrestha et al., 2020; Tebeu et al., 2015).

Regarding the applicability concerns addressed by the studies included in the systematic review, the vast majority of the studies showed low concern in all domains of applicability concern; however, studies focusing on certain populations, such as Awolude et al. and Tonui et al. (Awolude et al., 2021; Tonui et al., 2025), which focused on women with HIV, showed higher concerns within the domain of patient selection applicability concern. In short, despite the limitations concerning the study methods identified in several studies, the methodological quality of the studies included in the systematic review was found to be satisfactory for the interpretation of the results of the systematic review, under the condition that the sources of bias are taken into account.

DISCUSSION

This meta-analysis showed that visual inspection with acetic acid (VIA) had moderate diagnostic accuracy in detecting cervical lesions, with substantially varying sensitivity and relatively more stable specificity between studies. These findings are in line with previous reports that show that the performance of VIA is strongly influenced by the implementation context and characteristics of the targeted population (Acosta-Enriquez et al., 2024; Gustafson et al., 2023; Khanijahani et al., 2022). The wide variation in sensitivity in this analysis as seen in Mekuria et al., Tebeu et al., Jamal and Batool, and Rajpar et al (Jamal et al., n.d.; Mekuria et al., 2024; Rajpar et al., n.d.; Tebeu et al., 2015). is consistent with previous meta-analyses that

reported a wide range of VIA sensitivity, especially in low- and middle-income countries (Pramesh et al., 2022; Srinath et al., 2023). These variations are often due to differences in health infrastructure, levels of public awareness, and cultural and economic barriers that affect access and acceptance of screening.

The specificity of VIA in this analysis tends to be more consistent than sensitivity, a pattern that has also been reported in various comparative evaluations of cervical screening methods. This suggests that VIA is relatively more reliable in identifying individuals without disease than in detecting all high-degree lesions consistently (Debeaudrap et al., 2025; Mremi et al., 2022). For example, among HPV-positive women, VIA sensitivity for CIN3+ detection was reported around 79-86%, with specificity between 54% and 70%, but performance varied significantly by provider (Baena et al., 2023). The trade-off between the sensitivity and specificity apparent on the HSROC curve in this study reflects the inherent characteristics of visual inspection-based tests, which rely heavily on the subjectivity of clinical interpretation and examiner experience.

The heterogeneity seen in the HSROC curve, particularly through the broad prediction region, indicates significant clinical and methodological variation between studies. One of the main determinants of such heterogeneity is differences in population characteristics. Studies conducted on women living with HIV (e.g. Awolude et al.; Luckett et al.; Tonui et al.) face different epidemiological contexts than the general population, given that HIV infection is associated with an increased prevalence of persistent HPV infection and progression of cervical lesions (Agus Somia et al., 2025; Tesfom et al., 2025). Women with HIV have a 3 to 6 times higher risk of being infected with HPV, progressing to high-degree cervical lesions (HSIL), and cervical cancer than women without HIV, especially if CD4 cell counts are low and without optimal combination antiretroviral therapy (cART) (Gilles et al., 2023). This condition can affect both sensitivity and specificity through changes in cervical morphology as well as increased lesion prevalence, which in turn impacts the predictive value of the test. This phenomenon is known as the spectrum effect, in which the performance of diagnostic tests changes according to the characteristics of the population being examined.

In addition to population variation, VIA's role in screening algorithms also contributes to differences in accuracy estimates. In some studies, VIA was used as a primary screening method, while in others it acted as a triage test after HPV screening. When used as triage in HPV-positive populations, the prevalence of high-degree lesions is higher than in the general population, thus affecting the estimation of sensitivity and specificity (Rezhake et al., 2025; Wang et al., 2025). This is in line with the literature that suggests that a combination or sequence of diagnostic tests can result in shifts in the operational characteristics of the test (Nahm, 2022; Riggioni et al., 2024).

Methodological factors also have a significant contribution to the variation in results. Some of the studies in this analysis show the potential for partial verification, where histopathology as a reference standard is not systematically performed on

all participants, but mainly on individuals with positive screening results or clinical suspicion. This kind of verification bias can lead to overestimation of sensitivity and underestimation of specificity (Kohn, 2022; Niknejad et al., 2023). In contrast, studies with a more systematic prospective design and verification flow tend to result in more conservative and stable estimates. Variations in the definition of lesion targets, such as the use of CIN2+ compared to a combination of precancerous and invasive cancer lesions, may also affect outcomes, as other studies have shown that differences in clinical thresholds have a direct impact on the classification of true positives and false negatives (B. Zhang et al., 2024).

Although the diagnostic accuracy of VIA in this meta-analysis is not comparable to HPV-based screening, these findings should be interpreted in the context of the capacity of the global health system. WHO in its cervical cancer elimination strategy (target 90-70-90) emphasizes HPV-based screening as a more sensitive and sustainable approach (Luu et al., 2025). Dynamic models show that periodic HPV screening every 2-3 years can accelerate cervical cancer elimination, even faster than traditional Pap screening, with the potential for significant reductions in cases and deaths (Luu et al., 2025; Simms et al., 2023). However, the implementation of molecular screening still faces infrastructure, cost, and service distribution constraints in many low- and middle-income countries. In this context, VIA retains its pragmatic role as a low-cost screening method, provides immediate results, and enables a "screen-and-treat" approach, which has been shown to lower cervical cancer incidence and mortality in several community trials (Lawson et al., 2023; Lohiya et al., 2022).

The relatively stable specificity of most of the studies in this analysis suggests that VIA is quite effective in identifying individuals without disease, so it can reduce overtreatment if applied with the right protocols. However, variations in sensitivity indicate that some high-degree lesions may go undetected, especially in settings with limited training or a high case load (Moein et al., 2025). Therefore, the success of the implementation of VIA depends not only on intrinsic accuracy, but also on the quality of training, clinical supervision, and quality assurance systems. Previous implementation studies have shown that ongoing training and performance audits can improve the consistency of VIA interpretation (Alley et al., 2023; Merhi, 2023).

In addition to the studies included in the quantitative meta-analysis, several other studies remain important contributions to qualitative synthesis. Studies such as Awolude et al., Harshitha et al., and Luckett et al. (2024) report estimates of sensitivity and specificity without providing complete data to construct table 2×2, so they cannot be included in bivariate analysis. Nevertheless, the pattern of results reported in these studies is generally consistent with the findings of this meta-analysis, particularly regarding the variability of VIA sensitivity between populations. The study by Tonui et al., which used a Bayesian correction approach to address partial verification, showed that methodological adjustments can result in different estimates than conventional analyses, highlighting the importance of biased considerations in the interpretation of diagnostic performance. In

addition, the study by Jayabalan et al., which evaluated VIA not as the primary index test, demonstrates the complexity of VIA's role in broader screening algorithms (Jayabalan et al., 2023). Overall, the existence of these studies reinforces that VIA's performance is contextual and strongly influenced by study design, verification strategies, and its clinical role in the screening pathway.

The systematic review has several strengths, including a comprehensive literature search strategy on various databases, the use of the QUADAS-2 instruments for methodological quality assessment, as well as the application of the bivariate random-effects model and the HSROC approach that allows for a more accurate simultaneous estimation of sensitivity and specificity. In addition, the included studies covered a wide range of populations and settings in low- and middle-income countries, increasing the relevance of the findings to the global context. However, there are some limitations, including the relatively limited number of studies that meet the criteria for quantitative synthesis, substantial clinical and methodological heterogeneity, and potential verification bias in some studies. Variations in the definition of the lesion target and the role of VIA in the screening algorithm may also affect the combined estimates obtained. Future research needs to evaluate a combination of screening algorithms that are more adaptive to local contexts, including risk-based approaches and the integration of digital technologies to improve the consistency of visual interpretation.

CONCLUSION

This study concluded that VIA has moderate diagnostic accuracy as a diagnostic method of cervical lesions compared to histopathological methods. Sensitivity between studies had wide variance values, ranging from 0.25 (95% CI 0.05–0.70) to 0.92 (95% CI 0.65–0.99), with higher and consistent specificity values, with the highest values of 0.97 (95% CI 0.91–0.99) and 0.94 (95% CI 0.89–0.97), and the lowest value of 0.49 (95% CI 0.36–0.62). Implicitly, the results of this study support the use of VIA as a good screening method and are applicable especially to low- and middle-income countries with limited access to cytology or molecular tests. The wide variation in sensitivity indicates that there is a need for standardization of training, quality control, and consistent establishment of diagnostic thresholds. Thus, this study provides a basis for quantitative synthesis-based evidence regarding the diagnostic accuracy of VIA compared to histopathology, which can be used as a basis for cervical cancer screening policy making and optimization of implementation strategies in resource-constrained settings.

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