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Efficacy of Pap Smear versus VIA for detecting HPV-related Cervical Cancer in sexually active women in Adamawa and Taraba States: A Comparative Study

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Abstract **Original Research Article**

Human Papillomavirus (HPV) is recognized as the most prevalent sexually transmitted viral infection among sexually active adolescents. This study aimed to assess the efficacy of Pap smear versus Visual Inspection with Acetic Acid (VIA) in detecting HPV-related cervical cancer in sexually active women from Adamawa and Taraba States, Nigeria. The research involved 432 women, and the results revealed significant findings in the comparison between Pap smear and VIA. The prevalence rates of cytological abnormalities, precancerous lesions, and diagnostic accuracy indicators are presented, providing insights into the performance of each screening method. 432 of the women screened, 170 tested positive for precancerous lesions using VIA/VILI, resulting in a prevalence rate of 39.4%. Taraba State had the highest proportion of positive cases (96) with an incidence of 56.5%, while Adamawa State had 74 positive cases with a prevalence of 43.5%. The prevalence rates were statistically significant in Taraba State (OR = 1.281, df=1, 95% CL = 0.860-1.923, and P=0.027). For cervical cytological abnormalities detected by Papanicolaou smear, 195 (45.1%) of the women in both states were positive for abnormal cytology, while 236 (54.6%) were negative (showed no cervical abnormality). Most participants were diagnosed with low-grade squamous intraepithelial lesion (LSIL), accounting for 93 (21.6%). The proportion of atypical squamous cells of undetermined significance (ASCUS) was 61 (14.1%), and high-grade squamous intraepithelial lesion (HSIL) was 45 (10.4%). The participants' age ranged from 15 to 54 years, with the peak age prevalence observed in the 35-44 years' group (48.8%) showing precancerous lesions, followed by the 25-34 years' group with 50 cases (29. 4%).VIA confirmed a sensitivity of 61.76% (54.0-69.195% CL) and specificity of 65.27% (59.2-71.059% CL) with a positive predictive value (PPV), negative predictive value (NPV), and odds ratio (OR) of 53.6 (95% CL=10.0-15.0), 72.5 (95% CL=50.2-78.2), and 2.90, respectively. Cytological sensitivity, specificity, PPV, NPV, and OR were 53.6 (95% CL=46.7-51.2), 59.7 (95% CL=55.4-61.0), 53.5 (95% CL=49.4-58.2), 83.9 (95% CL=50.2-78.2), and 3.95. Cytological abnormality by Pap smear screening shows a moderate level of diagnostic performance over VIA, as the odds ratio for Pap smear is 3.95. However, VIA showed a statistically significant difference at P<.001. The study concludes that both VIA and Pap smear are valuable in detecting HPV-related cervical lesions, with Pap smear demonstrating higher sensitivity and specificity. These findings emphasize the importance of targeted prevention strategies, including vaccination programs, to control HPV infections and reduce cervical cancer prevalence.

Keywords: Pap Smear, Visual Inspection with Acetic Acid (VIA), Human Papillomavirus (HPV), Cervical Cancer, Nigeria.

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INTRODUCTION

Human Papillomavirus (HPV) infection is globally recognized as the most common sexually transmitted viral infection, particularly among sexually active adolescents (Bernard *et al*., 2010). High-risk HPV DNA is prevalent in 99.7% of cervical cancer specimens, affecting approximately 630 million people worldwide (WHO, 2010). While the majority of HPV infections clear within 12 to 24 months, persistent infections by high-risk HPV types significantly elevate the risk of cervical cancer progression (IARC, 2012; Asiaf *et al*., 2014; Peng *et al*., 2017). Notably, more than 99% of cervical cancer cases involve high-risk HPV (IARC, 2012; Peng *et al*., 2017), with HPV16 and 18 identified as the most virulent genotypes responsible for about 70% of all invasive

cervical cancers globally (Jansma *et al*., 2014). Cervical cancer poses a critical health issue, particularly impacting women in developing countries. Approximately 85% of the 250,000 yearly cervical cancer deaths occur in these regions (Eze *et al*., 2012). In Nigeria alone, an estimated 14,089 women are diagnosed with cervical cancer annually, making it the second most common cause of death in the country and the primary cause of death for middle-aged women globally (Omoare *et al*., 2016).

Visual Inspection with Acetic Acid (VIA) or Visual Inspection with Lugol's Iodine (VILI) is considered as an alternative screening method due to its cost-effectiveness, noninvasiveness, and the ability to provide instant results, facilitating immediate treatment of precancerous lesions (Consul *et al*., 2012). In contrast, Pap smear screening is regarded as a conventional method (Stormo *et al.,* 2012). However, implementing cytology-based screening programs in low-resource settings is challenging due to a lack of infrastructure, trained manpower, and funds. Scarce resources are often directed towards presumed more pressing reproductive health issues, limiting access to cervical cancer screening services and contributing to the continued increase in the disease burden (Nwozor and Oragudosi, 2013). Moreover, the lack of awareness regarding HPV and societal restrictions surrounding gynecological examinations pose additional barriers for women in accessing screening services, even when available (Ohihoin *et al.,* 2023). This situation is particularly alarming, considering cervical cancer's impact on all sexually active women. In Nigeria, especially in the North-East and Central regions, there is a scarcity of studies focusing on specific HPV strains, despite the established link between HPV and cancer. Overcoming these barriers necessitates targeted educational campaigns and community engagements to promote open dialogue and reduce stigma.

While HPV vaccination is a crucial preventive measure against cervical cancer, challenges persist in the availability and affordability of vaccines in developing countries. The absence of HPV vaccination programs in certain regions, such as Adamawa and Taraba States in Nigeria, underscores the need for expanded access to vaccines to effectively control HPV infections. Addressing these challenges requires a comprehensive understanding of the issues surrounding HPV infections and cervical cancer in specific regions. Screening efforts should be directed towards cost-effective strategies that are affordable and reliable (Consul *et al*., 2012). Investigating the prevalence of HPV in specific regions, such as Adamawa and Taraba States, is essential for determining effective detection methods in the diagnosis of HPV-related diseases, particularly cervical cancer. This information can guide public health practitioners in implementing targeted prevention and control strategies, including vaccination programs, screening initiatives, and treatment interventions.

MATERIALS AND METHODS

Study Areas

Adamawa State

The study was conducted in two Local Government Areas of Adamawa State, Nigeria: Mubi and Numan. Numan Local Government Area is situated within Adamawa State, in the North-east geopolitical zone of Nigeria. The study area lies between latitude 9°10' and 9°39' N of the equator and between longitudes 10°24' and 12°55' E of the Greenwich Meridian. While Mubi is the capital of Mubi North Local Government Area of Adamawa State in Nigeria It is divided into Mubi North and Mubi South. It lies on latitude 10°32'N to 10°11'N and longitude 13°12'E to 13°35'E, with a total landmass of 506.4 square kilometers and a population size of 759,045 people.

Taraba State

The study was conducted in two hospitals in two LGA of the State: Jalingo and Mutun Biyu. All laboratory analyses were carried out at the Taraba State Specialist Hospitals Jalingo. Taraba State and located in North Eastern Nigeria. It derived its name from the Taraba River that traversed its southern region. The study area encompasses a total land area of 54,428sqkm and had a population of 2,688,944. It shares its borders with Nasarawa and Benue States to the west, Plateau State to the northwest, Bauchi State and Gombe States to the north, Adamawa State to the northeast, and North-West Province, claimed by both Ambazonia and Cameroon, to the south. Mutum-biyu is the headquarters of Gassol LGA located about 80 km west of Jalingo, the state capital. It has a Latitude of 8° 38' 28" N, Longitude: 10° 46' 24" E (Lat/Long (dec): 8.64138,10.77355) with a Population of 11,702 (2016) (Magaji, 2018).

Questionnaire administration

A structured study questionnaire was obtained from each participants. The questionnaire was translated into Hausa or Fulani language to make it more comprehensible to the local women by an interpreter. Socio-demographic data including; age, occupation, level of education, marital status, age at start of active sexual activity, age at first menstruation and sexual intercourse, inter menstrual bleeding, number of sexual partners, parity, miscarriages, use of condom, history of smoking were determined.

Sample Size Determination:

The sample size was determined using the Leshe-kish formula for single proportion (Jekel et al., 2001)

$$\text{Sample size, n} = \frac{Z^2 * p * (1-p)}{e^2}$$

Sample size (n) =1.96^2*0.48*(1-0.48)/ (0.05^2) = 369; ≈ 400

Inclusion and Exclusion Criteria

The study included self-reported healthy women aged 15 to 65 years who were willing to provide specimens and provide informed consent for HPV DNA testing. These women were recruited from Adamawa and Taraba states during cervical cancer screening. While it excluded women who refused or were unwilling to give consent, those who had undergone hysterectomy, menstruating or experiencing vaginal bleeding during the study period, or had been treated for premalignant cervical lesions, were excluded from the study. Additionally, pregnant women and those who had never had sexual intercourse were also excluded.

Study Duration

The study was conducted from June 2022 to June 2023.

Informed Consent

Samples were collected only after obtaining informed consent from the participants. Confidentiality was maintained throughout the study, with data being handled anonymously and other information kept reasonably confidential.

Sample Collection

Prior to sample collection, we received competence-based training from RISE (Reaching Impact Saturation and Epidemic Control for HIV/AIDS in Taraba State) on conducting examinations, counseling participants, and collecting samples appropriately.
Two Screening Tests for Precancerous Lesions for cell abnormalities:

a) VIA/VILI: This test was performed by adding 5% acetic acid (vinegar) and/or Lugol's iodine before inspection of the cervix for the presence of precancerous/acetowhite lesions.

b) Pap Test: A smear was obtained from the cervical exfoliated cells around the ecto-cervix for the investigation of abnormal cells.

Screening Tests for Precancerous Lesions/Cell Abnormalities. VIA/VILI:

Screening tests for precancerous lesions or cell abnormalities were conducted by employing Visual Inspection with Acetic Acid (VIA) and Lugol's Iodine (VILI). Before sample collection, a comprehensive explanation of the screening procedure was provided to the women, and written informed consent was obtained. Effort was made to ensure the comfort and relaxation of the women, emphasizing the painless nature of the procedure. The women were positioned in a modified lithotomy position on a couch, with their legs resting on the couch. Examination of the external genitalia was carried out to identify any indications of abnormalities or lesions such as edema, vesicles, papules, sores, or warts. To visualize the cervix, a lubricated speculum was gently inserted into the vagina, ensuring adequate lighting for a clear view. The cervix was then gently probed using a cotton swab either dipped in 5% acetic acid or Lugol's iodine. Application of 5% acetic acid on the cervix causes swelling of the epithelial tissue and reversible coagulation or precipitation of the cellular proteins. When 5% acetic acid is applied to normal squamous epithelium, little coagulation occurs, and it appears as pink on VIA. Cervical neoplastic cells have high coagulation on application of 5% acetic acid because of their high nuclear protein content, and they appear as acetowhitening on VIA. After use, the swab was disposed of in a biohazard container. Thorough examination of the cervix followed by looking for changes such as acetowhite lesions or saffron-yellow areas after the application of 5% acetic acid and/or Lugol's iodine. Each of the results was reported as follows:

A. VIA negative (-): When any of the following situations were observed:
1. The cervix displayed was interpreted no acetowhite lesions.
2. Polyps were emerging from the cervix.
3. Nabothian cysts appeared as whitish acne, pimples, or button-like spots.
4. Shiny, pinkish-white, or hazy white areas were observed.
5. Indistinct lesions or faint spots with undefined edges.
6. Acetowhite regions were ill-defined, spotty, pale, discontinuous, and dispersed.

B. VIA positive (+): When any of the following occurred:
1. The squamocolumnar junction in the transformation zone, or the external os if visible, was in close proximity to distinct, well-defined, dense (opaque, dull, or oyster-white) acetowhite patches with regular or irregular edges.
2. The columnar epithelium exhibited prominently dense acetowhite areas.
3. The entire cervix turned densely white after the application of acetic acid.
4. The squamocolumnar junction, which became highly white after the administration of acetic acid, was in close proximity to condyloma and leukoplakia. Contaminated swabs, gauze, and other waste materials were properly disposed of in a plastic bag placed inside a plastic bucket following appropriate disposal protocols.

Papanicolaou Staining and Mounting of Cytological Slides

Every woman had a Pap smear test done by passing the tip of a cervical spatula through the cervical external os area and spinning it around the ecto-cervix, paying close attention to the squamo-columnar junction and the transformation zone (TZ) to obtained cervical smears. Exfoliated cervical cells swabs were collected using a spatula or the Cervex-cytobrush cell which was introduced into the cervical canal or os area and turned clockwise 360 degrees while exerting light pressure. The swab was withdrawn carefully, smeared on the slide and fixed in 95% ethanol and then transported to the laboratory for staining. The cervical cytology slides were stained using a modified Papanicolaou method. This staining procedure involved the use of Hematoxylin as a nuclear

stain, along with Orange-G-6 and Eosin Azure as cytoplasmic counterstains. The 95% ethanol-fixed smears each underwent a 4-minute wash under running water. Subsequently, the slides were placed in racks, and successive batches of Harris hematoxylin nuclear staining solution were applied to them. The slides were stained and then blued in running water for 3-5 minutes each. Following this, the slides were immersed in the initial counterstain, Orange G-6, for 2 minutes, after a quick dip in 95% ethanol (10 seconds, 10 dips). The slides were then washed twice for two minutes each in 95% ethanol before undergoing a 2-minute staining with Eosin Azure-50 (EA-50) as the second counterstain. Once stained, the slides were dehydrated using two rounds of absolute ethanol and then cleaned with xylene. A coverslip was affixed to the slide using DPX mountant, a translucent substance compatible with the clearing agent, possessing a refractive index similar to that of glass slides and specimens. The well-stained slide was removed from the final xylene bath, and excess xylene was gently removed with filter paper. thereafter, 1 to 2 drops of mountant were placed on a clean, dust-free cover slip. The slide containing the cells was then inverted onto the cover slip with the mountant, lightly pressed to eliminate air bubbles, and finally turned over. It was left on the bench to allow the mountant to spread evenly to cover the edges of the cover slip. Subsequently, the slides were left to dry on the bench before being screened for intra-epithelial lesions.

Statistical analysis

The data generated were analyzed using SPSS software version 22, developed by SPSS, Inc. Illinois, USA. To understand the findings, various statistical packages were applied. First, descriptive statistics were utilized to evaluate the demographic characteristics of the study participants and the outcomes of their HPV screenings. The results were presented through frequency tables, effectively conveying the analyzed data. chi-square tests with contingency tables were employed to investigate relationships between different categorical variables. MedCal statistical analysis was applied to assess and quantify the accuracy of the diagnostic tests and to examine risk factors linked to HPV infection. It involved metrics such as: Sensitivity, Specificity, Positive Predicted Value (PPV), Negative Predictive Value (NPV) and P-value. Regression analysis was employed to scrutinize the data and uncover the relationship between a dependent variable and the independent variables. In all statistical tests, the level of significance was set at a P-value less than 0.05 ($P<0.05$), with a 95% confidence interval.

RESULTS

Prevalence of HPV using Visual inspection with acetic acid (VIA) and Pap Smear screening in Adamawa and Taraba State

A total of 432 women who met the inclusion criteria were recruited for the study in Adamawa and Taraba states This study revealed the prevalence of HPV infections by state using VIA/VILI and Papanicolaou tests. Out of the 432 women screened, 170 tested positive for precancerous lesions using VIA/VILI, resulting in a prevalence rate of 39.4%, as shown in Table 1 below. Taraba State had the highest proportion of positive cases (96) with an incidence of 56.5% (OR = 1.281, df = 1, 95% CL = 0.860-1.923, and P = 0.027), while Adamawa State had 74 positive cases with a prevalence of 43.5% (OR = 0.110, df = 1, 95% CL = 1.398-2.041). However, no significant difference was detected across different age categories for low-risk and VIA/VILI in the detection of precancerous lesions between states and HPV infections (χ^2; VIA = 2.898; $\alpha = 0.05$). Regarding cervical cytology through Papanicolaou smear, 195 (45.1%) of the women in both states tested positive for abnormal cytology, while 236 (54.6%) tested negative (showing no cervical abnormality). The majority, 111 (56.9%), of women with abnormal cytology were from Taraba State (OR = 1.379, df = 1, 95% CL = 0.923-2.432, P = 0.221), while Adamawa State reported 43.1% abnormal cytology. However, no significant difference was observed in the performance of Pap smear for the detection of abnormal cervical cytology between states and HPV infection (OR = 1.286, df = 1, 95% CL =, P = 0.221). The age range for the participants was between fifteen (15) to fifty-five (55) years, with a mean age of 26.7 years (SD = 8.41). The prevalence rates were 39.4% by VIA and 45.1% by Pap smear screening.

Table 1: Prevalence of HPV using Visual inspection with acetic acid (VIA) and Pap Smear screening in Adamawa and Taraba State.

State	Number examined	Test	Infection (%)	df	OR	P-value	95%CL	Chi-square
Adamawa	210	PAP	84(43.1)	1	1.379	0.271	1.389-2.041	5.456
		VIA	74 (43.7)	1		0.027	0.019-0.390	
Taraba	222	PAP	111(56.9)	1	0.110	1.379	0.929-2.049	1.499
		VIA	96 (56.5)	1	1.281	0.221	0.866-1.923	

Prevalence of Cervical Cytological Abnormalities

Table 2 presents the results of different cervical cytologies and their association with HPV infections. A total of 234 (53.0%) of the subjects tested negative for intraepithelial lesions or malignancy (NILM). Among all cases with abnormal Pap test results, the majority of participants were diagnosed with low-grade squamous intraepithelial lesion (LSIL), accounting for 93 (21.6%). The proportion of atypical squamous cells of undetermined significance (ASCUS) was 61 (14.1%), and high-grade squamous intraepithelial lesion (HSIL) was 45 (10.4%). The high odds ratios and low p-values for NILM (OR = 1028.000, df = 1, 95% CL = 162.00-16627.00, P = 0.000) and ASC-US (OR = 3.632, df = 1, 95% CL = 3.632-3.632, P = 0.000) suggest a strong association with HPV infection, while LSIL and HSIL show weaker associations.

Table 2 Prevalence of cervical abnormalities among women in the study Area

SIL	Frequency (N)	Percentage (%)	Df	OR	95%CL	P-value	Chi-square
NILM	234	53.9	1	1028.0	162.00-16627.00	0.000	8.34
ASC-US	61	14.1	1	3.632	3.632-3.632	0.000	
LSIL	93	21.5	1	1.467	0.148-14.508	0.743	
HSIL	45	10.4	1	1.592	0.687-9.034	0.124	
TOTAL	432	100					

SIL: Squamous intraepithelial lesions; NILM: Negative for intraepithelial lesions or malignancy, ASCUS: Atypical squamous cells of unknown significance, LSIL: Low-grade squamous intraepithelial lesions, HSIL: high-grade squamous intraepithelial lesions.

Table 4 reveals the prevalence of HPV infection based on age groups through VIA/VILI and Pap tests. The participants' age ranged from 15 to 54 years. The peak age prevalence was observed in the 35-44 years' group, with 83 cases (48.8%) showing precancerous lesions, followed by the 25-34 years' group with 50 cases (29.4%). The least infected age group was 15-24 years, with 15 cases and an infection rate of 8.8%. A Chi-square test was performed to examine the significance of the difference in the detection frequency of precancerous lesions among different age groups. The results showed no significant difference between age groups and HPV infections ($p \leq 1.61$). Similar patterns were observed in the Pap smear test, where the 35-44 years' age group still recorded the highest incidence of precancerous lesions with 90 cases and an overall HPV prevalence of 46.2%, followed by the 25-34 years age group with 57 cases and a prevalence of 29.2%. The 45-54 years and 15-25 years' age groups had incidences of 14.9% (29 cases) and 9.7% (19 cases), respectively. A significant difference was found between age groups and abnormal cytology ($p \leq 1.72$).

Table 3. Age based prevalence of HPV using Visual inspection with acetic acid (VIA) and Pap Smear screening in the study area.

		VIA		Pap smear	
Age	**Number examined**	**Negative**	**Positive**	**Negative**	**Positive**
15-24 years	39	24(9.2)	15(8.8)	20(8.5)	19(9.7)
25-34 years	130	80(30.5)	50(29.4)	73(30.9)	57(29.2)
35-44 years	197	114(43.5)	83(48.8)	107(45.3)	90(46.2)
45-54 years	66	44(16.8)	22(12.9)	37(15.3)	29(14.9)
Total	432	262(60.6)	170(39.4)	236(54.6)	195(45.1)

Cytomorphological Characteristics of Pre-Cancerous Cell

Plate 1a provides an illustration of ASCUS slides. In this slide, the nuclei are observed to be approximately 3.0 times larger than those of normal intermediate squamous cells. The cells exhibit mild hyperchromasia, with a distinctive perinuclear halo and variations in nuclear sizes and atypia. These cells are ovoid in shape and display transparent cytoplasm, prominent nuclei, nuclear polymorphism, and

multiple nuclei.

Plate 1b illustrates the cytomorphological characteristics of a Low-Grade Squamous Intraepithelial Lesion (LSIL) slide. LSIL typically presents abnormalities in the epithelial cells, often linked to infection with HPV. The cytoplasm is often transparent, with poorly defined boundaries, and large nuclei (3-6 times larger than normal cells). A prominent feature in this slide is the presence of koilocytes, cells affected by HPV. Koilocytes exhibit several distinctive traits, including darkly stained, enlarged, and raisin-like or hyperchromatic nuclei. These nuclei are distinctly separated from the surrounding cytoplasm, resulting in a noticeable clearing or halo effect. Additionally, the slide demonstrates the presence of binucleation and multinucleation, both of which are prominent features associated with LSIL. Their nucleo-cytoplasmic ratio is below 1/3, and the nuclear membrane is smooth or slightly invaginate, with uniform nuclear chromatin that is slightly granular. Bi- or tri-nuclei, respectively, frequent modifications in koilocytosis cells, i.e., the morphological marker of HPV infection (nuclear pleomorphism, nuclear plications, hyperchromasia, perinuclear halo with a clear, distinct area around the nucleus, and peripheral densification of the cytoplasm).

Plate 1c, the slide illustrates the cytomorphology of a High-Grade Squamous Intraepithelial Lesion (HSIL). The image showcases several distinctive features, including the arrangement of the cells individually in a straight and cohesive pattern. Increased nuclei occupy more than two-thirds of the cytoplasm, being hyperchromic with reticulate chromatin and visible empty spaces. The nuclear membrane is irregular, sometimes with multiple abnormal nuclei. Most notably, there is a high nuclear-to-cytoplasm ratio, with the nucleus nearly equal in size to the cytoplasm in most of the cells. These observations are indicative of HSIL and provide valuable information for cytological assessment and diagnosis.

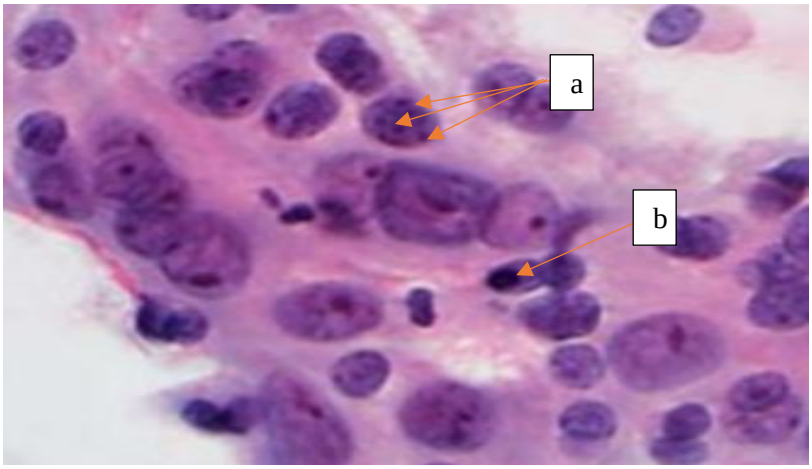

Plate 3a: cytological features of ASCUS: Squamous cells showing mildly hyperchromasia and irregular nuclear contours. (Pap. X 800). a), multiple nuclei, b) prominent nucleolus.

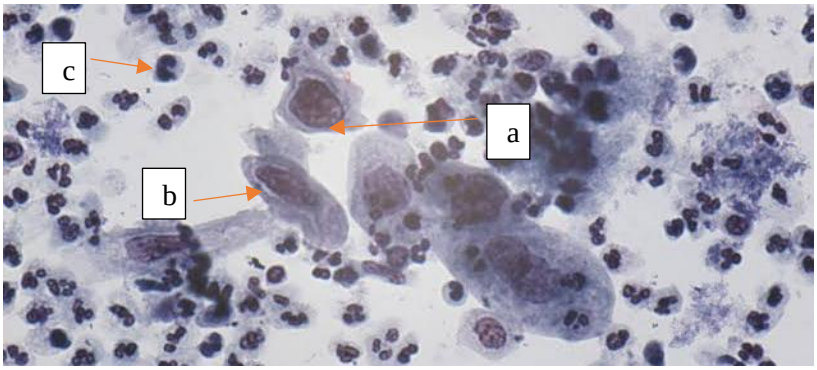

Plate 3b: cytological features of LSIL: cytological presentation of LSIL showing cyanophilic intermediate squames with varying dyskaryotic features of koilocytes. (a), enlarged nucleo-cytoplasmic volume ratio of 3:1 (b), irregular nuclear membrane, (c), bi- nuclei. Hyperchromasia showing raisioid/ hyperchromatic nucleus with irregular nuclear contours for LSIL.

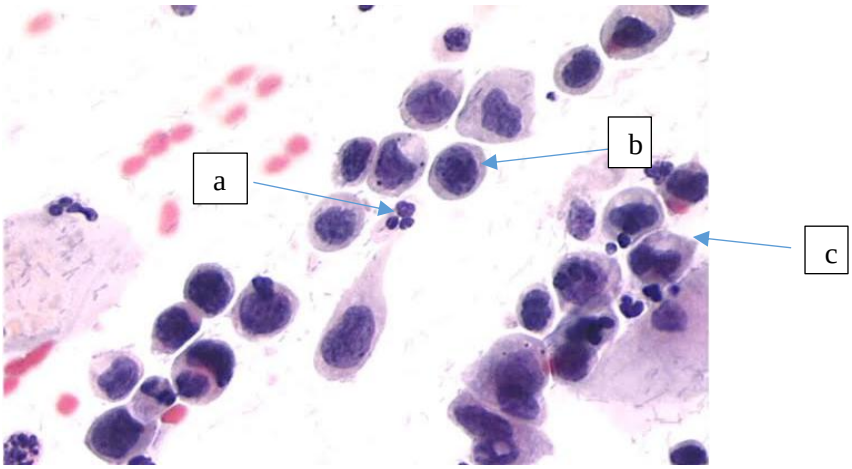

Plate 3c: Cytomorphological Features of HIS: cytological presentation of (HSIL) abnormal squamous cells; a) tri-nuclei, (b). Eosinophillic squames with prominent nucleolus and polymorphs in smear. c) grossly increased nucleo-cytoplasm (N/C) volume ratio of 3:1with a dense hyperchromatic granule. multi-nucleate cell.

Prevalence of Precancerous Lesions Revealed by Lugos' Iodine and 5% Acetic Acid Revealed in Clinical Inspection of the Cervix on VIA/VILI

Plate 2a (VILI Positive) revealed the clinical findings during cervical examination using lugos' iodine It reveals a visible ulcero-proliferative growth on the cervix. After the application of lugos' iodine, the growth transformed into a dense bright mustard-yellow or saffron yellow iodine non-uptake area on the TZ

Plate 2b, revealed the clinical finding during the inspection of the cervix using Visual Inspection with acetic acid. The image depicts a distinct well defined dense (opaque, dull, or oyster white) acetowhite area with irregular margin in the upper lip, adjacent to the junction of the squamous-columnar borders seen in the transformation zone (TZ) at the 12 o'clock position. This observation indicates a non-uptake of Lugol's iodine in this region. VIA positive at 12: o'clock position with acetowhite lesion.

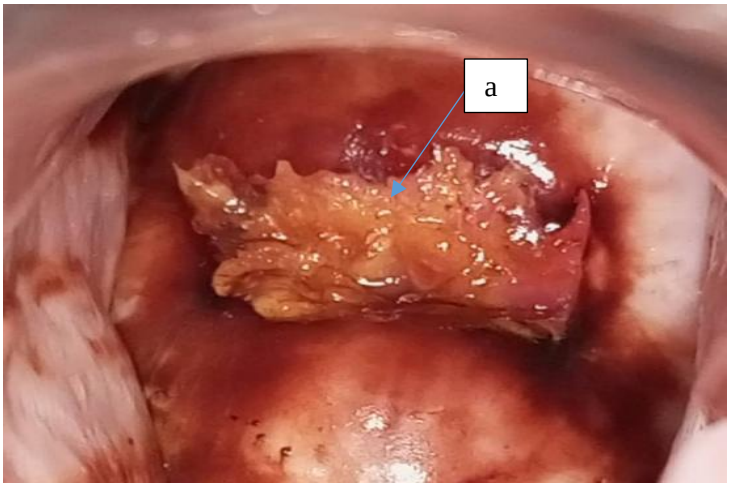

Plate 4 a: VILI positive: (a) lesion with a distinct and well-defined but irregular margin (a) and is situated around the squamous-columnar junction occupying 25-50% of the cervix.

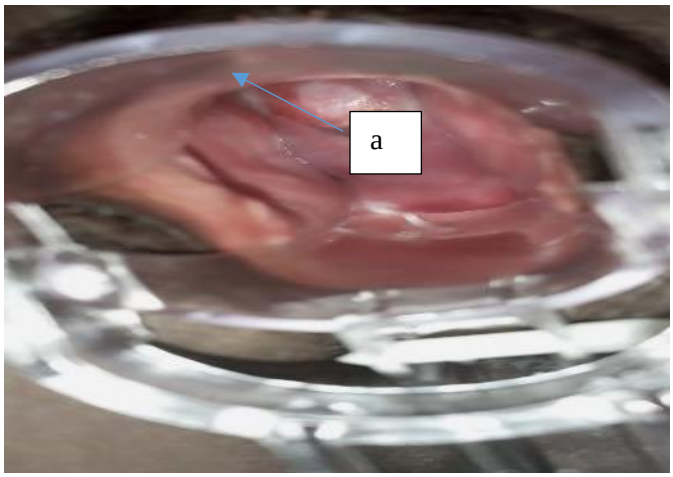

Plate 4: (b) VIA positive
Plate 4 b: a) A distinct well defined dense (opaque, dull, or oyster white) acetowhite area with irregular margin in the upper lip.

Comparison between Cytology and VIA

The tests of validity of the screening methods used in detection of cervical epithelial abnormalities is shown in Table 5. Among the VIA group, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of Papanicolaou test cytology, VIA, and Papanicolaou test cytology plus VIA ranged from 53.6% to 83.9%. A Comparison is presented between cytological results and VIA, considering a cytological abnormal positivity threshold. Various accuracy indicators (Youden index and Cohen's kappa) are provided to evaluate the performance of the diagnostic tests and assess the agreement between the methods. These indicators were employed to evaluate the diagnostic performance of VIA and Pap smear screening. The Youden index is reported as 0.652, indicating good diagnostic performance, while the Cohen's kappa index is 0.321, signifying a moderate agreement between the methods. VIA demonstrated a sensitivity of 61.76% at 54.0-69.195% CL and specificity of 65.27% at 59.2-71.0% CL. The positive predictive value (PPV), negative predictive value (NPV), and odds ratio (OR) were 53.6 (95% CL 10.0-15.0), 72.5 (95% CL 50.2-78.2), and 2.90, respectively. For cytological results, the sensitivity, specificity, PPV, NPV, and OR were reported as 53.6 (95% CL 46.7-51.2), 59.7 (95% CL 55.4-61.0), 53.5 (95% CL 49.4-58.2), 83.9 (95% CL 50.2-78.2), and 3.95. Consequently, cytological abnormalities identified through Pap smear screening exhibit a moderate level of diagnostic performance over VIA, with an OR for Pap smear of 3.95. However, VIA showed a statistically significant difference at $P < 0.001$.

Table 4, Comparison was made between cytology and VIA among women in the study area.

Test	**Test positivity**		**Sensitivity**		**Specificity**		**PPV**		**NPV**		**P-value**	**OR**
	%	95%CL	%	95%CL	%	95%CL	%	95%CL	%	95%CL		
VIA	39.4	59.54-70.8	61.8	54.0-69.1	65.3	59.2-71.0	53.6	10.0-15.0	72.5	50.2-78.2	0.01	2.90
Pap smear	45.1	0.581-0.689	53.6	46.7-51.2	59.7	55.4-61.0	53.5	49.4-58.2	83.9	86.4-90.1	0.20	3.95

Figure 1 depicts a sensitivity plot against specificity for VIA and Pap smear screening among women with four cytological abnormalities, revealing a higher area under the ROC curve of 0.635. A highly statistically significant result of $P < 0.001$ was observed between VIA and Pap smear screening. Among women with cytological abnormalities identified by Pap smear, a high sensitivity and specificity of 98.0% and 80.0%, respectively, were achieved. The Youden Index was employed to assess the disease accuracy test performance of the two diagnostics. The Youden index was calculated at 0.652, suggesting that the diagnostic test performance for Pap smear screening has a good ability to correctly balance sensitivity and specificity. Additionally, the Cohen's kappa value of 0.321 indicates a moderate level of agreement and some consistency between the two methods. However, a strong statistically significant association was observed between VIA and Pap smear screenings.

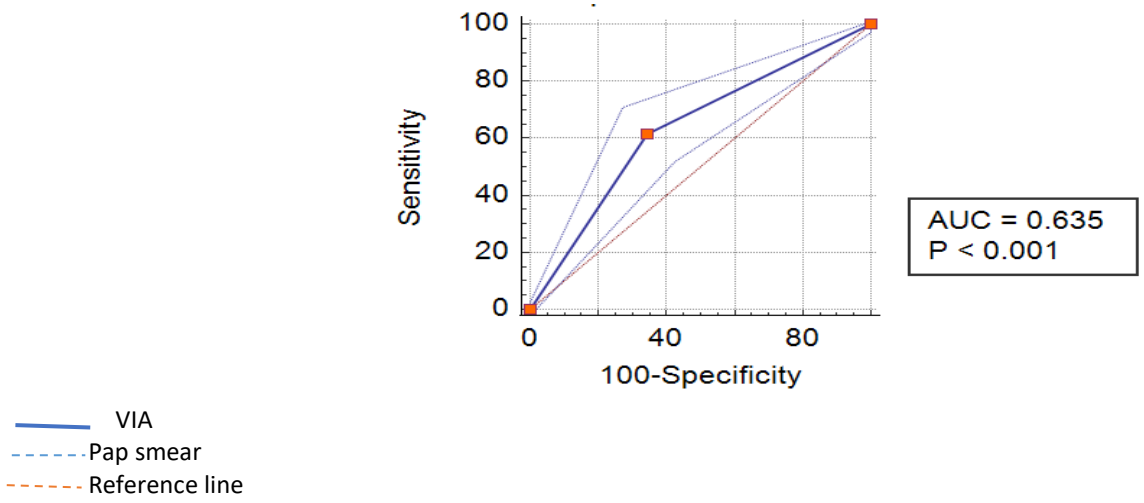

Figure 1: showed the sensitivity plotted against specificity for VIA and Pap smear among women with cytological abnormalities

DISCUSSION

This study revealed a statistically significant difference in the overall diagnostic test performance of the efficacy of the Pap smear test over VIA (P=0.001). The tests of validity of VIA being essentially comparable to that of Papanicolaou test cytology in this study are dissimilar to previous reports by Omole-Ohonsi *et al.* (2013) in Nigeria and Abdel-Hady *et al.* (2006).

The age range of women involved in this study was 15-55 years. This age range in our study is related to that used by the American Cancer Society in 2013, which recommended all women to begin cervical carcinoma screening at age 21 to 65 years old (American Cancer Society, 2013). The age group ranging from 25-35 years old was at high risk of developing cervical carcinoma because this age group is in the menopause period.

In our study, the proportion of women who were screened positive with VIA was 39.2%, and with Pap smear, it was 45.6%. Our findings were similar to the study of Niyodusenga *et al*. (2020) and higher than those observed in other studies in India by Hedge *et al*. (2011), which showed 12% cases of VIA positive while positive Pap smear cases were 11.7%. Kavita and Shefali, (2010) showed 16.2% cases of positive VIA and 5.2% cases of positive Pap smear.

The cytological screening of VIA was carried out considering four different positivity thresholds (NILM, ASCUS, LSIL, and HSIL). NILM demonstrated a higher sensitivity, and HSIL showed the highest specificity, which was far higher compared to the work of Imankulova *et al*. (2023) of NILM 9.28%. This rate is substantially equal to that of Jacquet et al. (2010) and lower than that of Horo *et al*. (2012) and Abdoulaye *et al.* (2017), who reported 6.2% of NILM in Cote d'Ivoire. Also, our findings align with an earlier study conducted by Kolawole *et al*. (2015) in Lokoja, Nigeria, which reported higher rates of 40.0% for ASCUS, 50.0% for LSIL, and 10.0% for HSIL. Studies conducted recently in Nigeria have similarly found a prevalence of precancerous cervical cancer lesions similar to our findings with a reported prevalence of 11% (Tebeu *et al.*, 2009).

In comparing VIA and Pap smear screening, this study, the sensitivity of VIA was higher (61.8%) than that of Pap smear (59.7). This result is similar to that found in the study conducted by Niyodusenga *et al*. (2020), specificity of VIA was higher than at (65.3%) as compared to Pap smear (63.89%). Our results communicate to the findings reported by Garg, (2011), the positive predictive value of Pap smear and VIA had equivalent rate of (53.6%) and (53.6%) respectively this results are lower to that found by Niyodusenga *et al*. (2020). The negative predictive value for VIA was lower than that of Pap smear 72.2% and 83.9% respectively. This differ from the study of Egede *et al*. (2018). The overall accuracy of Pap smear cytology is 0.682%. suggesting that the diagnostic test performance for Pap smear screening has a good ability to correctly balance sensitivity and specificity.

While The overall accuracy of visual inspection with the acetic acid test is 0.31% indicating that Pap smear screening is superior to VIA. 0.321 and has a moderate level of agreement and some consistency between the two methods (Omole-Ohonsi *et al*. (2013). Signifying a strong statistically significant association was observed between VIA and Pap smear screenings. This study disagrees with reports of David *et al.* (2022).

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