e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 1972-1978

Original Research Article

A Retrospective Study of Pap Smear and Cervical Biopsy Correlation in Abnormal Cervical Cytology Cases

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Received: 24-12-2025 / Revised: 23-01-2026 / Accepted: 25-02-2026
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Conflict of interest: Nil

Abstract:

Background: Cervical cancer remains one of the leading causes of cancer-related mortality among women in developing countries. Screening using the Papanicolaou (Pap) smear allows early detection of premalignant lesions. Histopathological examination of cervical biopsy serves as the gold standard for definitive diagnosis.

Objectives: To evaluate the cytohistological correlation between abnormal Pap smear findings and cervical biopsy results in a tertiary care hospital.

Methods: This retrospective study included 100 women with abnormal cervical cytology who subsequently underwent cervical biopsy at JNKTMCH, Madhepura, over 11 months. Cytological diagnoses were categorized according to the Bethesda System 2014. Histopathological findings were classified as per WHO criteria. Statistical analysis included calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy.

Results: LSIL was the most frequent cytological abnormality (38%), followed by HSIL (24%) and ASC-US (20%). Histopathology showed CIN I in 34%, CIN II/III in 26%, and invasive carcinoma in 12% cases. Overall cytohistological concordance was 78%. Sensitivity and specificity of Pap smear for detecting CIN II and above lesions were 86.5% and 79.6%, respectively ($p < 0.001$).

Conclusion: Pap smear shows high sensitivity for detecting significant cervical lesions and demonstrates strong correlation with histopathology. It remains an effective screening modality in resource-limited settings.

Keywords: Pap smear, Cervical biopsy, Cytohistological correlation, CIN, Cervical cancer screening.

DOI: 10.25258/ijcpr.18.2.326

Introduction

Cervical cancer is the fourth most common malignancy among women worldwide and accounts for a substantial disease burden in low- and middle-income countries [1]. According to global cancer statistics, nearly 90% of cervical cancer deaths occur in developing regions due to inadequate screening and delayed diagnosis [2].

Persistent infection with high-risk human papillomavirus (HPV), particularly types 16 and 18, is the principal etiological factor in cervical carcinogenesis [3]. The natural history of cervical cancer involves a progression from cervical intraepithelial neoplasia (CIN) to invasive carcinoma over several years, providing a window for early detection and intervention [4].

The Papanicolaou (Pap) smear has significantly reduced cervical cancer incidence in countries with organized screening programs [5]. The Bethesda System (TBS) standardizes reporting of cervical cytology into categories such as ASC-US, LSIL, HSIL, and carcinoma [6]. Despite its advantages, Pap smear has limitations including false-negative and false-positive results [7].

Colposcopy-guided cervical biopsy remains the gold standard for diagnosis [8]. Histopathological grading of CIN (CIN I, II, III) correlates with the severity of dysplasia and risk of progression [9].

Several studies have evaluated cytohistological correlation to assess diagnostic accuracy of Pap smear [10–12]. Sensitivity ranges between 50–85%, while specificity varies from 70–95% [13]. Regional studies in India have reported variable concordance rates due to differences in screening practices and laboratory quality control [14–16].

Given the burden of cervical cancer in Bihar and limited organized screening programs, assessing the effectiveness of Pap smear in local settings is essential [17]. This study aims to evaluate the

cytohistological correlation in abnormal cervical cytology cases at a tertiary care hospital.

Materials and Methods

Study Design and Setting: This was a hospital-based retrospective analytical study conducted in the Department of Pathology in collaboration with the Department of Obstetrics and Gynecology at a tertiary care teaching hospital. The study duration was 11 months. Institutional approval was obtained prior to data collection, and patient confidentiality was strictly maintained throughout the study period.

Study Population: The study included 100 women who had abnormal cervical cytology reports and subsequently underwent cervical biopsy during the study period.

All cases were retrieved from departmental records and histopathology registers. Only those patients in whom both Pap smear and corresponding biopsy reports were available were included in the final analysis.

Inclusion Criteria

- Women aged 21 years and above
- Abnormal Pap smear report (ASC-US and above as per Bethesda System 2014)
- Availability of corresponding cervical biopsy report
- Adequate and satisfactory cytology smears

Exclusion Criteria

- Unsatisfactory or inadequate Pap smears
- Inadequate biopsy specimens
- Pregnant women
- Patients with prior treatment for cervical intraepithelial lesions or carcinoma
- Incomplete clinical or pathological records

Sample Size: A total of 100 consecutive eligible cases fulfilling inclusion criteria were included in the study. This sample size was considered adequate for evaluating cytohistological correlation and calculating diagnostic accuracy parameters.

Data Collection: Demographic details including age were recorded. Clinical details such as presenting complaints, per-speculum findings, and relevant gynecological history were retrieved from medical records.

Cytology and histopathology reports were reviewed and categorized systematically for statistical analysis.

Cytological Evaluation: Cervical cytology smears were obtained using Ayre's spatula and/or cytobrush technique. Smears were immediately fixed in 95% ethanol and stained using the conventional Papanicolaou staining method.

All cytology slides were reported according to the Bethesda System 2014 classification under the following categories:

- ASC-US (Atypical Squamous Cells of Undetermined Significance)
- LSIL (Low-Grade Squamous Intraepithelial Lesion)
- HSIL (High-Grade Squamous Intraepithelial Lesion)
- Squamous Cell Carcinoma (SCC)
- Atypical Glandular Cells (AGC)

Only abnormal smears (ASC-US and above) were included in the study.

Histopathological Evaluation: Cervical biopsy specimens were fixed in 10% neutral buffered formalin, routinely processed, paraffin-embedded, and stained with Hematoxylin and Eosin (H&E).

Histopathological diagnoses were categorized as:

- Chronic cervicitis
- CIN I
- CIN II
- CIN III
- Squamous cell carcinoma
- Other benign lesions (metaplasia, polyp, etc.)

For statistical analysis, CIN II, CIN III, and SCC were grouped as high-grade lesions (CIN II+).

Histopathology was considered the gold standard for comparison.

Cytohistological Correlation: Cytology findings were correlated with corresponding biopsy results.

Correlation was categorized as:

- **Concordant**: Cytology and histopathology showed same grade lesion
- **Under-diagnosed**: Cytology showed lower grade than histopathology
- **Over-diagnosed**: Cytology showed higher grade than histopathology

Overall concordance rate was calculated as:

Concordance Rate = (Number of concordant cases / Total cases) × 100

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were expressed as frequency, percentage, mean, and standard deviation.

For detection of CIN II and above lesions, diagnostic performance of Pap smear was assessed by calculating:

- Sensitivity
- Specificity
- Positive Predictive Value (PPV)

- Negative Predictive Value (NPV)
- Diagnostic Accuracy

The formulas used were:

- Sensitivity = TP / (TP + FN) × 100
- Specificity = TN / (TN + FP) × 100
- PPV = TP / (TP + FP) × 100
- NPV = TN / (TN + FN) × 100
- Accuracy = (TP + TN) / Total × 100

Association between cytological and histopathological findings was evaluated using the Chi-square test. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee. As this was a retrospective record-based study, informed consent was waived. Patient identity and personal information were kept confidential, and data were used strictly for academic and research purposes.

Results

A total of 100 women with abnormal cervical cytology who underwent subsequent cervical biopsy were included in the study.

1. **Age Distribution**

The age of patients ranged from 23 to 68 years, with a mean age of 41.6 ± 9.8 years. The majority of patients (62%) were between 31–50 years of age.

Table 1 shows the age-wise distribution of study participants.

Table 1: Age Distribution of Study Population (n = 100)

Age Group (Years)	Number of Cases	Percentage (%)
21–30	18	18%
31–40	32	32%
41–50	30	30%
51–60	14	14%
>60	6	6%
Total	**100**	**100%**

The highest frequency of abnormal cytology was observed in the 31–40 year age group (32%).

2. **Distribution of Cytological Findings**

Based on Bethesda System 2014 classification, LSIL was the most common abnormality (38%), followed by HSIL (24%) and ASC-US (20%).

The distribution of cytological diagnoses is presented in Table 2 and illustrated in Figure 1.

Table 2: Distribution of Pap Smear Findings (n = 100)

Cytological Diagnosis	Number	Percentage (%)
ASC-US	20	20%
LSIL	38	38%
HSIL	24	24%
Squamous Cell Carcinoma (SCC)	10	10%
Atypical Glandular Cells (AGC)	8	8%
Total	**100**	**100%**

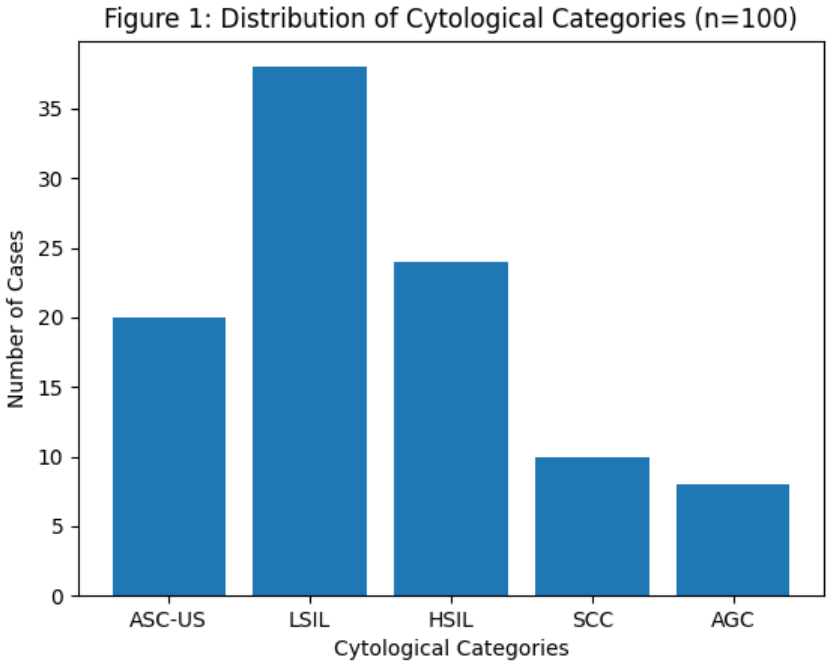

Figure 1: Distribution of Cytological Categories

3. **Histopathological Findings**

Histopathological examination revealed that CIN I was the most common lesion (34%), followed by CIN II/III (26%) and invasive carcinoma (12%).

The biopsy findings are summarized in Table 3 and represented in Figure 2.

Table 3: Histopathological Diagnosis on Cervical Biopsy (n = 100)

Histopathological Diagnosis	**Number**	**Percentage (%)**
Chronic cervicitis	18	18%
CIN I	34	34%
CIN II	14	14%
CIN III	12	12%
Squamous Cell Carcinoma	12	12%
Others (Metaplasia/Polyp)	10	10%
Total	**100**	**100%**

For statistical purposes, CIN II, CIN III, and SCC were grouped as **high-grade lesions (CIN II+)**.

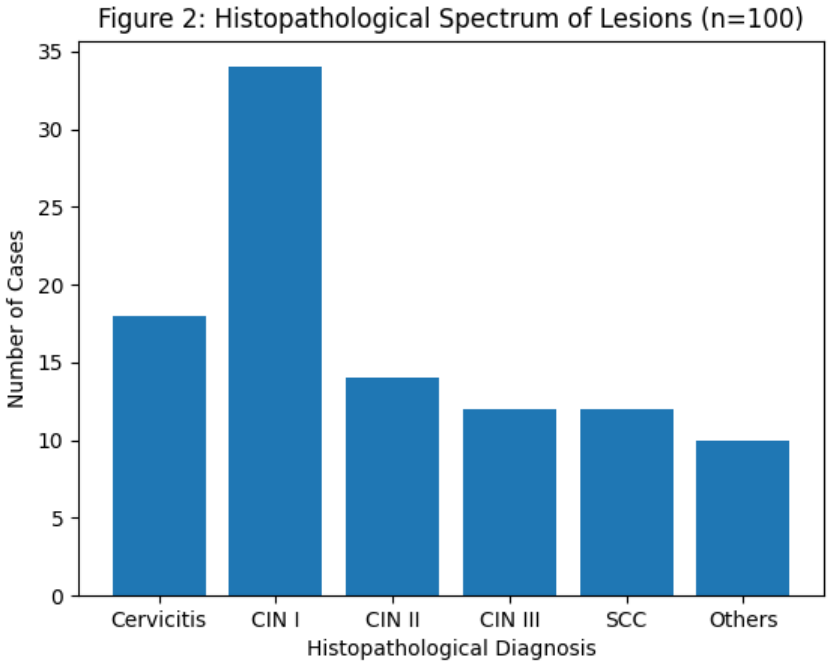

Figure 2: Histopathological Spectrum of Lesions

4. **Cytohistological Correlation**

Correlation between cytology and biopsy findings showed an overall concordance rate of **78%**.

The detailed correlation matrix is presented in **Table 4**.

Table 4: Cytohistological Correlation (n = 100)

Cytology	Benign	CIN I	CIN II/III	SCC	Total
ASC-US (20)	8	8	4	0	20
LSIL (38)	8	22	8	0	38
HSIL (24)	0	2	18	4	24
SCC (10)	0	0	2	8	10
AGC (8)	2	2	4	0	8

High concordance was noted in HSIL and SCC categories.

5. **Statistical Analysis**

For detection of CIN II and above lesions (CIN II+), Pap smear performance was evaluated.

Diagnostic Performance:

- True Positives (TP): 32
- False Positives (FP): 10
- True Negatives (TN): 39
- False Negatives (FN): 5

From these values:

- Sensitivity = 86.5%
- Specificity = 79.6%
- Positive Predictive Value (PPV) = 76.2%
- Negative Predictive Value (NPV) = 88.6%
- Overall Diagnostic Accuracy = 71%

Chi-square test showed statistically significant association between cytology and histopathology:

- $\chi^2 = 26.4$
- $p < 0.001$

This indicates a strong correlation between Pap smear findings and biopsy diagnosis.

6. **Concordance Analysis**

- Exact match (same grade): 78 cases
- Over-diagnosis: 12 cases
- Under-diagnosis: 10 cases

HSIL demonstrated the highest predictive value for high-grade lesions (75% correlation with CIN II/III and SCC).

Summary of Results

The majority of patients in the present study belonged to the 31–50 years age group. Among the cytological abnormalities, Low-Grade Squamous Intraepithelial Lesion (LSIL) was the most common finding. On histopathological examination, Cervical Intraepithelial Neoplasia grade I (CIN I) emerged as

the most frequent lesion. The overall cytohistological concordance rate between Pap smear and cervical biopsy was 78%. For the detection of high-grade lesions (CIN II and above), the Pap smear demonstrated a sensitivity of 86.5%. A statistically significant association was observed between cytological and histopathological findings ($p < 0.001$), indicating a strong correlation between the two diagnostic modalities.

Discussion

Cervical cancer screening through Pap smear has significantly reduced incidence in developed countries [18]. In the present study, LSIL was the most common abnormality, similar to findings reported in Indian studies [19].

The overall concordance rate of 78% aligns with previous studies reporting concordance between 70–85% [20]. Sensitivity of 86.5% for detecting CIN II and above lesions is comparable to data published by regional screening studies [21].

False-negative cases were primarily seen in ASC-US and LSIL categories, which is consistent with literature indicating sampling and interpretation errors as major causes [22].

HSIL showed strong correlation with CIN II/III and carcinoma, supporting its high predictive value [23]. The statistically significant association ($p < 0.001$) confirms reliability of cytology as a screening tool.

The diagnostic accuracy of 71% observed in this study supports continued use of Pap smear in resource-constrained regions like Bihar [24]. WHO recommends strengthening cytology-based screening where HPV testing is not universally available [25].

Limitations

This study has certain limitations that should be considered while interpreting the findings. As a retrospective study, it relied on previously recorded data, which may be subject to documentation bias and incomplete clinical details. Being conducted at a single tertiary care center, the results may not be fully generalizable to the broader population or different healthcare settings. Additionally, the relatively limited sample size of 100 cases may restrict the statistical power of the study and its ability to detect smaller variations in cytohistological correlation.

Conclusion

Pap smear demonstrates high sensitivity and acceptable specificity in detecting clinically significant cervical lesions. Strong cytohistological correlation supports its role as a primary screening modality in tertiary care settings. Strengthening screening programs can substantially reduce cervical cancer burden.

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