

Original Research Article

Cervical pap smear study: a cytohistological correlation in patients of tertiary care centre

Sanam Divya Goud¹, Ch. Jyothi², T. Divyagna^{3*}, R. Soujanya⁴

¹Department of Pathology, Government Medical College, Karimnagar, Telangana, India

²Department of Pathology, Government Medical College. Wanaparthy, India

³Department of Pathology, Government Medical College Nirmal, Telangana, India

⁴Department of Pathology, Government Medical College Narsampet, Telangana, India

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*Correspondence:

Dr. T. Divyagna,

E-mail: divyagnat@gmail.com

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ABSTRACT

Background: The second most prevalent disease in Indian women and a leading source of morbidity and death is cervical cancer. The Pap smear is a quick, low-cost and effective screening technique for early detection of benign and malignant cervical lesions. The objectives of this study were to analyze the cytomorphological patterns of cervical smears, ascertain the frequency of abnormalities in epithelial cells and use histopathological correlation to evaluate the Pap test's diagnostic accuracy.

Methods: From January to December of 2022, this retrospective study was carried out in the pathology department of Gandhi Hospital in Telangana. The Bethesda Reporting System for Cervical Cytology, 2014 was used to analyze and classify conventional Pap smears from women ages 20 to 80. Histopathological findings and abnormal epithelial findings were associated and the diagnostic accuracy, sensitivity, specificity and predictive values were computed.

Results: Out of 4,848 satisfactory smears analyzed, epithelial cell abnormalities constituted 1.63% of all cases. The most common abnormality was ASCUS, which was followed by LSIL. Approximately two-thirds of abnormal lesions occurred in women over 40 years of age. Cytological findings demonstrated good concordance with histopathological diagnoses, with an overall diagnostic accuracy of 79.68%.

Conclusions: A safe, easy, non-invasive and reasonably priced way to identify precancerous and cancerous cervical abnormalities is through Pap smear screening. By enabling early detection and prompt treatment, routine screening in sexually active women can dramatically lower the incidence of cervical cancer.

Keywords: Bethesda system, Cervical cancer, Cytology, Epithelial abnormalities

INTRODUCTION

Worldwide, for women, cervical cancer is a major public health concern. It is the second most prevalent cancer among Indian women and the fourth most frequent cancer worldwide.^{1,2} India contributes significantly to the global burden, with approximately 122,844 new cases and 67,477 deaths recorded every year.³ Additionally, the nation has South Asia's highest age-standardized incidence rate.⁴

Still, one of the main causes of morbidity is cervical cancer and death even though it is mainly avoidable because of late diagnosis and insufficient screening coverage. Most cases could be prevented if women had access to and complied with systematic, high-quality cytological screening programs.⁵ The long pre-invasive period of 10–20 years from mild dysplasia to invasive carcinoma offers a valuable opportunity for early detection and timely treatment, making one of the most avoidable cancers in women is cervical cancer.^{6,7} The Papanicolaou (Pap)

smear, introduced by Papanicolaou and Traut in 1941, revolutionized the early detection of cervical cancer.⁸ It remains the cornerstone of cervical screening worldwide. Long before symptoms show up, the Pap test can identify minute cellular alterations linked to early invasive cancer and cervical intraepithelial neoplasia (CIN).^{6,7} The procedure is simple, cost-effective, non-invasive and feasible in outpatient settings, making it particularly suitable for LMICs like India. According to the American College of Obstetricians and Gynecologists (ACOG) guidelines of 2009, It is advised that all sexually active women over 21 undergo screening.⁹ Regular screening not only aids in the detection of precancerous lesions but also identifies infections and inflammatory conditions that can affect cervical health. Countries that have implemented organized Pap smear programs have reported a marked reduction in the incidence and mortality of cervical cancer.⁸

Although Pap smear cytology is an excellent screening tool, cervical biopsy remains the confirmatory diagnostic method for identifying pre-malignant and malignant lesions.¹⁰ However, biopsies are invasive, require clinical infrastructure and are not suitable for large-scale screening. Therefore, correlating Pap smear results with histopathological findings plays an important role in validating the accuracy and reliability of cytology. This cyto-histological correlation serves as an internal quality assurance tool and helps in identifying the causes of diagnostic discrepancies.¹¹ Errors can occur due to sampling limitations, technical artifacts such as poor fixation or staining or interpretational challenges caused by reactive or degenerative cellular changes. Continuous evaluation through such correlation studies ensures better diagnostic precision, improves laboratory standards and enhances the credibility of cervical screening programs.

Regular evaluation of Pap smear outcomes is essential to understand regional variations in disease patterns and diagnostic accuracy. Socio-cultural practices, hygiene, sexual behavior and access to healthcare services vary widely across India and significantly influence the prevalence of cervical abnormalities. Studies from different parts of the country report varying rates of epithelial cell abnormalities, ranging from less than 1% to about 6%, reflecting differences in population characteristics and screening quality.

Hence, region-specific studies help in assessing the real-world performance of Pap cytology in different demographic settings. In order to ascertain the frequency of epithelial cell abnormalities, the current study was conducted to examine cervical cytology patterns at a Telangana tertiary care teaching hospital and to correlate cytological findings with histopathological diagnoses. This study intends to demonstrate the continued significance of cytological screening as a safe, economical and efficient technique for the early identification and prevention of cervical cancer in Indian women by assessing the diagnostic accuracy of Pap smears.

METHODS

Study design

Cervical Pap smears were analyzed in this retrospective observational study. Over the course of a year, from January 2022 to December 2022, every smear was examined and reported at the Gandhi hospital and Department of Pathology in Secunderabad. The study's objectives were to assess cervical smear cytomorphological patterns and ascertain the frequency of anomalies in epithelial cells and correlate cytological findings with histopathological results to assess diagnostic accuracy.

Setting

The study was performed at a tertiary care teaching hospital that receives referrals from both urban and rural areas of Telangana, India. Cervical smears were obtained from women attending the gynecology OPD for various gynecological complaints. Smear collection was carried out by trained residents using a modified Ayre's wooden spatula, ensuring sampling from both endocervix and ectocervix. For microscopic examination, the obtained smears were promptly fixed in 95% ethyl alcohol, stained using the Papanicolaou technique and mounted with DPX. The Bethesda Reporting System for Cervical Cytology, 2014 was followed while reporting.

Ethical consideration

Prior to commencing the study, IEC approval was obtained from Gandhi Medical College, Secunderabad. The Declaration of Helsinki's tenets were followed in this investigation. As the data were collected retrospectively from existing records, individual informed consent was not required. All patient identifiers were kept confidential and data were used exclusively for research purposes.

Participants

The study included sexually active women aged 20–80 years who presented with symptoms such as leucorrhoea, lower abdominal pain, menorrhagia, postcoital bleeding or postmenopausal bleeding.

Inclusion criteria

The study included sexually active women aged 20 years and above who attended the gynecology outpatient department with complaints such as leucorrhoea, lower abdominal pain, menorrhagia, postcoital bleeding or postmenopausal bleeding.

Exclusion criteria

Pregnant and lactating women, unmarried women and patients previously diagnosed with carcinoma cervix were excluded from the study. Smears that were unsatisfactory

due to obscuring blood, mucus or inadequate cellularity were also excluded from the final analysis.

Of the 4910 pap smears examined, 62 smears were deemed unsatisfactory due to obscuring mucus, blood or scant cellularity and were excluded. The final analysis included 4848 satisfactory smears.

Bias

Potential bias was minimized by ensuring that all smears were screened and interpreted by experienced cytopathologists blinded to the patients’ clinical and histopathological details at the time of cytological assessment. Only cases with both cytology and subsequent histopathology were included for correlation to reduce selection bias. Technical artifacts were minimized by adhering to standardized smear preparation, fixation and staining protocols.

Statistical analysis

Patient data, including clinical details and cytological findings, were compiled using Microsoft Excel and analyzed using SPSS version 26 software. Descriptive statistics were used to summarize demographic and clinical parameters. Sensitivity, NPV, PPV, specificity and diagnostic accuracy of Pap smear were calculated using histopathological diagnosis as the gold standard. The Chi-square test was used to determine significance when the p-value was less than 0.05 was used to assess statistical significance.

RESULTS

A total of 4910 cervical smears were examined during the one-year study period (January–December 2022). Of these, 62 smears were deemed unsatisfactory because of excessive blood, mucus or inadequate cellularity and were excluded. The final analysis included 4848 satisfactory smears.

Age distribution

Participants ranged from 20 to 80 years of age, grouped in 10-year intervals. The majority (about 65%) of women were older than 30 years. The 31–40 years age group accounted for the highest number of screened women, representing approximately 38% of the total. The youngest patient was 20 years old, while postmenopausal women comprised a smaller but significant proportion of the study population (Figure 1).

Clinical profile

The most frequent clinical symptom was leucorrhoea, reported in 25.8% of patients, predominantly among women aged 20–40 years. Menorrhagia was the second most common complaint (21.4%), primarily seen in the 20–50 years age range. Postmenopausal bleeding occurred

mainly among women aged 51–70 years (Table 1). On per speculum examination, white discharge was the most common finding (23.1%), while contact bleeding was observed in 0.06% of cases (Figure 2).

Cytological findings (Bethesda 2014 Classification)

Based on cytological evaluation, 4768 smears (98.35%) were classified as NILM. Within the NILM category, non-specific inflammatory changes were the most prevalent, observed in 69% of cases. The majority of these inflammatory smears were obtained from women in their reproductive years. Other non-neoplastic findings included atrophic smears (4.49%) and squamous metaplasia (7.26%). Among infectious etiologies, bacterial vaginosis was identified in 4.57%, Candida infection in 3% (Figure 3) and Trichomonas vaginalis in 0.45% of cases (Table 2).

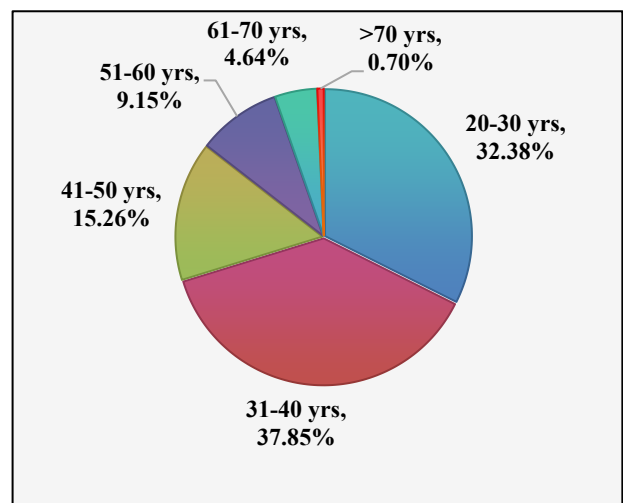


Figure 1: Age wise distribution of cases in percentage.

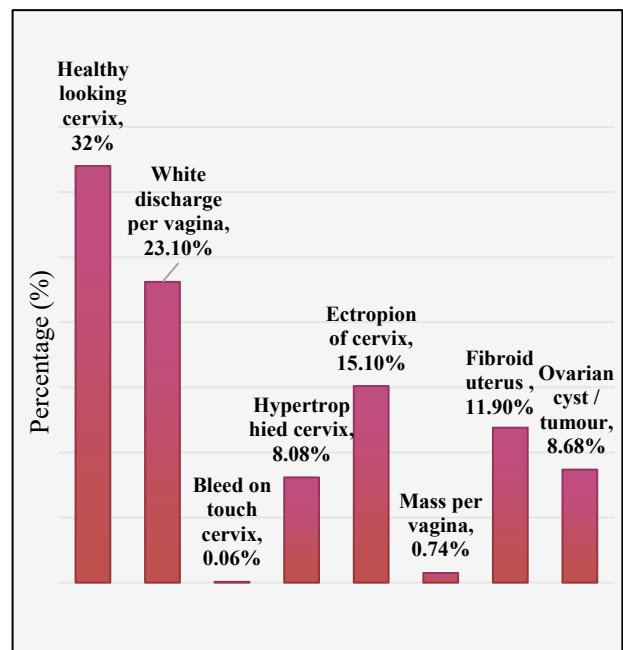


Figure 2: Per speculum and USG findings.

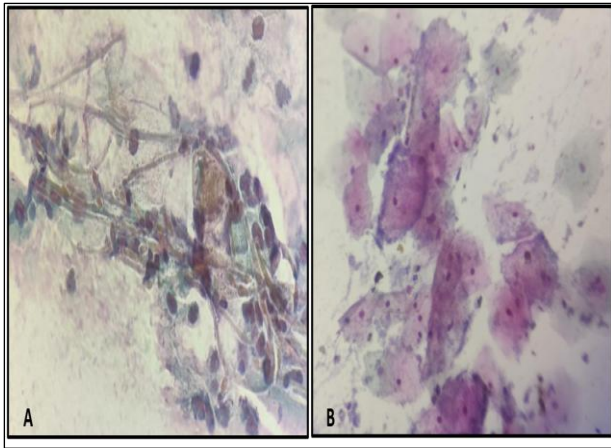


Figure 3 (A and B): Pap smear 40X, Pseudohyphae of candida, altered flora with many coccobacilli and clue cells.

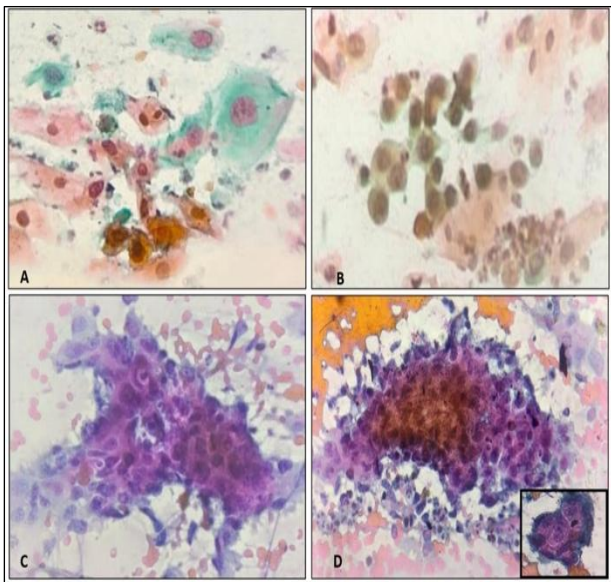


Figure 4 (A-D): Pap smear H & E stain 40X. ASCUS, LSIL, HSIL, SCC (inset-Keratin pearl).

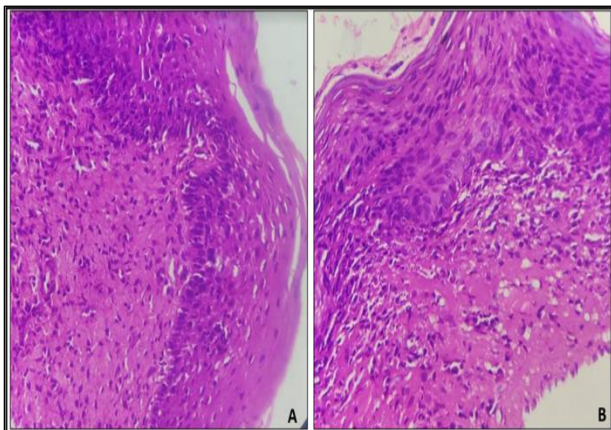


Figure 5 (A and B): A-H and E staining 40X CIN I, B-H and staining 40X CIN II.

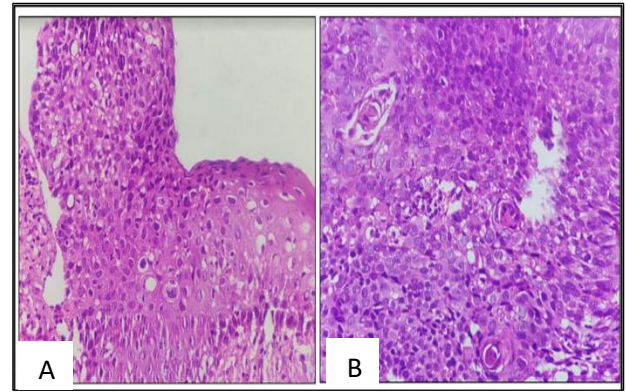


Figure 6 (A and B): A-H and E staining 40X CIN III, B-H and E staining 40X SCC.

Epithelial cell abnormalities

Abnormal epithelial lesions were detected in 80 smears (1.65%). Of these, 18 cases (0.37%) had High-Grade Squamous Intraepithelial Lesion (HSIL), 26 cases (0.54%) had Low-Grade Squamous Intraepithelial Lesion (LSIL), 34 cases (0.7%) had Atypical Squamous Cells of Undetermined Significance (ASCUS) and 2 cases (0.04%) had Squamous Cell Carcinoma (SCC). Most intraepithelial abnormalities (dysplasia) occurred among women aged 41–50 years, whereas invasive carcinoma was predominantly observed after the age of 50 years (Table 3) (Figure 4).

Cyto-histological correlation

Of the 80 cases showing preneoplastic or malignant changes on cytology, histopathological correlation was available in 64 cases, while 16 patients were lost to follow-up. Among the cases reported as ASCUS on cytology, histopathological examination revealed 14 non-neoplastic lesions, 9 cases of CIN I and 1 case of CIN II. In the LSIL category, biopsy findings confirmed 3 non-neoplastic lesions, 13 cases of CIN I, 8 cases of CIN II and 2 cases of CIN III. Of the 18 cases diagnosed cytologically as HSIL, histopathology showed 1 case of CIN I, 6 cases of CIN II, 3 cases of CIN III and 2 cases of squamous cell carcinoma, while 6 cases did not undergo biopsy. All 2 cases reported as squamous cell carcinoma on cytology demonstrated complete concordance with histopathological diagnosis, showing a 100% cytohistological correlation.

Diagnostic performance

When compared to histopathology, Pap smear showed an overall PPV of 92.5%, NPV of 56.52%, sensitivity of 78.72%, specificity of 82.35% and diagnostic accuracy of 79.68%. The p value (0.0001) indicated a statistically significant correlation between cytological and histopathological diagnoses. Although Pap smear was less sensitive for detecting HSIL (45%), it maintained high specificity (93.18%) and overall good diagnostic reliability (78.13%).

Table 1: Age wise distribution of cases according to clinical symptoms.

| Symptoms | Age groups (in years) | | | | | | Total | (%) |
|--------------------------|-----------------------|-------|-------|-------|-------|-----|-------|-------|
| | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | >71 | | |
| Asymptomatic | 310 | 219 | 110 | 286 | 94 | 10 | 1029 | 21.22 |
| Back pain | 138 | 340 | 43 | 50 | 40 | 10 | 621 | 12.8 |
| Abdominal pain | 35 | 124 | 220 | 38 | 28 | 03 | 448 | 9.24 |
| Leucorrhoea | 680 | 504 | 60 | 08 | 01 | 00 | 1253 | 25.8 |
| Burning micturition | 32 | 80 | 12 | 27 | 26 | 06 | 183 | 3.7 |
| Amenorrhea | 15 | 28 | 01 | 02 | 00 | 00 | 46 | 0.94 |
| Menorrhagia | 240 | 520 | 286 | 03 | 00 | 00 | 1049 | 21.4 |
| Dyspareunia | 12 | 13 | 03 | 04 | 00 | 00 | 31 | 0.63 |
| Post coital bleeding | 08 | 08 | 05 | 00 | 00 | 00 | 21 | 0.43 |
| Post menopausal bleeding | 00 | 00 | 00 | 15 | 16 | 00 | 31 | 0.63 |
| Pass per vagina | 00 | 00 | 00 | 11 | 20 | 05 | 36 | 0.74 |

Table 2: Distribution of Non neoplastic lesions according to age.

| Non neoplastic lesions | Age groups (years) | | | | | | Total | (%) |
|--------------------------------|--------------------|-------|-------|-------|-------|-----|-------|-------|
| | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | >71 | | |
| Normal | 222 | 148 | 44 | 38 | 18 | - | 470 | 9.69 |
| Squamous metaplasia | 18 | 128 | 48 | 86 | 64 | 08 | 352 | 7.26 |
| Atrophy | - | - | 32 | 64 | 102 | 20 | 218 | 4.49 |
| NILM Non-specific inflammation | 1204 | 1404 | 464 | 236 | 32 | 06 | 3346 | 69 |
| Bacterial vaginosis | 54 | 78 | 90 | - | - | - | 222 | 4.57 |
| Candida | 64 | 52 | 22 | - | - | - | 138 | 03 |
| Trichomonas | 06 | 12 | 04 | - | - | - | 22 | 0.45 |
| Total | 1568 | 1822 | 704 | 424 | 216 | 34 | 4768 | 98.35 |

Table 3: Statistical values for different abnormal epithelial lesions in percentage.

| Particulars | LSIL | HSIL | SCC |
|---------------------|-------|-------|-------|
| Sensitivity | 56.52 | 45 | 50 |
| Specificity | 68.29 | 93.18 | 100 |
| PPV | 50 | 75 | 100 |
| NPV | 73.68 | 79.24 | 96.77 |
| Diagnostic accuracy | 64.06 | 78.13 | 96.88 |

DISCUSSION

The present study was conducted to assess the cytomorphological findings of cervical smears, determine the frequency of epithelial abnormalities and evaluate the diagnostic accuracy of the Pap smear through correlation with histopathology. The findings confirm the value of cytological screening as the major method for early cervical lesion diagnosis, especially in low-resource environments where access to preventive healthcare is still restricted.

The majority of women screened in this study belonged to the 31–40 years age group, which is comparable to reports from other Indian studies.¹²⁻¹⁴ This age group represents the reproductive period when cervical epithelial changes are more likely to occur due to hormonal variations and sexual activity. Leucorrhoea was the most frequent

complaint, followed by menorrhagia findings that align with other research.^{15,16} On per speculum examination, most cervixes appeared healthy, while white discharge was noted in nearly one-fourth of participants, similar to other results.^{17,18} These findings suggest that many women with non-specific symptoms still benefit from routine cytological screening, underscoring the importance of opportunistic testing. In this study, most cervical smears were reported as negative for intraepithelial lesion or malignancy, a finding comparable with the other works.¹⁹ Non-specific inflammatory smears were the most common, followed by atrophic and metaplastic changes. Bacterial vaginosis emerged as the leading infectious cause, followed by Candida and Trichomonas, echoing findings.²⁰ The high rate of inflammatory smears highlights persistent reproductive tract infections and poor genital hygiene among women in developing regions. Addressing these through education and healthcare outreach could indirectly reduce the risk of cervical neoplasia by improving overall reproductive health.

Epithelial cell abnormalities were detected in 1.65% of all cases. This prevalence is comparable with findings though lower than figures reported in some international studies.²⁰ Such variation is likely due to differences in population characteristics, screening methods and interpretation criteria. ASCUS were the most frequent abnormality, followed by LSIL. These results are similar to some other studies.^{21,22} Although some researchers, identified low-grade lesions as the predominant category. Differences among studies may also reflect the use of varying cytological classification systems and interobserver variability.^{5,20}

Among the 80 cases with abnormal cytology, histopathological confirmation was available for 64. The correlation between cytological and histological findings was strong, especially for high-grade lesions and invasive carcinoma, where agreement was complete. The false-positive rate in ASCUS was attributed mainly to reactive epithelial changes and sampling artifacts. Accurate diagnosis depends on both sample adequacy and the experience of the cytopathologist. These findings are consistent with the observations who also reported excellent concordance between cytology and histopathology for malignant lesions.²³ In the current investigation, Pap smears had an overall diagnostic accuracy of 79.68%, a sensitivity of 78.72% and a specificity of 82.35%. These findings are consistent with previous research.^{24,25} The relatively lower sensitivity for detecting high-grade lesions observed here mirrors the trend reported reflecting the inherent limitations of cytology-based screening. Nevertheless, the high positive predictive value of 92.5% supports its effectiveness as a first-line screening method. Variations in diagnostic indices among different studies may arise from differences in sample quality, interpretation standards and the inclusion of follow-up histology data.^{26,27}

The findings of this study reinforce the role of Pap smear cytology as a simple, inexpensive and reliable technique for detecting precancerous and malignant cervical lesions. Regular screening among sexually active women, combined with health education, proper sampling and consistent follow-up, can substantially reduce cervical cancer incidence. Strengthening cytology-histology correlation and ensuring continuous quality assurance in laboratories will further improve diagnostic accuracy. Expanding awareness and accessibility of screening programs, especially in rural communities, remains crucial for reducing the burden of cervical cancer in India.

CONCLUSION

Cytological screening of cervical smears remains a simple, reliable and cost-effective method for the early detection of cervical epithelial abnormalities. Most samples were negative for intraepithelial lesion or malignancy, with inflammatory and reactive changes comprising the majority of findings. ASCUS were the most frequent epithelial abnormality, followed by LSIL. Correlation with

histopathological findings demonstrated good diagnostic accuracy, particularly for high-grade and malignant lesions. Despite moderate sensitivity, the high specificity and PPV of Pap smear cytology confirm its value as an essential screening tool. Routine cervical cytology, supported by adequate sampling, continuous quality assurance and timely follow-up, can significantly reduce the burden of cervical cancer. Expanding organized screening programs and increasing public awareness remain critical steps toward effective cervical cancer control in India.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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