Section: Miscellaneous

Original Research Article

PROSPECTIVE STUDY OF CERVICAL CYTOLOGY, HPV STATUS AND HISTOPATHOLOGICAL CORRELATION IN WOMEN WITH CERVICAL LESIONS

Pahula Verma[1], Ravi Saini[2], Deergha Singh[2], Isha Gupta[3]

[1]*Associate Professor, Department of Obstetrics and Gynaecology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India.*
[2]*Assistant Professor, Department of Pathology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India.*
[3]*Professor and Head, Department of Pathology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India.*

Received *: 16/04/2026*
Received in revised form *: 07/06/2026*
Accepted *: 23/06/2026*

Corresponding Author:
Dr. Pahula Verma,
Associate Professor, Department of Obstetrics and Gynaecology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India.
Email: dr.pahulaverma@gmail.com

DOI: 10.70034/ijmedph.2026.3.300

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 1883-1889

ABSTRACT

Background: Cervical cancer develops through a progressive sequence of persistent high-risk human papillomavirus infection, cervical epithelial abnormalities, cervical intraepithelial neoplasia, and invasive carcinoma. Cervical cytology is a simple and widely used screening tool, while HPV testing helps identify women at increased risk of significant cervical pathology. Histopathological examination remains the gold standard for confirmation and grading of cervical lesions. The aim of the present study was to evaluate cervical cytology, high-risk HPV status, and their histopathological correlation in women presenting with cervical lesions at a tertiary care hospital.

Materials and Methods: This prospective observational study included 102 women with clinically suspected cervical lesions. Detailed clinical history and examination were performed in all cases. Cervical cytology was done using Pap smear and reported according to The Bethesda System. Cervical samples were tested for high-risk HPV DNA, and HPV-positive cases were further classified according to genotype, wherever available. Cervical biopsy was performed from clinically abnormal or suspicious areas, and histopathological findings were considered the reference standard. Data were analyzed using IBM SPSS Statistics version 27.0. Categorical variables were expressed as frequency and percentage. The association between cytology, HPV status, and histopathology was assessed using chi-square test or Fisher's exact test, and $p < 0.05$ was considered statistically significant.

Results: The majority of women were aged 41–50 years (33.33%), and 65.69% were multiparous. The most common symptom was abnormal vaginal discharge (52.94%), while cervical erosion was the commonest clinical finding (41.18%). Pap smear showed NILM/inflammatory changes in 43.14% and abnormal cytology in 56.86% of cases. LSIL was the most common abnormal cytological finding (18.63%). High-risk HPV positivity was observed in 52.94% of women, with HPV 16 being the predominant genotype. Histopathology revealed benign lesions in 47.06%, premalignant lesions in 43.14%, and malignant lesions in 9.80%. Cytology showed significant correlation with histopathology ($p < 0.001$). Pap smear had sensitivity of 88.89%, specificity of 79.17%, and diagnostic accuracy of 84.31%, while HPV testing showed sensitivity of 81.48%, specificity of 79.17%, and accuracy of 80.39%.

Conclusion: Cervical cytology and HPV testing showed significant association with histopathological diagnosis. Combined evaluation improves early detection and management of premalignant and malignant cervical lesions.

Keywords: Cervical cytology, HPV, Pap smear, Histopathology, Cervical lesions.

INTRODUCTION

Cervical cancer remains one of the most important preventable malignancies affecting women worldwide. It develops through a recognizable sequence of persistent high-risk human papillomavirus infection, epithelial transformation, cervical intraepithelial neoplasia, and invasive

carcinoma. Because this process usually evolves gradually, cervical cancer offers a valuable opportunity for early detection and prevention through screening, timely diagnosis, and appropriate treatment. Despite advances in vaccination and screening, cervical cancer continues to represent a major clinical and public health challenge, particularly in low- and middle-resource settings where organized screening coverage, follow-up, and treatment access may be limited.[1]

The cervix is vulnerable to a wide spectrum of inflammatory, premalignant, and malignant lesions. Many women with cervical pathology present with non-specific symptoms such as vaginal discharge, lower abdominal pain, post-coital bleeding, intermenstrual bleeding, postmenopausal bleeding, or clinically unhealthy cervix on examination. These symptoms may be associated with benign inflammatory changes, but they may also indicate underlying cervical intraepithelial neoplasia or invasive malignancy. Therefore, systematic evaluation of women with cervical lesions is essential, especially in tertiary care hospitals where symptomatic and clinically suspicious cases are commonly referred for further assessment.[2]

Human papillomavirus plays a central etiological role in cervical carcinogenesis. Persistent infection with oncogenic HPV types causes molecular and cellular alterations in the cervical transformation zone, eventually leading to dysplastic and neoplastic changes. HPV testing has therefore become an important component of modern cervical cancer prevention, as it identifies women at increased risk before obvious morphological abnormalities may be seen. However, HPV positivity alone does not confirm the presence of cervical intraepithelial neoplasia or carcinoma; rather, it indicates biological risk and requires correlation with cytology, clinical findings, and histopathology.[3]

Cervical cytology remains a widely used and practical screening tool, particularly in settings where HPV-based primary screening is still being implemented. The Pap smear helps identify epithelial abnormalities such as atypical squamous cells, low-grade squamous intraepithelial lesion, high-grade squamous intraepithelial lesion, glandular abnormalities, and features suggestive of malignancy. Cytology is useful because it is relatively simple, acceptable, and capable of detecting premalignant changes before invasive cancer develops. However, cytology has limitations, including sampling error, interpretative variability, inflammatory obscuration, and false-negative results. These limitations make histopathological confirmation essential in women with abnormal cytology or clinically suspicious cervical lesions.[4]

Histopathological examination of cervical biopsy is considered the definitive method for diagnosing cervical lesions. It allows accurate classification of benign inflammatory conditions, cervical intraepithelial neoplasia, carcinoma in situ, squamous cell carcinoma, adenocarcinoma, and other uncommon cervical pathologies. Histopathology not only confirms cytological abnormalities but also grades the severity of disease and guides further management. In clinical practice, the final treatment plan often depends on the histopathological diagnosis rather than cytology or HPV status alone. Therefore, correlation between cytology, HPV status, and histopathology provides a more complete assessment of cervical disease.[5]

The integration of cytology and HPV testing has improved risk stratification in women with cervical abnormalities. Cytology reflects current cellular changes, while HPV testing reflects the underlying viral risk responsible for cervical neoplasia. When both are interpreted together and correlated with biopsy findings, diagnostic confidence improves, especially in cases with equivocal cytology, persistent inflammation, high-risk HPV positivity, or suspicious cervical appearance. This combined approach is particularly relevant in women with visible cervical lesions, because clinical appearance alone cannot reliably distinguish benign from premalignant or malignant pathology.[6]

MATERIALS AND METHODS

This was a prospective observational study conducted at a tertiary care hospital among women presenting with clinically suspected cervical lesions. The study was designed to evaluate the correlation between cervical cytology, high-risk human papillomavirus status, and histopathological findings in women with cervical lesions. A total of 102 women with cervical lesions were included in the study. Women attending the outpatient department with symptoms or clinical findings suggestive of cervical pathology were evaluated. Eligible participants were enrolled after obtaining informed consent and were subjected to cervical cytology, HPV testing, and histopathological examination as per the study protocol.

Inclusion Criteria

Women with clinically visible cervical lesions, abnormal cervical appearance on per speculum examination, or symptoms suggestive of cervical pathology such as abnormal vaginal discharge, post-coital bleeding, intermenstrual bleeding, postmenopausal bleeding, lower abdominal pain, or persistent cervicitis were included in the study. Women willing to undergo cervical cytology, HPV testing, and cervical biopsy to undergo cervical cytology, HPV testing, and cervical biopsy were considered eligible.

Exclusion Criteria

Women who were pregnant, menstruating at the time of examination, previously treated for cervical intraepithelial neoplasia or cervical carcinoma, had undergone hysterectomy, or were unwilling to provide consent were excluded from the study. Patients with inadequate cytology smears,

insufficient biopsy material, or incomplete clinical and laboratory data were also excluded.

Methodology

Clinical Evaluation

A detailed history was obtained from each participant, including age, parity, age at marriage, age at first intercourse, menstrual history, obstetric history, contraceptive use, sexual history, socioeconomic status, personal hygiene practices, smoking status, and presenting complaints. General physical examination, abdominal examination, and pelvic examination were performed. On per speculum examination, the cervix was assessed for erosion, hypertrophy, ulceration, growth, bleeding on touch, discharge, congestion, polypoidal lesions, or any suspicious cervical abnormality.

Cervical Cytology

Cervical cytology was performed using a Pap smear technique. Samples were collected from the ectocervix and endocervix using an Ayre's spatula and endocervical brush under proper aseptic precautions. Smears were immediately fixed in alcohol and stained by the Papanicolaou method. Cytology smears were reported according to The Bethesda System, including negative for intraepithelial lesion or malignancy, inflammatory smear, atypical squamous cells of undetermined significance, low-grade squamous intraepithelial lesion, high-grade squamous intraepithelial lesion, atypical glandular cells, and malignancy.

HPV Testing

Cervical samples were collected for HPV testing before biopsy, using a sterile cervical sampling brush. The sample was placed in the appropriate transport medium and processed for detection of high-risk HPV DNA. HPV status was categorized as positive or negative. Where applicable, high-risk HPV genotypes, including HPV 16 and HPV 18, were recorded separately. HPV positivity was analyzed in relation to cytological abnormalities and histopathological diagnosis.

Histopathological Examination

Cervical biopsy was performed from the clinically abnormal or suspicious area of the cervix. In cases where the lesion was not clearly visible, biopsy was taken under colposcopic guidance wherever indicated. Tissue samples were fixed in 10% formalin, processed using routine histopathological techniques "gold standard", embedded in paraffin, sectioned, and stained with hematoxylin and eosin. Histopathological diagnosis was considered the reference standard and was categorized as chronic cervicitis, cervical intraepithelial neoplasia grade 1, cervical intraepithelial neoplasia grade 2, cervical intraepithelial neoplasia grade 3, carcinoma in situ, squamous cell carcinoma, adenocarcinoma, or other benign and malignant lesions.

Study Parameters

The main study parameters included age distribution, parity, presenting symptoms, clinical appearance of the cervix, Pap smear findings, HPV status, HPV genotype where available, and histopathological diagnosis. The association of cervical cytology with histopathology and HPV status with histopathology was assessed. The diagnostic performance of cervical cytology and HPV testing was evaluated by calculating sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy using histopathology as the gold standard.

Outcome Measures

The primary outcome was the correlation between cervical cytology, HPV status, and histopathological findings in women with cervical lesions. Secondary outcomes included the prevalence of high-risk HPV infection among women with cervical lesions, distribution of cytological abnormalities, frequency of premalignant and malignant cervical lesions on histopathology, and diagnostic utility of Pap smear and HPV testing in detecting significant cervical pathology.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27.0. Continuous variables such as age were expressed as mean and standard deviation, while categorical variables such as symptoms, cytology findings, HPV status, and histopathological diagnosis were expressed as frequency and percentage. The association between categorical variables was assessed using the chi-square test or Fisher's exact test, as appropriate. Correlation between cervical cytology, HPV status, and histopathology was evaluated statistically. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated for Pap smear and HPV testing, taking histopathology as the reference standard. A p-value of less than 0.05 was considered statistically significant.

RESULTS

[Table 1]: Socio-demographic and Reproductive Profile of Study Participants

The age distribution of the study population revealed that the majority of women belonged to the 41–50 years age group (33.33%), followed by 31–40 years (27.45%) and 51–60 years (19.61%). Women aged ≤30 years and >60 years constituted 11.76% and 7.84% of the study population, respectively. With respect to parity, multiparous women (Para ≥3) constituted the largest proportion of cases (65.69%), whereas only 5.88% of women were nulliparous. This finding suggests a possible association between high parity and the occurrence of cervical lesions. Regarding age at marriage, the majority of participants (61.76%) were married between 18 and 25 years of age, while 30.39% were married before the age of 18 years. Assessment of socioeconomic status showed that more than half of the women (51.96%) belonged to the middle socioeconomic class, followed by the lower socioeconomic class (34.31%). Only 13.73%

belonged to the upper socioeconomic class. Nearly half of the women (48.04%) reported no contraceptive use. Among contraceptive users, IUCD usage was observed in 22.55%, oral contraceptive use in 15.69%, and barrier contraceptive use in 13.73% of participants.

[Table 2]: Distribution of Presenting Symptoms and Clinical Cervical Findings

The most common presenting symptom among women with cervical lesions was abnormal vaginal discharge, reported by 52.94% of participants. This was followed by lower abdominal pain (37.25%) and persistent cervicitis (28.43%). Symptoms suggestive of significant cervical pathology, including post-coital bleeding (23.53%), intermenstrual bleeding (17.65%), and postmenopausal bleeding (13.73%), were also frequently encountered. On per speculum examination, cervical erosion was the most commonly observed clinical finding, present in 41.18% of women. Other notable findings included congestion with discharge (30.39%), cervical hypertrophy (25.49%), and bleeding on touch (21.57%). More suspicious lesions such as ulcerative or growth lesions were identified in 14.71% of cases, while polypoidal lesions were noted in 5.88%.

[Table 3]: Distribution of Cervical Cytology Findings and HPV Status

Cervical cytology revealed that 43.14% of women had NILM (Negative for Intraepithelial Lesion or Malignancy) or inflammatory smears, while 56.86% demonstrated abnormal cytological findings. Among abnormal cytology results, LSIL (18.63%) was the most frequent abnormality, followed by HSIL (15.69%), ASC-US (12.75%), malignancy (5.88%), and ASC-H/AGC (3.92%). HPV testing demonstrated that 54 women (52.94%) were positive for high-risk HPV infection, whereas 47.06% were HPV negative. Among HPV-positive cases, HPV 16 was the predominant genotype, accounting for 48.15% of infections. HPV 18 was detected in 18.52% of positive cases, while other high-risk HPV types were identified in 27.78%. Multiple high-risk HPV infections were observed in 5.56% of HPV-positive women. The predominance of HPV 16 and HPV 18 supports their established role as the most important oncogenic HPV types associated with cervical carcinogenesis.

[Table 4]: Histopathological Diagnosis of Cervical Lesions

Histopathological examination, which served as the gold standard for diagnosis, revealed that 47.06% of women had chronic cervicitis or other benign cervical lesions. Among premalignant lesions, CIN 1 was the most common histopathological diagnosis, observed in 21.57% of cases, followed by CIN 2 (11.76%) and CIN 3/carcinoma in situ (9.80%). Malignant lesions were identified in 9.80% of women, comprising squamous cell carcinoma (7.84%) and adenocarcinoma (1.96%). Overall, 43.14% of participants had premalignant lesions (CIN 1–CIN 3), while 52.94% had histopathologically significant lesions (CIN 1 and above).

[Table 5]: Correlation between Cervical Cytology and Histopathological Diagnosis

A strong correlation was observed between cervical cytological findings and histopathological diagnosis. Among women with NILM/inflammatory smears, the majority (86.36%) had benign histopathological findings. However, a small proportion of women with apparently negative cytology were found to have CIN lesions on histopathology, including CIN 1 (9.09%), CIN 2 (2.27%), and CIN 3 (2.27%), indicating the possibility of false-negative cytology results. Among women with ASC-US, CIN 1 was the most common histopathological finding (46.15%), followed by CIN 2 (15.38%), while 38.46% had benign lesions. Similarly, among women with LSIL, more than half (52.63%) were diagnosed with CIN 1 on histopathology, while 21.05% had CIN 2 lesions. Women with HSIL cytology showed a high prevalence of advanced cervical lesions. Histopathological examination revealed CIN 3/carcinoma in situ in 43.75%, CIN 2 in 31.25%, and invasive squamous cell carcinoma in 6.25% of HSIL cases. Furthermore, all cases reported as malignancy on cytology were confirmed as squamous cell carcinoma on histopathology. Among women with ASC-H/AGC, 50.00% were diagnosed with adenocarcinoma and 25.00% each with CIN 3 and squamous cell carcinoma. The association between cervical cytology and histopathological diagnosis was found to be highly statistically significant (Chi-square test, $p < 0.001$).

[Table 6]: Diagnostic Performance of Pap Smear and HPV Testing

The diagnostic performance of Pap smear and HPV testing was assessed using histopathological findings as the reference standard. An abnormal Pap smear (ASC-US and above) demonstrated a sensitivity of 88.89%, indicating that it correctly identified nearly nine out of ten women with histopathologically significant cervical lesions. The specificity was 79.17%, suggesting a good ability to correctly classify women without disease. The positive predictive value and negative predictive value of Pap smear were 82.76% and 86.36%, respectively, with an overall diagnostic accuracy of 84.31%. HPV testing showed a sensitivity of 81.48% and a specificity of 79.17%. The positive predictive value, negative predictive value, and overall diagnostic accuracy were 81.48%, 79.17%, and 80.39%, respectively. Both abnormal cytology and HPV positivity showed a highly significant association with histopathological diagnosis ($p < 0.001$).

Table 1: Socio-demographic and reproductive profile of study participants

Parameter	Category	Number of patients	Percentage (%)
Age group	≤30 years	12	11.76
	31–40 years	28	27.45
	41–50 years	34	33.33
	51–60 years	20	19.61
	>60 years	8	7.84
Parity	Nulliparous	6	5.88
	Para 1–2	29	28.43
	Para ≥3	67	65.69
Age at marriage	<18 years	31	30.39
	18–25 years	63	61.76
	>25 years	8	7.84
Socioeconomic status	Lower	35	34.31
	Middle	53	51.96
	Upper	14	13.73
Contraceptive use	None	49	48.04
	Barrier method	14	13.73
	Oral contraceptive pills	16	15.69
	IUCD	23	22.55

Table 2: Distribution of presenting symptoms and clinical cervical findings

Parameter	Finding	Number of patients	Percentage (%)
Presenting symptom	Abnormal vaginal discharge	54	52.94
	Lower abdominal pain	38	37.25
	Persistent cervicitis	29	28.43
	Post-coital bleeding	24	23.53
	Intermenstrual bleeding	18	17.65
	Postmenopausal bleeding	14	13.73
Clinical finding on per speculum examination	Cervical erosion	42	41.18
	Congestion with discharge	31	30.39
	Cervical hypertrophy	26	25.49
	Bleeding on touch	22	21.57
	Ulcerative/growth lesion	15	14.71
	Polypoidal lesion	6	5.88

Table 3: Distribution of cervical cytology findings and HPV status

Parameter	Category	Number of patients	Percentage (%)
Pap smear cytology	NILM / inflammatory smear	44	43.14
	ASC-US	13	12.75
	LSIL	19	18.63
	HSIL	16	15.69
	ASC-H / AGC	4	3.92
	Malignancy	6	5.88
Cytology grouping	Normal / inflammatory	44	43.14
	Abnormal cytology	58	56.86
HPV status	HPV positive	54	52.94
	HPV negative	48	47.06
HPV genotype among HPV-positive cases	HPV 16	26	48.15
	HPV 18	10	18.52
	Other high-risk HPV types	15	27.78
	Multiple high-risk HPV infection	3	5.56

Table 4: Histopathological diagnosis of cervical lesions

Histopathological diagnosis	Number of patients	Percentage (%)
Chronic cervicitis / benign cervical lesion	48	47.06
CIN 1	22	21.57
CIN 2	12	11.76
CIN 3 / carcinoma in situ	10	9.80
Squamous cell carcinoma	8	7.84
Adenocarcinoma	2	1.96
Total	102	100.00

Table 5: Correlation between cervical cytology and histopathological diagnosis

Cytology finding	Benign n (%)	CIN 1 n (%)	CIN 2 n (%)	CIN 3/CIS n (%)	SCC n (%)	Adenocarcinoma n (%)	Total
NILM / inflammatory	38 (86.36)	4 (9.09)	1 (2.27)	1 (2.27)	0 (0.00)	0 (0.00)	44
ASC-US	5 (38.46)	6 (46.15)	2 (15.38)	0 (0.00)	0 (0.00)	0 (0.00)	13
LSIL	4 (21.05)	10 (52.63)	4 (21.05)	1 (5.26)	0 (0.00)	0 (0.00)	19
HSIL	1 (6.25)	2 (12.50)	5 (31.25)	7 (43.75)	1 (6.25)	0 (0.00)	16

ASC-H / AGC	0 (0.00)	0 (0.00)	0 (0.00)	1 (25.00)	1 (25.00)	2 (50.00)	4
Malignancy	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	6 (100.00)	0 (0.00)	6
Total	48 (47.06)	22 (21.57)	12 (11.76)	10 (9.80)	8 (7.84)	2 (1.96)	102

Chi-square test: p < 0.001.

Table 6. Diagnostic performance of Pap smear and HPV testing using histopathology as reference standard

Test parameter	Disease present, CIN 1 and above n	Disease absent, benign n	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic accuracy (%)	p-value
Abnormal Pap smear, ASC-US and above	48	10	88.89	79.17	82.76	86.36	84.31	<0.001
HPV positive status	44	10	81.48	79.17	81.48	79.17	80.39	<0.001

DISCUSSION

In the present study, the majority of women were in the 41–50 years age group (33.33%), followed by 31–40 years (27.45%), showing that cervical lesions were more frequent in middle-aged women. Multiparity was also prominent, with 65.69% being para ≥3, and 30.39% married before 18 years of age. This pattern is comparable with the hospital-based study by Pankaj et al. (2024) from Bihar, in which HPV infection was significantly associated with age >50 years, longer duration of marriage, high parity, illiteracy, and low socioeconomic status. In contrast to their HPV prevalence of 37.30%, the present study showed a higher HPV positivity of 52.94%, probably because only women with clinically suspected cervical lesions were included.[7]

The most common presenting symptom in the present study was abnormal vaginal discharge (52.94%), followed by lower abdominal pain (37.25%), persistent cervicitis (28.43%), post-coital bleeding (23.53%), intermenstrual bleeding (17.65%), and postmenopausal bleeding (13.73%). This finding is supported by Salih et al. (2017), who studied cervical cytopathological changes among women presenting with vaginal discharge and reported that abnormal vaginal discharge was the dominant presenting complaint in their study population. The high proportion of discharge in both studies indicates that persistent vaginal discharge should not be treated only as an infective symptom, but should also prompt cervical evaluation by Pap smear and further testing when clinically indicated.[8]

On clinical examination in the present study, cervical erosion was the most common finding (41.18%), followed by congestion with discharge (30.39%), cervical hypertrophy (25.49%), bleeding on touch (21.57%), ulcerative/growth lesion (14.71%), and polypoidal lesion (5.88%). Similar findings were reported by Chaudhary et al. (2014) in women with unhealthy cervix, where cervical erosion was also the commonest clinical finding, reported in 173 out of 200 women. The higher proportion of cervical erosion in their study may be due to inclusion of women with unhealthy cervix from a rural population, whereas the present study included a broader group of clinically suspected cervical lesions.[9] In the present study, cervical cytology showed NILM/inflammatory smear in 43.14% and abnormal cytology in 56.86% of women. Among abnormal smears, LSIL was the most frequent abnormality (18.63%), followed by HSIL (15.69%), ASC-US (12.75%), malignancy (5.88%), and ASC-H/AGC (3.92%). In comparison, Atla et al. (2015) reported NILM in 69.64% and epithelial cell abnormality in 27.50% among 356 Pap smears. The higher abnormal cytology rate in the present study is expected because all included women had clinically suspected cervical lesions, while Atla et al. included a wider screening population.[10] HPV testing in the present study showed high-risk HPV positivity in 52.94% of women. Among HPV-positive cases, HPV 16 was the most common genotype (48.15%), followed by other high-risk HPV types (27.78%), HPV 18 (18.52%), and multiple high-risk HPV infection (5.56%). This predominance of HPV 16 is consistent with Bhatla et al. (2006), who evaluated invasive cervical carcinoma cases in Delhi and found HPV positivity in 98.10% of evaluable cases, with HPV 16 in 73.60%, HPV 18 in 14.20%, and HPV 45 in 11.30%. The lower HPV 16 proportion in the present study may be because the study population included benign, premalignant, and malignant lesions, while Bhatla et al. studied invasive carcinoma cases.[11] Histopathology in the present study revealed chronic cervicitis/benign cervical lesion in 47.06%, CIN 1 in 21.57%, CIN 2 in 11.76%, CIN 3/carcinoma in situ in 9.80%, squamous cell carcinoma in 7.84%, and adenocarcinoma in 1.96%. Overall, premalignant lesions were present in 43.14%, while malignancy was present in 9.80%. Selvanayaki et al. (2020) reported non-neoplastic lesions in 46.40%, premalignant lesions in 16.00%, and malignant lesions in 37.60% among abnormal Pap smear cases. Compared with their study, the present study had a similar benign lesion rate but a lower malignant lesion rate, possibly because cases were enrolled at the stage of clinically suspected cervical lesions rather than only abnormal cytology-selected cases.[12] The present study demonstrated a significant cytology–histopathology correlation, with increasing cytological abnormality corresponding to increasing histological severity.

Among NILM/inflammatory smears, 86.36% were benign, but CIN lesions were still detected in a small proportion, indicating false-negative cytology. LSIL correlated mainly with CIN 1 (52.63%), while HSIL showed a high frequency of CIN 2 and above, including CIN 3/CIS in 43.75% and SCC in 6.25%. Similarly, Belekar et al. (2023) reported a total cytology–histology concordance rate of 84.15%, with concordance of 100.00% for SCC, 82.35% for HSIL, 82.00% for ASC-US, and 65.60% for LSIL. The significant association in the present study ($p < 0.001$) confirms that Pap smear findings strongly predict histological severity, although biopsy remains essential for confirmation.[13]

The diagnostic performance of Pap smear in the present study showed sensitivity of 88.89%, specificity of 79.17%, PPV of 82.76%, NPV of 86.36%, and diagnostic accuracy of 84.31% for detecting CIN 1 and above. HPV testing showed sensitivity of 81.48%, specificity of 79.17%, PPV of 81.48%, NPV of 79.17%, and accuracy of 80.39%. Katyal et al. (2011) reported Pap smear sensitivity and specificity of 69.20% and 63.72%, while HPV DNA testing showed higher sensitivity and specificity of 92.30% and 84.00%, respectively. In contrast, Pap smear performed slightly better than HPV testing in the present study, which may reflect the inclusion of clinically evident cervical lesions and direct histopathological correlation in all cases.[14]

HPV testing remained a valuable adjunct in the present study, as HPV positivity showed a statistically significant association with histopathology ($p < 0.001$) and identified high-risk women even when cytology alone may not fully define risk. Gupta et al. (2016) reported HPV-DNA positivity in 24 out of 110 women, with sensitivity of 90.00%, specificity of 84.61%, PPV of 69.23%, and NPV of 95.66%. Compared with their study, the present study showed slightly lower HPV sensitivity and NPV, but a higher HPV positivity rate, again suggesting that HPV prevalence and test performance vary according to study population, lesion severity, and selection criteria. Overall, the findings support combined use of cytology, HPV testing, and histopathology for better evaluation of women with cervical lesions.[15]

CONCLUSION

The present study showed a significant correlation between cervical cytology, high-risk HPV status, and histopathological findings in women with cervical lesions. Abnormal Pap smear findings and HPV positivity were strongly associated with premalignant and malignant cervical lesions. Pap smear showed good diagnostic sensitivity and accuracy, while HPV testing served as an important adjunct for identifying high-risk women. Combined evaluation with cytology, HPV testing, and histopathology can improve early detection and appropriate management of cervical lesions in tertiary care settings.

REFERENCES

1. Singh D, Vignat J, Lorenzoni V, Eslahi M, Ginsburg O, Lauby-Secretan B, et al. Global estimates of incidence and mortality of cervical cancer in 2020: a baseline analysis of the WHO Global Cervical Cancer Elimination Initiative. **Lancet Glob Health**. 2023;11(2):e197-e206. doi:10.1016/S2214-109X(22)00501-0.
2. World Health Organization. Global strategy to accelerate the elimination of cervical cancer as a public health problem. Geneva: World Health Organization; 2020. Available from: https://www.who.int/publications/i/item/9789240014107.
3. World Health Organization. WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention. 2nd ed. Geneva: World Health Organization; 2021. Available from: https://www.who.int/publications/i/item/9789240030824.
4. Fontham ETH, Wolf AMD, Church TR, Etzioni R, Flowers CR, Herzig A, et al. Cervical cancer screening for individuals at average risk: 2020 guideline update from the American Cancer Society. CA Cancer J Clin. 2020;70(5):321-346. doi:10.3322/caac.21628.
5. WHO Classification of Tumours Editorial Board. Female genital tumours. 5th ed. Vol 4. Lyon: International Agency for Research on Cancer; 2020. Available from: https://publications.iarc.who.int/Book-And-Report-Series/Who-Classification-Of-Tumours/Female-Genital-Tumours-2020.
6. Perkins RB, Guido RS, Castle PE, Chelmow D, Einstein MH, Garcia F, et al. 2019 ASCCP risk-based management consensus guidelines for abnormal cervical cancer screening tests and cancer precursors. J Low Genit Tract Dis. 2020;24(2):102-131. doi:10.1097/LGT.0000000000000525.
7. Pankaj S, Rani J, Kumari P, Abhilashi K, Choudhary V, Kumari S, et al. Prevalence, risk factors and genotype distribution of human papillomavirus infection among women with and without invasive cervical cancer: findings from a hospital-based study in Bihar, India. Natl Med J India. 2024;37(1):13-17. doi:10.25259/NMJI_634_21.
8. Salih MM, Al Hag FTES, Khalifa MA, El Nabi AH. Cervical cytopathological changes among women with vaginal discharge attending teaching hospital. J Cytol. 2017;34(2):90-94. doi:10.4103/JOC.JOC_214_15.
9. Chaudhary RD, Inamdar SA, Hariharan C. Correlation of diagnostic efficacy of unhealthy cervix by cytology, colposcopy and histopathology in women of rural areas. Int J Reprod Contracept Obstet Gynecol. 2014;3(1):213-218. doi:10.5455/2320-1770.ijrcog20140343.
10. Atla BL, Uma P, Shamili M, Kumar SS. Cytological patterns of cervical Pap smears with histopathological correlation. Int J Res Med Sci. 2015;3(8):1911-1916. doi:10.18203/2320-6012.ijrms20150300.
11. Bhatla N, Dar L, Patro AR, Kriplani A, Gulati A, Verma K, et al. Human papillomavirus type distribution in cervical cancer in Delhi, India. Int J Gynecol Pathol. 2006;25(4):398-402. doi:10.1097/01.pgp.0000209574.62081.e4.
12. Selvanayaki KM, Archana A. A comparative study of Pap smear cytology and histopathology of cervix biopsy. Trop J Pathol Microbiol. 2020;6(3):230-237. doi:10.17511/jopm.2020.i03.04.
13. Belekar SV, Kamal M, Warke AS. Cervical cytology and histology correlation as an analytic quality assurance exercise: experience from an accredited cytology laboratory. J Cytol. 2023;40(4):205-210. doi:10.4103/joc.joc_174_22.
14. Katyal S, Mehrotra R. Complementary procedures in cervical cancer screening in low resource settings. J Obstet Gynaecol India. 2011;61(4):436-438. doi:10.1007/s13224-011-0067-y.
15. Gupta V, Tandon A, Bansal N, Nanda A. How useful is HPV-DNA test for screening of cervical cancer: a prospective study. Int J Reprod Contracept Obstet Gynecol. 2016;5(2):456-459. doi:10.18203/2320-1770.ijrcog20160390.