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Original Research Article

Assessment of Cervical Cytology for Identifying Precancerous Cervical Lesions: Pap Smear-Based Evaluation

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Abstract:

Background: Cervical cancer is largely preventable, and early detection of precancerous lesions through screening can significantly reduce morbidity and mortality.

Objective: This study aimed to evaluate the utility of the Pap smear for detecting precancerous cervical lesions in women attending a gynecology outpatient clinic.

Methods: A total of 780 sexually active women over 21 years of age attending the Department of Obstetrics & Gynecology at Nalanda Medical College and Hospital, Patna, Bihar, were enrolled. Women with visible malignant cervical lesions, previously treated cervical cancer, or pregnancy were excluded. All participants underwent detailed history taking, clinical, per speculum, and vaginal examinations. Cervical smears were collected using an Ayre spatula, fixed in 95% ethyl alcohol, and sent for cytopathological evaluation according to the 2014 Bethesda System. Women with abnormal cytology results were referred for colposcopy and biopsy as indicated.

Results: Most participants were aged 41–50 years and multiparous. Vaginal discharge (36.66%) was the most common complaint, followed by abdominal pain (25.38%) and irregular menstrual cycles (12.82%), while 15.12% were asymptomatic. Adequate smears were obtained in 93.72% of cases. Cytology was negative for malignancy in 49.35%, with 42.94% showing inflammation. ASCUS, LSIL, and HSIL were detected in 2.3%, 4.35%, and 1.02% of women, respectively. Abnormal findings were further evaluated with colposcopy and biopsy as indicated.

Conclusions: The Pap smear is a simple, safe, cost-effective, and reliable screening tool for early detection of precancerous cervical lesions. Abnormal results warrant colposcopy and biopsy to guide timely management and reduce cervical cancer morbidity and mortality.

Keywords: Cervical malignancy, HPV DNA testing, Pap smear, Precancerous lesions, Screening.

Introduction

Cervical cancer is a significant public health concern and remains one of the leading causes of cancer-related mortality among women worldwide [1]. Globally, it is estimated that hundreds of thousands of women are diagnosed with cervical cancer each year, and a substantial proportion succumb to the disease due to late-stage diagnosis and inadequate treatment [2]. The burden of cervical cancer is disproportionately higher in developing countries, including India, compared to developed nations. This discrepancy is largely attributable to the implementation of effective cytology-based screening programs in high-income countries, which have led to a significant reduction in both incidence and mortality over the past few decades [3].

In low-resource settings, however, challenges such as limited awareness, lack of healthcare infrastructure, cultural barriers, and inadequate access to screening services contribute to a higher prevalence of the disease. According to the World Cancer Statistics, more than 80% of all cervical cancer cases are reported from developing countries, with India alone accounting for over one-fifth of global cervical cancer deaths [4]. Every year, approximately 122,844 women in India are diagnosed with cervical cancer, and around 67,477 women die because of this disease [5].

Cervical cancer is considered largely preventable because it progresses through a prolonged pre-invasive stage, allowing an opportunity for early

detection and intervention [6]. The Papanicolaou (Pap) smear test remains the cornerstone of cervical cancer screening due to its simplicity, noninvasive nature, cost-effectiveness, and ability to detect precancerous cervical intraepithelial neoplasia before progression to invasive disease [7]. The overall sensitivity of the Pap smear for detecting high-grade squamous intraepithelial lesions (HSIL) is reported to be approximately 70.8%, and this sensitivity can be further enhanced when combined with HPV DNA testing [8]. Regular and timely screening using these methods can prevent the development of invasive cervical cancer and reduce associated morbidity and mortality.

Despite the availability of effective screening tools, awareness and utilization of cervical cancer screening programs remain low, particularly in rural and socioeconomically disadvantaged populations. Many women do not seek screening due to lack of knowledge, fear, social stigma, or limited access to health-care facilities [9]. Moreover, cultural and societal factors often influence women's health-seeking behavior, resulting in delayed diagnosis and treatment. Educational initiatives aimed at raising awareness about cervical cancer, its risk factors, and the importance of early detection are essential. Women and their families should be counseled about recognizing early symptoms, the significance of regular Pap smears, and the necessity of follow-up care for abnormal results [10].

Strengthening primary health-care systems to incorporate accessible screening programs and follow-up mechanisms is crucial for reducing the national burden of cervical cancer [11]. Establishing effective screening strategies, particularly at primary and community health centers, can facilitate early identification of precancerous lesions, enable timely intervention and reduce progression to invasive disease. In addition, integration of HPV vaccination programs with screening services can further reduce the incidence of cervical cancer in the long term [12].

Given these factors, there is a pressing need to evaluate the prevalence of precancerous cervical lesions in women attending gynecological clinics, assess the effectiveness of the Pap smear test in real-world settings, and understand its clinical correlation with symptoms and demographic characteristics. Such studies can inform public health policies, improve early detection strategies, and contribute to reducing the morbidity and mortality associated with cervical cancer in resource-limited settings.

Methodology

Study Design: This study employed a prospective, hospital-based observational design aimed at evaluating cervical cytology using Pap smear testing for the identification of precancerous cervical lesions.

Study Area: The study was conducted in the Department of Obstetrics & Gynaecology, Nalanda Medical College and Hospital (NMCH), Patna, Bihar, India.

Study Duration: The study was carried out over a period from April 2025 to October 2025.

Sample Size: A total of 780 women were included in the study.

Study Population: The study population consisted of sexually active women aged above 21 years attending the Obstetrics & Gynecology outpatient department with various gynecological complaints suggestive of cervical pathology.

Selection Criteria

Inclusion Criteria

- Sexually active women aged >21 years.
- Women presenting with symptoms such as:
- Vaginal discharge
- Blood-mixed or foul-smelling discharge
- Postcoital bleeding
- Intermenstrual bleeding
- Postmenopausal bleeding
- Lower abdominal pain
- Infertility
- Secondary amenorrhea
- Women willing to provide informed written consent

Exclusion Criteria

- Women not willing to participate in the study.
- Presence of frank cervical growth on clinical examination.
- Previously treated cases of cervical cancer.
- Pregnant women.

Data Collection: Data collection was conducted using a structured and pre-tested proforma. A detailed history was obtained from each participant, including demographic characteristics, menstrual history, obstetric background, sexual history, and presenting complaints. This was followed by a thorough clinical evaluation, including per-speculum and per-vaginal examinations, with findings documented systematically. All information was recorded confidentially to ensure patient privacy throughout the study.

Procedure: After obtaining informed consent, each participant was placed in the lithotomy position, and a sterile bivalve speculum was inserted to obtain a clear visualization of the cervix and vaginal walls. A cervical cytology sample was collected from the ectocervix using a wooden Ayre spatula rotated 360° around the external os. The collected material was immediately smeared onto a labeled glass slide and fixed in 95% ethyl alcohol to prevent air-drying artifacts. The slides were subsequently sent to the Department of Pathology for cytological examination.

Reporting was performed according to the 2014 Bethesda System, classifying smears as either negative for intraepithelial lesion or malignancy or demonstrating epithelial cell abnormalities, including ASC-US, LSIL, HSIL, or glandular abnormalities. Women with abnormal cytology results were referred for colposcopy evaluation, and those with suspicious findings (Reid score ≥6) underwent colposcopy-guided cervical biopsy. Further management was provided based on biopsy results and disease severity.

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using SPSS software version [insert version]. Descriptive statistics such as mean, standard deviation, frequency, and percentage were calculated for demographic characteristics, clinical presentations, and cytological findings. The association between categorical variables, such as abnormal Pap smear results and clinical parameters, was assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant. Results were presented in the form of tables, graphs, and charts for clarity and ease of interpretation.

Result

In this study, most women with LSIL were aged 41–50 years, followed by women in the 51–60-year age group. HSIL was predominantly observed in women aged 41–50 years [Table 1]. Most women with LSIL were multiparous, having four or more children, suggesting that higher parity (>3) may be a significant risk factor for the development of cervical precancerous lesions.

Table 1: Demographic Profile of Patients

Demographic Variable	Negative for malignancy (n=385)	Inflammation (n=335)	ASCUS (n=18)	LSIL (n=34)	HSIL (n=8)
Age (years)					
21-30	108	120	0	1	0
31-40	142	93	2	4	1
41-50	78	61	7	19	4
51-60	46	44	7	7	1
61-70	10	14	2	3	2
>70	1	3	0	0	0
Parity					
P1+0	100	82	0	0	0
P2+0	70	89	2	1	1
P3+0	73	69	3	12	1
P4+0	85	61	8	15	3
P5+0	31	23	4	5	2
>P5+0	26	11	1	1	1
Religion No. (%)	Number	Percentage %			
Hindu	545	(69.87%)			
Muslim	235	(30.12%)			
Socioeconomic status	Number	Percentage%			
Rural	450	(57.69%)			
Urban	330	(42.30%)			

Most women in the study were Hindu, while fewer women were Muslim. This may be due to religious, cultural, or awareness-related factors that limited participation in cervical cancer screening programs. Most participants belonged to rural communities rather than urban areas, likely because government-run cervical cancer screening awareness programs are more active in rural regions [Table 1].

White vaginal discharge was the most common symptom, reported by 36.66% of women, followed by abdominal pain in 25.38%, an irregular menstrual cycle in 12.82%, postcoital bleeding in 2.43%, postmenopausal bleeding in 1.53%, something coming out per vaginum in 3.71%, frequency of micturition in 2.3%, and 15.12% of women were asymptomatic [Table 2].

Table 2: Symptoms of Women Attending Gynecological Outdoor		
Symptoms	**n = 780**	**%**
Asymptomatic	118	15.12
White discharge per vaginum	286	36.66
Pain in abdomen	198	25.38
Postcoital bleeding	19	2.43
Irregular cycle	100	12.82
Postmenopausal bleeding	12	1.53
Something coming out through per vaginum	29	3.71
Frequency of micturition	18	2.3

Table 3 shows that on per speculum examination, a healthy-looking cervix was observed in 25% of participants. White discharge per vaginum was the most common finding, seen in 29.1% of women, followed by cervical erosion in 18.84%, hypertrophied cervix in 11.28%, ectropion of the cervix in 5.89%, uterovaginal prolapse or cystocele in 5.38%, and cervical bleeding on touch in 4.48%. Cases with chronic cervicitis and cervical bleeding on touch were associated with epithelial abnormalities [Table 3].

Table 3: Per Speculum Examination Findings		
Finding	**n = 780**	**%**
Healthy looking cervix	195	25
White discharge per vaginum	227	29.1
Hypertrophied cervix	88	11.28
Cervical erosion	147	18.84
Ectropion of cervix	46	5.89
Bleed on touch cervix	35	4.48
UV prolapse/cystocele	42	5.38

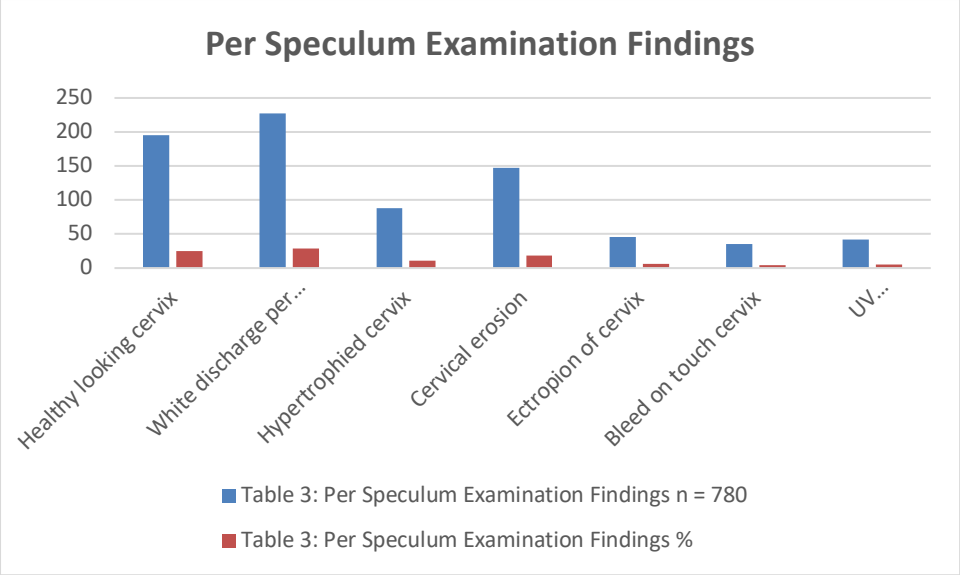

Figure 1: Showed that Per Speculum Examination Findings

Table 4 shows that 49.35% of participants were negative for malignancy and 42.94% had inflammation. Epithelial cell abnormalities, including ASCUS, LSIL, and HSIL, were detected in 2.3%, 4.35%, and 1.02% of women, respectively. Adequate samples were obtained in 93.72% of participants, while 6.28% of samples were unsatisfactory for reporting [Table 4].

Table 4: According to Epithelial Cell Abnormality		
Pap Report	**n = 780**	**%**
Adequate sample	731	93.72
Unsatisfactory sample	49	6.28
Negative for malignancy	385	49.35
Inflammation	335	42.94
ASCUS	18	2.3
LSIL	34	4.35
HSIL	8	1.02
Squamous cell carcinoma	0	0

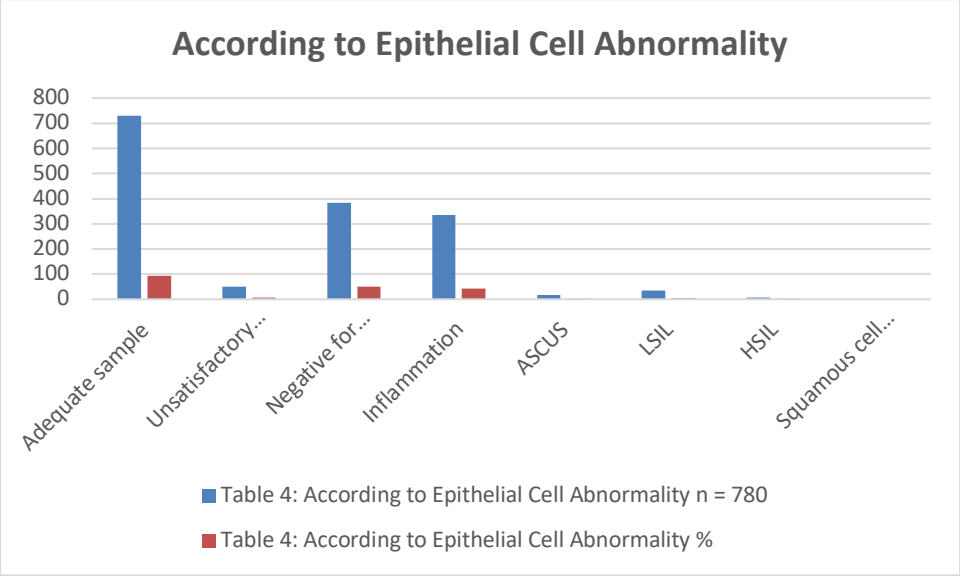

Figure 2: Showed that According to Epithelial Cell Abnormality

The results in Table 5 show that the highest number of abnormal Pap smear findings were observed in patients with white vaginal discharge, followed by those with abdominal pain. No LSIL or HSIL was found in patients presenting with postcoital bleeding, and HSIL was found in only one patient with postmenopausal bleeding [Table 5].

Table 5: Correlation of Pap Smear Findings with Symptoms (Completely corrected for consistency with total N=780)					
Symptoms	**Negative (n=385)**	**Inflammation (n=335)**	**ASCUS (n=18)**	**LSIL (n=34)**	**HSIL (n=8)**
Asymptomatic (n=118)	78	40	0	0	0
White discharge (n=286)	126	133	7	17	3
Pain in abdomen (n=198)	103	82	4	7	2
Postcoital bleeding (n=19)	10	9	0	0	0
Irregular bleeding (n=100)	45	43	4	8	0
Frequency of micturition (n=18)	10	6	1	1	0
Something coming out per vaginum (n=29)	18	8	1	2	0
Postmenopausal bleeding (n=12)	5	4	1	1	1

Discussion

Cervical cancer remains a significant public health concern, particularly in developing countries like India, where awareness, accessibility, and implementation of organized screening programs are limited (WHO 2002). Globally, cervical cancer ranks as the fourth most common cancer among women, yet it is largely preventable through early detection and timely intervention. Fashedemi et al., (2025) overserved that the Pap smear testing, also known as cervical cytology, is a simple, cost-effective, and non-invasive method for the early detection of precancerous cervical lesions [14] and Crosby et al., (2022) demonstrated that Early identification of such lesions through routine screening allows for appropriate management, which can prevent progression to

invasive carcinoma, thereby reducing morbidity and mortality associated with the disease [15].

Jain et al., (2022) studied that, most abnormal Pap smear findings were detected in women aged 41–50 years, followed by the 31–40-year age group [16]. Low-grade squamous intraepithelial lesions (LSIL) were detected in 4.35% of participants, high-grade squamous intraepithelial lesions (HSIL) in 1.02%, and atypical squamous cells of undetermined significance (ASCUS) in 2.3% of women. Arafah et al., (2021) studied that cervical epithelial abnormalities commonly occur in middle-aged women, with precursor lesions developing several years prior to the onset of invasive carcinoma [17]. This emphasizes the critical window for screening women in their 30s and 40s to identify lesions before progression (NIHDP et al., 2022) [18].

Multiparity appeared to be an important risk factor in the study, as most women with LSIL and HSIL had three or more children. Tekalegn et al., (2022) suggested that increased parity may be associated with hormonal changes, cervical trauma, and prolonged exposure to oncogenic human papillomavirus (HPV) infections, which collectively contribute to cervical epithelial transformation [19]. Among the participants, white vaginal discharge was the most common presenting complaint (36.66%), followed by abdominal pain (25.38%) and irregular menstrual cycles (12.82%).

Inflammation was noted in 42.94% of participants, a prevalence comparable to reports from other Indian and international studies. Persistent cervical inflammation, often secondary to chronic infections, is recognized as a cofactor in cervical carcinogenesis, as it may facilitate viral persistence, DNA damage, and cellular proliferation. This underscores the importance of prompt diagnosis and management of cervical infections to mitigate the risk of epithelial abnormalities.

An unsatisfactory smear rate of 6.28% was recorded, likely attributable to technical issues such as improper sample collection, smear dryness, or fixation errors. This highlights the need for rigorous training of healthcare personnel in cervical sampling techniques, as well as adherence to quality control measures, to ensure the reliability of cytological screening.

Priyanka et al., (2021) revealed that Overall, 8.48% of the women screened exhibited epithelial cell abnormalities, a rate comparable to other Indian and international studies. The relatively low prevalence of HSIL observed in this study may reflect early detection, the younger demographic screened, and the effectiveness of opportunistic screening in identifying lesions before progression [20]. Mohamed et al., (2025) de3monstrated that the necessity for regular cervical screening, particularly among women aged 30–50 years, and call attention to the urgent need for community-based awareness programs to encourage participation in Pap smear screening [21].

Furthermore, integrating HPV testing with cytology, adopting "screen-and-treat" strategies, and improving access to healthcare in rural and underserved populations could enhance early detection rates and reduce cervical cancer incidence. Public health interventions focusing on vaccination against high-risk HPV strains, education on risk factors such as multiparity and sexually transmitted infections, and promotion of regular gynecological check-ups are essential for effective cervical cancer prevention. The study reinforces that a multi-pronged approach—combining awareness, vaccination, screening, and timely treatment—is crucial to combating the burden of cervical cancer, especially in resource-limited settings.

Conclusion

Pap smear testing is a very useful, simple, economical, and safe tool for detecting precancerous cervical epithelial lesions. It should be established as a routine screening procedure to reduce the treatment burden, morbidity, and mortality. Every woman above the age of 30 years should undergo routine cervical cancer screening, even into the postmenopausal period. The Pap test has been regarded as the gold standard of cervical screening programs. When the Pap test is combined with an HPV DNA test, the sensitivity for detection of cervical pathology is increased. The community should be educated about the Pap smear test, including its goal and the required frequency of application, by widespread educational and media programs. Most women who visited an outpatient clinic are not aware of cervical cancer screening. Thus, there is a need to spread cancer screening programs to help prevent mortality and morbidity due to cervical cancer.

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