

Assessment of Cervical Cytomorphological Variations in Pap Smears Among Postmenopausal Women: A Retrospective Observational Study

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Abstract

Background: Cervical cancer remains a major cause of cancer-related morbidity and mortality among women, particularly in low- and middle-income countries. Postmenopausal women are susceptible to characteristic cervical cytomorphological alterations due to estrogen deficiency, which may obscure or mimic epithelial abnormalities, making accurate cytological evaluation essential for early detection of premalignant and malignant lesions.

Aim: To assess cervical cytomorphological variations in Pap smears among postmenopausal women and evaluate their association with age and clinical presentation using the Bethesda System for Reporting Cervical Cytology (2014).

Materials and Methods: This retrospective observational study was conducted in the Department of Pathology, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Bihar, India. Cervical cytology records of postmenopausal women aged ≥ 45 years who underwent conventional Pap smear examination between May 2025 and April 2026 were reviewed. Of 126 retrieved Pap smears, 120 satisfactory smears were included after excluding six unsatisfactory samples. Cytological findings were reported according to the Bethesda System (2014). Data were analysed using IBM SPSS Statistics version 27.0. Associations between categorical variables were assessed using the Chi-square test, with $P < 0.05$ considered statistically significant.

Results: The majority of participants were aged 50–54 years (31.7%) and multiparous (60.0%). Negative for intraepithelial lesion or malignancy (NILM) was observed in 98 (81.7%) women, whereas epithelial cell abnormalities were detected in 22 (18.3%). Inflammatory and atrophic smears were identified in 62 (51.7%) and 38 (31.7%) women, respectively. Abnormal Pap smear findings increased significantly with advancing age ($P = 0.031$). Significant associations were observed between cytological findings and excessive vaginal discharge ($P = 0.021$), postmenopausal bleeding ($P < 0.001$), blood-stained vaginal discharge ($P = 0.034$), postcoital bleeding ($P = 0.002$), mass per vaginum ($P = 0.007$), and chronic pelvic inflammatory disease ($P = 0.041$).

Conclusion: Most postmenopausal women demonstrated NILM cytology; however, nearly one-fifth had epithelial cell abnormalities. Advancing age and high-risk clinical presentations were significantly associated with abnormal cervical cytology. These findings support continued cervical cancer screening and timely cytological evaluation of symptomatic postmenopausal women to facilitate early detection and appropriate management of premalignant and malignant cervical lesions.

Keywords: Cervical Cytology; Papanicolaou Smear; Postmenopausal Women; Cervical Cancer Screening; Epithelial Cell Abnormalities.

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Introduction

Cervical cancer remains a major global public health concern and is the fourth most frequently diagnosed cancer among women worldwide, accounting for a substantial proportion of cancer-

related morbidity and mortality, particularly in low- and middle-income countries where organized screening programs are limited [1]. Despite significant advances in prevention and early

detection, cervical cancer continues to impose a considerable disease burden in developing nations, including India, where inadequate screening coverage, poor awareness, socioeconomic inequalities, and limited access to healthcare contribute to delayed diagnosis and poorer clinical outcomes [1,2].

Persistent infection with high-risk human papillomavirus (hrHPV), particularly HPV genotypes 16 and 18, has been established as the primary etiological factor in the development of cervical intraepithelial neoplasia and invasive cervical carcinoma [3]. Although HPV infection is common among sexually active women, only persistent infection with oncogenic HPV types leads to progressive epithelial dysplasia through the expression of viral oncoproteins that interfere with normal cell-cycle regulation [3]. This prolonged pre-invasive phase provides an important opportunity for the early detection and treatment of precancerous lesions before progression to invasive malignancy.

The Papanicolaou (Pap) smear remains one of the most effective, economical, and widely accepted screening tools for the early detection of premalignant and malignant cervical lesions. Since its introduction by George N. Papanicolaou, cytology-based cervical screening has significantly reduced both the incidence and mortality of cervical cancer in countries with well-established screening programs [2,4]. Although HPV-based screening has gained increasing importance, conventional and liquid-based Pap smear cytology continue to play a pivotal role in cervical cancer screening, particularly in resource-limited settings such as India where cytology remains the primary screening modality [2,4].

To improve diagnostic accuracy and standardize reporting, the Bethesda System for Reporting Cervical Cytology (TBS) was developed and has undergone periodic revisions, with the 2014 Bethesda System currently serving as the internationally accepted reporting framework [4,5]. The Bethesda System provides uniform terminology for specimen adequacy, non-neoplastic findings, epithelial cell abnormalities, and other clinically significant cytological alterations, thereby facilitating effective communication between cytopathologists and clinicians and ensuring appropriate patient management and follow-up [4,5]. Postmenopausal women constitute a unique population in cervical cytology because menopause-associated estrogen deficiency induces characteristic atrophic changes in the cervical and vaginal epithelium. These changes frequently result in hypocellular smears, predominance of parabasal cells, inflammatory alterations, and reactive epithelial changes that may occasionally mimic epithelial dysplasia, thereby posing diagnostic

challenges [5,6]. Furthermore, cervical cancer screening participation often declines after menopause owing to misconceptions regarding reduced cancer risk, cultural barriers, and limited healthcare utilization, increasing the likelihood of delayed detection of premalignant and malignant lesions [6].

Aim & Objectives

Aim: To assess the cervical cytomorphological variations in Pap smears among postmenopausal women and evaluate their association with age and clinical presentation using the Bethesda System for Reporting Cervical Cytology (2014) [7].

Objectives

- To determine the demographic and clinical characteristics of postmenopausal women undergoing cervical cytological evaluation.
- To evaluate the relationship between age and abnormal Pap smear findings among postmenopausal women.
- To determine the spectrum of cytomorphological patterns observed in Pap smears.
- To classify Pap smear diagnoses according to the Bethesda System for Reporting Cervical Cytology (2014).
- To assess the association between clinical presentations and cytological findings among postmenopausal women.

Materials & Methods

Study Design: This retrospective observational study was conducted to evaluate cervical cytomorphological variations in Papanicolaou (Pap) smears among postmenopausal women. The study involved a retrospective review of cervical cytology records and Pap smear slides archived in the Department of Pathology.

Study Setting: The study was carried out in the Department of Pathology, Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India, a tertiary care teaching hospital catering to both urban and rural populations.

Study Period: The study included Pap smear records collected over a 12-month period from May 2025 to April 2026.

Study Population: The study population comprised postmenopausal women aged ≥ 45 years who underwent conventional Pap smear examination either for routine cervical cancer screening or for evaluation of gynecological symptoms. A total of 126 Pap smears were retrieved from the departmental archives. After exclusion of six unsatisfactory smears, 120

satisfactory Pap smears were included in the final analysis.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee of Bhagwan Mahavir Institute of Medical Sciences, Pawapuri.

As this was a retrospective record-based study, patient confidentiality and anonymity were maintained throughout the study by de-identifying all patient information before analysis. The study complied with the ethical principles of the Declaration of Helsinki.

Inclusion Criteria

The following cases were included:

- Postmenopausal women aged ≥ 45 years.
- Women who underwent Pap smear examination for routine cervical cancer screening.
- Women presenting with gynecological complaints including excessive vaginal discharge, blood-stained discharge, postcoital bleeding, postmenopausal bleeding, lower abdominal pain, mass per vaginum, uterine fibroids, or chronic pelvic inflammatory disease.
- Satisfactory conventional Pap smears as defined by the Bethesda System for Reporting Cervical Cytology (2014) [7].

Exclusion Criteria

The following cases were excluded:

- Unsatisfactory Pap smears.
- Women aged < 45 years.
- Women with a history of hysterectomy.
- Patients with clinically diagnosed invasive cervical carcinoma at presentation.
- Women previously treated for cervical or other genital tract malignancies.

Methodology

Pap Smear Collection: Conventional cervical cytology was performed following standard institutional protocol under aseptic precautions. Patient demographic and clinical details, including age, clinical history, laboratory identification number, and date of sample collection, were recorded on the requisition form.

A sterile Cusco's speculum lubricated with lukewarm water was introduced to visualize the cervix. Cervical samples were collected using an Ayre's spatula by obtaining separate scrapings from the ectocervix and endocervix. The smears were immediately spread onto clean glass slides and fixed in 95% isopropyl alcohol for 20–30 minutes to preserve cellular morphology.

Cytological Processing and Evaluation: The fixed smears were stained using the conventional Papanicolaou staining technique. All slides were examined independently by experienced pathologists under light microscopy. Cytological interpretation and reporting were performed according to the Bethesda System for Reporting Cervical Cytology (2014) [7]. Smears were categorized as:

- Negative for intraepithelial lesion or malignancy (NILM)
- Epithelial cell abnormalities (ASC-US, ASC-H, LSIL, HSIL, AGC, squamous cell carcinoma, and adenocarcinoma)
- Inflammatory and infectious lesions
- Atrophic changes
- Unsatisfactory for evaluation

Investigations: The following investigations were included:

- Conventional Pap smear examination.
- Microscopic evaluation of Pap-stained cervical smears.
- Cytological classification according to the Bethesda System for Reporting Cervical Cytology (2014).

Outcome Measures

Primary Outcome: Distribution of cervical cytomorphological patterns in Pap smears among postmenopausal women.

Secondary Outcomes

- Frequency of epithelial cell abnormalities.
- Prevalence of inflammatory and infectious lesions.
- Frequency of atrophic cytological changes.
- Distribution of premalignant and malignant cervical lesions.
- Proportion of satisfactory and unsatisfactory Pap smears.

Statistical Analysis: Data were entered into Microsoft Excel 365 (Microsoft Corporation, Redmond, WA, USA) and analysed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA).

Categorical variables were summarized as frequencies (n) and percentages (%). Continuous variables, where applicable, were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR) according to data distribution. The normality of continuous variables was assessed using the Shapiro–Wilk test. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed P value < 0.05 was considered statistically significant. Results were presented in appropriately formatted tables and

figures following standard SPSS reporting guidelines suitable for biomedical publications.

Results

Table 1: Demographic Characteristics of Postmenopausal Women Included in the Study (n = 120)

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	45–49	26	21.7
	50–54	38	31.7
	55–59	30	25.0
	60–64	18	15.0
	≥65	8	6.6
Parity	Nulliparous	6	5.0
	Primiparous (P1)	12	10.0
	Multiparous (P2–P4)	72	60.0
	Grand multiparous (≥P5)	30	25.0
Smoking status	Non-smoker	104	86.7
	Current smoker	10	8.3
	Former smoker	6	5.0
Age at natural menopause (years)	<40 (Premature)	3	2.5
	40–44 (Early menopause)	25	20.8
	45–49	64	53.3
	≥50	28	23.4
	Total	120	100.0

Table 1 present the largest proportion of participants belonged to the 50–54 years age group (38; 31.7%), followed by those aged 55–59 years (30; 25.0%) and 45–49 years (26; 21.7%). Women aged 60–64 years accounted for 18 (15.0%) participants, while those aged ≥65 years comprised the smallest group (8; 6.6%). With respect to parity, the majority of women were multiparous (P2–P4) (72; 60.0%), followed by grand multiparous (≥P5) women (30; 25.0%). Primiparous (P1) women constituted 12 (10.0%) of the study population, whereas only 6 (5.0%) participants were nulliparous. Most participants were non-smokers (104; 86.7%), while 10 (8.3%) were current smokers and 6 (5.0%) were former

smokers. Regarding the age at natural menopause, more than half of the women (64; 53.3%) attained menopause between 45 and 49 years, which was the most common age category. Twenty-eight (23.4%) women experienced menopause at 50 years or later, whereas 25 (20.8%) attained menopause between 40 and 44 years, indicating early menopause. Premature menopause (<40 years) was observed in only 3 (2.5%) participants. Overall, the demographic profile indicates that the study population predominantly comprised multiparous, non-smoking women who attained natural menopause between 45 and 49 years, consistent with the reported average age of menopause among Indian women.

Table 2: Relationship Between Abnormal Pap Smears and Age Among Postmenopausal Women (n = 120)

Age Group (years)	Normal Pap Smear (NILM) n (%)	Abnormal Pap Smear* n (%)	Total	P value
45–49	24 (92.3)	2 (7.7)	26	0.031*
50–54	33 (86.8)	5 (13.2)	38	
55–59	23 (76.7)	7 (23.3)	30	
60–64	12 (66.7)	6 (33.3)	18	
≥65	6 (75.0)	2 (25.0)	8	
Total	98 (81.7)	22 (18.3)	120	

*P < 0.05 was considered statistically significant, Statistical analysis: Chi-square test.

Table 2 show that 98 (81.7%) women had negative for intraepithelial lesion or malignancy (NILM) cytology, whereas 22 (18.3%) exhibited abnormal Pap smear findings. The frequency of abnormal cervical cytology increased progressively with advancing age.

Among women aged 45–49 years, 24 (92.3%) had normal Pap smear results, while only 2 (7.7%) showed abnormal cytological findings. In the 50–54 years age group, 33 (86.8%) participants had

NILM and 5 (13.2%) demonstrated abnormal Pap smears. The proportion of abnormal cytology further increased in women aged 55–59 years, with 7 (23.3%) abnormal Pap smears compared with 23 (76.7%) normal smears. The highest prevalence of abnormal Pap smear findings was observed among women aged 60–64 years, where 6 (33.3%) participants had abnormal cytology and 12 (66.7%) had NILM. Among women aged 65 years and

above, 2 (25.0%) had abnormal Pap smear findings, whereas 6 (75.0%) had normal cytology.

Statistical analysis using the Chi-square test demonstrated a significant association between increasing age and the occurrence of abnormal Pap smear findings ($P = 0.031$). These findings suggest

that the likelihood of detecting epithelial cell abnormalities increases with advancing age among postmenopausal women, highlighting the importance of continued cervical cytological screening even after menopause.

Table 3: Distribution of Cytomorphological Patterns Observed in Pap Smears Among Postmenopausal Women (n = 120)

Cytomorphological Pattern	Frequency (n)	Percentage (%)
Negative for Intraepithelial Lesion or Malignancy (NILM)	88	73.3
Inflammatory smear	62	51.67
Atrophic smear	38	31.67
Specific infectious organisms*	10	8.3
Reactive cellular changes	18	15.0
Epithelial cell abnormalities	22	18.3

Table 3 presents the distribution of cytomorphological patterns observed in Pap smears among the 120 postmenopausal women. The most common cytological finding was negative for intraepithelial lesion or malignancy (NILM), observed in 88 (73.3%) women.

Non-neoplastic cytological abnormalities were frequently encountered, with inflammatory smears identified in 62 (51.7%) participants, making inflammation the most prevalent associated cytological feature. Atrophic smears, characteristic

of postmenopausal estrogen deficiency, were noted in 38 (31.7%) women.

Reactive cellular changes were present in 18 (15.0%) participants, while specific infectious organisms were detected in 10 (8.3%) cases, indicating a relatively low prevalence of identifiable infectious etiologies. Epithelial cell abnormalities, including atypical squamous cells and squamous intraepithelial lesions as classified by the Bethesda System 2014, were observed in 22 (18.3%) women.

Table 4: Distribution of Cases Based on Pap Smear Diagnosis According to the Bethesda System for Reporting Cervical Cytology (2014) (n = 120)

Pap Smear Diagnosis	Frequency (n)	Percentage (%)
Negative for intraepithelial lesion or malignancy (NILM)	98	81.7
ASC-US (Atypical squamous cells of undetermined significance)	7	5.8
ASC-H (Atypical squamous cells—cannot exclude HSIL)	2	1.7
LSIL (Low-grade squamous intraepithelial lesion)	6	5.0
HSIL (High-grade squamous intraepithelial lesion)	3	2.5
AGC (Atypical glandular cells)	1	0.8
Squamous cell carcinoma	2	1.7
Adenocarcinoma	1	0.8
Total	120	100.0

Table 4 show the majority of participants, 98 (81.7%), were reported as negative for intraepithelial lesion or malignancy (NILM), indicating the absence of cytological evidence of premalignant or malignant lesions.

Among the epithelial cell abnormalities, atypical squamous cells of undetermined significance (ASC-US) were the most frequently encountered diagnosis, observed in 7 (5.8%) women. Low-grade squamous intraepithelial lesion (LSIL) was identified in 6 (5.0%) participants, while high-grade squamous intraepithelial lesion (HSIL) was detected in 3 (2.5%) cases, representing clinically

significant precancerous lesions requiring further evaluation. Atypical squamous cells—cannot exclude HSIL (ASC-H) were reported in 2 (1.7%) women, whereas atypical glandular cells (AGC) were identified in 1 (0.8%) participant.

Malignant cytological findings were relatively uncommon. Squamous cell carcinoma was diagnosed in 2 (1.7%) women, while adenocarcinoma was identified in 1 (0.8%) case. Overall, epithelial cell abnormalities were detected in 22 (18.3%) participants, with squamous epithelial abnormalities constituting the majority of abnormal cytological diagnoses.

Table 5: Association Between Clinical Presentations and Cytological Findings Among Postmenopausal Women (n = 120)

Clinical Presentation	Total Cases (n)	NILM n (%)	Inflammatory Smear n (%)	Atrophic Smear n (%)	Epithelial Cell Abnormalities n (%)	χ^2 value	P value
Excessive vaginal discharge	34	26 (76.5)	25 (73.5)	8 (23.5)	5 (14.7)	10.82	0.021*
Postmenopausal bleeding	24	16 (66.7)	10 (41.7)	12 (50.0)	8 (33.3)	15.47	<0.001*
Blood-stained discharge	12	8 (66.7)	6 (50.0)	3 (25.0)	4 (33.3)	8.64	0.034*
Postcoital bleeding	10	5 (50.0)	3 (30.0)	2 (20.0)	5 (50.0)	12.91	0.002*
Lower abdominal pain	18	15 (83.3)	9 (50.0)	7 (38.9)	2 (11.1)	3.94	0.412
Mass per vaginum	8	4 (50.0)	2 (25.0)	2 (25.0)	4 (50.0)	9.86	0.007*
Fibroid uterus	8	7 (87.5)	2 (25.0)	3 (37.5)	1 (12.5)	2.18	0.624
Chronic pelvic inflammatory disease	6	4 (66.7)	5 (83.3)	1 (16.7)	1 (16.7)	7.82	0.041

*p < 0.05 was considered statistically significant

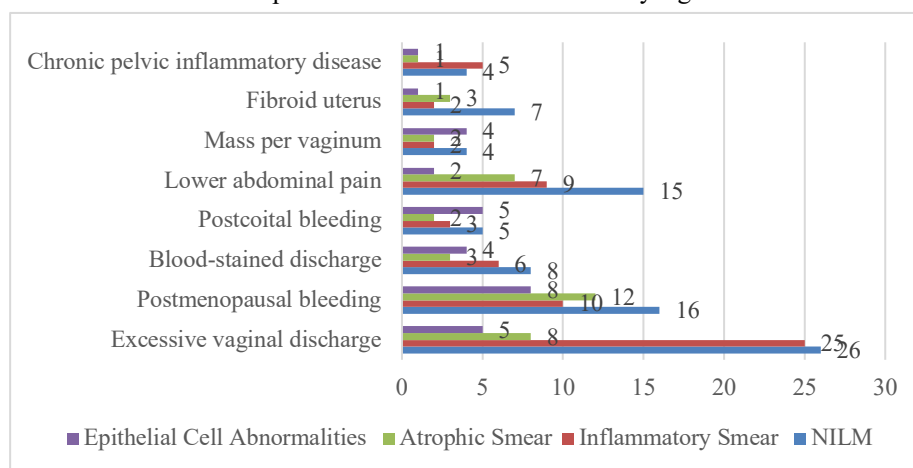
**Figure 1: Association Between Clinical Presentations and Cytological Findings Among Postmenopausal Women**

Table 5 figure I, show that women presenting with excessive vaginal discharge (n = 34) predominantly exhibited negative for intraepithelial lesion or malignancy (NILM) cytology (26; 76.5%), while inflammatory smears were observed in 25 (73.5%), atrophic smears in 8 (23.5%), and epithelial cell abnormalities in 5 (14.7%). The association between excessive vaginal discharge and cytological findings was statistically significant ($\chi^2 = 10.82$, p = 0.021).

Among women with postmenopausal bleeding (n = 24), 16 (66.7%) had NILM, whereas 10 (41.7%) demonstrated inflammatory changes, 12 (50.0%) showed atrophic smears, and 8 (33.3%) had epithelial cell abnormalities. A highly significant association was observed between postmenopausal bleeding and abnormal cytological findings ($\chi^2 = 15.47$, p < 0.001).

Similarly, blood-stained vaginal discharge (n = 12) was significantly associated with abnormal cytology ($\chi^2 = 8.64$, p = 0.034). Among these women, 8 (66.7%) had NILM, 6 (50.0%) exhibited inflammatory smears, 3 (25.0%) had atrophic smears, and 4 (33.3%) demonstrated epithelial cell abnormalities. Women presenting with postcoital bleeding (n = 10) showed the highest proportion of epithelial cell abnormalities, with 5 (50.0%) cases demonstrating abnormal epithelial cytology. NILM was reported in 5 (50.0%), inflammatory smears in 3 (30.0%), and atrophic smears in 2 (20.0%) participants. This association was statistically significant ($\chi^2 = 12.91$, p = 0.002).

Among women with lower abdominal pain (n = 18), the majority had NILM (15; 83.3%), while inflammatory smears, atrophic smears, and epithelial cell abnormalities were observed in 9

(50.0%), 7 (38.9%), and 2 (11.1%) participants, respectively. However, no statistically significant association was found between lower abdominal pain and cytological findings ($\chi^2 = 3.94$, $p = 0.412$).

In cases presenting with mass per vaginum ($n = 8$), 4 (50.0%) women demonstrated epithelial cell abnormalities, an equal proportion had NILM, and smaller proportions exhibited inflammatory (25.0%) and atrophic (25.0%) smears. This association was statistically significant ($\chi^2 = 9.86$, $p = 0.007$).

Among women diagnosed with fibroid uterus ($n = 8$), 7 (87.5%) had NILM, while inflammatory smears, atrophic smears, and epithelial cell abnormalities were observed in 2 (25.0%), 3 (37.5%), and 1 (12.5%) cases, respectively. The association between fibroid uterus and cytological findings was not statistically significant ($\chi^2 = 2.18$, $p = 0.624$).

Women with chronic pelvic inflammatory disease ($n = 6$) predominantly exhibited inflammatory smears (5; 83.3%), whereas NILM, atrophic smears, and epithelial cell abnormalities were observed in 4 (66.7%), 1 (16.7%), and 1 (16.7%) cases, respectively. The association between chronic pelvic inflammatory disease and cytological findings was statistically significant ($\chi^2 = 7.82$, $p = 0.041$).

Discussion

In the present study, the largest proportion of postmenopausal women belonged to the 50–54-year age group (31.7%), followed by the 55–59-year group (25.0%) and 45–49-year group (21.7%). Only 6.6% were aged ≥ 65 years. Thus, most women undergoing Pap smear evaluation were concentrated in the early and intermediate postmenopausal age groups. These findings are broadly comparable with those of Dhanalakshmi et al. (2023), who studied 138 satisfactory Pap smears from postmenopausal women at a tertiary-care centre in Tamil Nadu and reported a mean age of approximately 57.5 years among women with inflammatory/benign cervical lesions [8]. Their study also demonstrated that cervical cytomorphological abnormalities remain frequent during the postmenopausal period, supporting continued attention to this age group. Similarly, Sharma et al. (2026), in a prospective study of 158 postmenopausal women, reported a mean age of 52.04 ± 7.90 years, with 39.9% of participants aged 46–50 years. The relatively young postmenopausal profile in that study is broadly consistent with the predominance of women aged 45–59 years in the present investigation [9]. A particularly important observation was the statistically significant association between age group and abnormal Pap smear findings (χ^2 test, $p = 0.031$). Overall, 81.7% women had NILM cytology, while 18.3%

demonstrated an abnormal final Pap smear diagnosis. The proportion of abnormal findings increased from only 7.7% among women aged 45–49 years to 13.2% at 50–54 years, 23.3% at 55–59 years, and 33.3% at 60–64 years. Although it declined to 25.0% among women aged ≥ 65 years, that subgroup contained only eight women; therefore, the apparent decline should be interpreted cautiously.

This pattern is strongly supported by Sharma et al. (2026), who found epithelial abnormalities in 14.6% of postmenopausal women and reported a statistically significant increase in abnormalities with advancing age ($p = 0.021$) [9]. Their findings corroborate the present statistically significant age–cytology relationship. Similarly, Dhanalakshmi et al. (2023) observed age-related differences in the severity of cytological lesions. While the mean age associated with benign/inflammatory lesions was approximately 57.5 years, HSIL occurred at a higher mean age of 65.5 years and squamous cell carcinoma at approximately 70.5 years [8]. These findings provide biological and clinical support for the progressive increase in abnormal cytology observed with age in the present study.

In present study, NILM was recorded in 73.3%, while inflammatory smears were present in 51.67%, atrophic smears in 31.67%, reactive cellular changes in 15.0%, specific infectious organisms in 8.3%, and epithelial cell abnormalities as a cytomorphological feature in 18.3%. Sutariya et al. (2024) examined 450 postmenopausal women and similarly documented substantial benign cytological changes, reporting inflammatory lesions in 23.11% and atrophic changes in 8.66% [10]. Although the prevalence of both findings was higher in the present study, the qualitative pattern was comparable, with benign and inflammatory abnormalities comprising an important component of postmenopausal cervical cytology. Likewise, Gupta et al. (2023) reported a high frequency of inflammatory smears (83.4%) in their tertiary-care cervical cytology population and identified bacterial vaginosis, candidiasis, and trichomoniasis among specific infectious findings [11]. Although their study population was not restricted exclusively to postmenopausal women, it reinforces the observation that inflammation is frequently encountered during routine cervical cytological assessment.

The 31.67% prevalence of atrophic smears in the present investigation is particularly noteworthy. Atrophy is expected following menopause because estrogen withdrawal leads to thinning and reduced maturation of the squamous epithelium, resulting in greater representation of parabasal-type cells and altered cytological maturation. Thazha et al. (2026) reported atrophic smears as their most common cytomorphological pattern, occurring in 41.0% of

300 naturally postmenopausal women aged 45–60 years. They further observed that normal cytology decreased with age whereas atrophic and inflammatory alterations increased [12].

In current study, 81.7% of participants were NILM and 18.3% had an epithelial abnormality or malignant diagnosis. Among abnormal diagnoses, ASC-US was the most common (5.8%), followed by LSIL (5.0%), HSIL (2.5%), ASC-H (1.7%), squamous cell carcinoma (1.7%), AGC (0.8%), and adenocarcinoma (0.8%). The predominance of NILM is consistent with contemporary postmenopausal studies. Sharma et al. (2026) reported NILM in 85.4% and epithelial abnormalities in 14.6% of postmenopausal women [9]. Their ASC-US frequency of 6.3% was particularly close to the 5.8% observed in the present study. Dhanalakshmi et al. (2023) documented epithelial abnormalities in 14.5% of postmenopausal smears, again reasonably comparable with the 18.3% final abnormality rate in the present investigation [8]. They reported ASC-US in 7.24%, LSIL in 2.89%, HSIL in 2.17%, and SCC in 2.17%.

Thus, the present ASC-US prevalence of 5.8% falls below their 7.24%, whereas LSIL was somewhat more frequent (5.0% versus 2.89%). In contrast, HSIL (2.5% versus 2.17%) and SCC (1.7% versus 2.17%) were remarkably similar between the two investigations. Sutariya et al. (2024) reported epithelial abnormalities in 7.55% of 450 postmenopausal Pap smears [10], which is lower than the 18.3% final Bethesda abnormality prevalence observed in the present series. Differences between studies may result from variation in referral patterns, symptom burden, population characteristics, age distribution, prior screening, laboratory thresholds, sampling technique, and cytological interpretation. In present study, excessive vaginal discharge was the most common presenting complaint ($n=34$), with inflammatory smears identified in 73.5% of women and epithelial cell abnormalities in 14.7% ($\chi^2=10.82$, $p=0.021$). These findings are consistent with Sharma et al. (2026), who reported that inflammatory cervical lesions and bacterial vaginosis were the predominant cytological findings among symptomatic postmenopausal women presenting with vaginal discharge, emphasizing that chronic inflammation remains a frequent cause of abnormal cervical cytology in this age group [9]. Postmenopausal bleeding showed the strongest association with abnormal cytological findings ($\chi^2=15.47$, $p<0.001$). Half of the women demonstrated atrophic smears, while one-third exhibited epithelial cell abnormalities. Similar observations were reported by Thazha et al. (2026), who found that advancing menopausal age was associated with increasing atrophic and

inflammatory cervical changes, whereas epithelial abnormalities were predominantly observed among symptomatic women, highlighting the need for prompt cytological evaluation of postmenopausal bleeding [12].

Blood-stained vaginal discharge was also significantly associated with epithelial abnormalities (33.3%; $\chi^2=8.64$, $p=0.034$). Likewise, Sharma et al. (2026) reported that women presenting with abnormal vaginal discharge or bleeding had a higher frequency of epithelial abnormalities than asymptomatic women, reinforcing the importance of Pap smear evaluation in symptomatic postmenopausal patients [9].

Postcoital bleeding demonstrated one of the strongest associations in the present analysis. Half of the ten women presenting with postcoital bleeding showed epithelial cell abnormalities ($\chi^2 = 12.91$, $p = 0.002$). Jasper et al. (2022), who evaluated cervical cancer occurrence among women referred with postcoital bleeding and/or abnormal cervical appearance and emphasized that postcoital bleeding remains an important symptom in pathways evaluating possible cervical disease [13]. This finding agrees with Akdam et al. (2024), who demonstrated that postcoital bleeding is an important clinical indicator warranting colposcopic and cytological evaluation because of its association with underlying cervical epithelial lesions and HPV-related pathology [14]. Women presenting with mass per vaginum also showed a high prevalence of epithelial abnormalities (50.0%), and the association was statistically significant ($\chi^2=9.86$, $p=0.007$). Dhanalakshmi et al. (2023) likewise identified mass per vaginum among the presentations associated with epithelial abnormalities in their postmenopausal population [8]. Among women with chronic pelvic inflammatory disease, inflammatory smears predominated (83.3%), with statistically significant association ($\chi^2=7.82$, $p=0.041$). Similar findings were reported by Li et al. (2023), who demonstrated that chronic genital tract inflammation and alterations in the vaginal microenvironment contribute to reactive cytological changes and increase the detection of atypical squamous cells in postmenopausal women [15].

Limitations of the Study

- This was a retrospective, single-centre observational study, limiting the generalizability of the findings to the broader population.
- The sample size ($n = 120$) was relatively small, which may have reduced the statistical power for less common cytological abnormalities.
- Histopathological confirmation and HPV DNA testing were not available for all abnormal

cytological findings, limiting cytohistological correlation.

- The retrospective design depended on existing medical records, which may have resulted in incomplete clinical information and selection bias.
- Long-term clinical follow-up of women with abnormal Pap smear findings was not performed; therefore, disease progression and treatment outcomes could not be assessed.

Conclusion

Authors found that the majority of postmenopausal women had negative for intraepithelial lesion or malignancy (NILM) cytology, although 18.3% exhibited epithelial cell abnormalities. Inflammatory and atrophic smears were the predominant non-neoplastic cytomorphological findings. The prevalence of abnormal Pap smear findings increased significantly with advancing age, emphasizing the higher risk of cervical epithelial abnormalities in older postmenopausal women.

Furthermore, postmenopausal bleeding, postcoital bleeding, blood-stained vaginal discharge, mass per vaginum, excessive vaginal discharge, and chronic pelvic inflammatory disease showed significant associations with abnormal cytological findings. These findings highlight the continued value of cervical cytology as an effective screening tool in postmenopausal women and support sustained cervical cancer screening, particularly among older women and those presenting with high-risk clinical symptoms, to facilitate early detection and timely management of premalignant and malignant cervical lesions.

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References

1. Kumar A, Sharma S, Gupta R. Role of conventional Pap smear in current times. *J Clin Gynecol Obstet.* 2024;13(2):45-50.
2. Khairwa A, Singh P, Jain M. Cytohistopathological correlation of cervical Pap smears in detecting premalignant and malignant lesions. *J Mol Genet Med.* 2022;6(4):172-180.
3. Ali M, Sinha R, Kumar A, Karim S, Irfan M, Singh M, et al. HPV DNA status and clinical history of patients as adjuncts for accurate cytological Pap smear reporting. *Sci Rep.* 2024;14(1):17486.
4. Wang T, Li X, Chen Y. Updates in cervical cancer screening guidelines and Bethesda system: A scoping review. *J Clin Transl Pathol.* 2023;3(1):15-25.
5. Mishra E, Gupta N, Verma R. Cervical cancer screening using Papanicolaou smear and Bethesda System 2014: A clinical study. *J Cytol.* 2025;42(1):12-18.
6. Tung HJ, Lee CY, Chen YL. Cervical cancer screening after menopause: Trends and challenges. *J Womens Health (Larchmt).* 2025;34(3):210-216.
7. Nayar R, Wilbur DC. The Pap test and Bethesda 2014. The reports of my demise have been greatly exaggerated. (After a quotation from Mark Twain). *Acta Cytol.* 2015;59:121-32.
8. Dhanalakshmi MNK, Rajendran K, Fathima AT, Raja V, Balamurugan S. Cytomorphological variations in Pap smears amongst postmenopausal women reporting at a tertiary care centre, Tamil Nadu, India. *J Clin Diagn Res.* 2023;17(3). doi:10.7860/JCDR/2023/60352.17636.
9. Sharma R, Sharma K, Agrawal A, Kasana S. A study on Pap smear findings in post menopausal women. *Int J Med Pharm Res.* 2026;7(3):4311-4316. doi:10.5281/zenodo.21369033.
10. Sutariya R, Santoki M, Patel P, Bhalodia J. A study of cytopathological pattern of cervical Papanicolaou smear among post menopausal women. *Int J Clin DiagnPathol.* 2024;7(3):198-205. doi:10.33545/pathol.2024.v7.i3c.604.
11. Gupta A, Singh P, Dubey K, Mewara S, Sharma M, Gupta Y. The cytological pattern of cervical Papanicolaou smear in a tertiary hospital of India. *Asian J Med Sci.* 2023;14(8):157-163.
12. Thazha SK, Sukesh, Kuruvilla S, Kotian S, Scaria B. Cervical cytomorphological patterns in postmenopausal women aged 45–60 years: a comparative Pap smear study. *Int J Health Sci.* 2026;10(2). doi:10.53730/ijhs.v10n2.15984.
13. Jasper B, Thorley E, Martins FC, Halder K. The incidence of cervical cancer in women

- with postcoital bleeding and abnormal appearance of the cervix referred through the 2-week wait pathway in the United Kingdom: a retrospective cohort study. *J ObstetGynaecol Res.* 2022;48(11):2872-2878. doi:10.1111/jog.15366.
14. Akdam A, Van Mil L, Tzur Y, Laskov I, Grisaru D, Schejter E, et al. Human papilloma virus typing as a triage tool for women with postcoital bleeding: a retrospective cohort study. *J Womens Health (Larchmt).* 2024;33(6):648-655.
15. Li B, Dong L, Wang C, Li J, Zhao X, Dong M, et al. Analysis of the related factors of atypical squamous cells of undetermined significance (ASC-US) in cervical cytology of post-menopausal women. *Front Cell Infect Microbiol.* 2023;13:1123260.