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# POSTMENOPAUSAL CERVICAL CYTOLOGY: SPECTRUM AND CLINICAL CORRELATES OF PAP SMEAR FINDINGS AT A TERTIARY CARE CENTRE

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ABSTRACT

**Background:** Hypoestrogenism after menopause produces distinctive atrophic and reactive changes in cervical smears that may mimic epithelial atypia or obscure genuine lesions. This study evaluated the spectrum of cytomorphological findings and their clinical associations among postmenopausal women attending a tertiary care centre.

**Materials and Methods:** This hospital-based descriptive cross-sectional study included 162 postmenopausal women undergoing conventional Pap-smear examination. Sociodemographic, reproductive and clinical information and per-speculum findings were recorded. Smears were stained by the Papanicolaou method and classified according to the 2014 Bethesda System. Cytomorphological maturation patterns, benign changes, organisms and epithelial abnormalities were documented. Associations were analysed using Fisher's exact test, with $p<0.05$ considered significant.

**Results:** The participants' mean age was 60.9±8.2 years; 65.4% were rural residents and 79.0% had never undergone cervical screening. Initial smear adequacy was 96.3%, and all initially unsatisfactory smears were satisfactory after repeat collection. Overall, 91.4% of smears were negative for intraepithelial lesion or malignancy. An atrophic/parabasal-cell-predominant pattern was observed in 70.3% of NILM smears, while inflammation was present in 47.3%. Epithelial abnormalities occurred in 14 women (8.6%): ASC-US 3.7%, ASC-H 0.6%, LSIL 1.9%, HSIL 1.9% and squamous-cell carcinoma 0.6%. Abnormalities were significantly associated with age ≥65 years ($p=0.029$), menopause duration ≥10 years ($p=0.047$), postmenopausal bleeding ($p=0.006$) and a suspicious cervical appearance ($p<0.001$).

**Conclusion:** Atrophy and inflammation dominated the postmenopausal cytological spectrum, but clinically significant epithelial abnormalities remained detectable. Careful cytomorphological interpretation, adequate sampling and prompt evaluation of bleeding or suspicious cervical findings are essential to balance early lesion detection against overdiagnosis of atrophy-related atypia.

**Keywords:** Pap smear; postmenopausal women; cervical cytology; atrophic smear; epithelial abnormalities.

## INTRODUCTION

Cervical cancer remains a major preventable cause of morbidity and mortality among women, particularly in low- and middle-income countries. GLOBOCAN 2022 estimated 662,301 new cases and 348,874 deaths worldwide; India alone accounted for approximately 127,526 cases and 79,906 deaths[1,2] Persistent infection with oncogenic human papillomavirus is the essential causal event in most cervical cancers, but the prolonged pre-invasive phase provides an opportunity for detection and

treatment through organised screening.[3,4] Although HPV-based testing is increasingly preferred, conventional Papanicolaou (Pap) cytology remains a practical, inexpensive tool in many resource-constrained settings and simultaneously demonstrates epithelial abnormalities, inflammation, infections and hormonal patterns.

Postmenopausal women constitute a diagnostically distinctive group. Declining oestrogen levels cause thinning and reduced maturation of the cervical and vaginal squamous epithelium, producing smears with diminished superficial and intermediate cells and predominance of parabasal cells.[5,6] These cells may show nuclear enlargement, increased nuclear-to-cytoplasmic ratio, hyperchromasia, syncytial clustering, degeneration and numerous naked nuclei, often against an inflammatory or granular background. Such atrophic and reactive alterations may mimic atypical squamous cells of undetermined significance, atypical squamous cells—cannot exclude HSIL, or even high-grade squamous intraepithelial lesions, thereby increasing equivocal or false-positive interpretations.[6,7] Conversely, low cellularity and recession of the transformation zone into the endocervical canal may reduce sampling adequacy and obscure genuine lesions.[5,8] In a study of 924 postmenopausal women, high-risk HPV prevalence was 11.5%, while HPV testing was more specific than co-testing for clinically significant dysplasia (89.6% versus 67.4%).[8]

Standardised reporting under the Bethesda System is therefore essential for distinguishing negative atrophic patterns from epithelial abnormalities requiring further evaluation.[9] Indian data also demonstrate variability: a tertiary-care study of 600 postmenopausal and elderly women found epithelial abnormalities in 5.5%, increasing to 10.5% among those aged over 65 years.[10] Characterising this cytomorphological spectrum can improve diagnostic accuracy, reduce unnecessary referrals and identify clinically important lesions. The present study was therefore undertaken to evaluate the spectrum and frequency of cytomorphological variations in Pap smears among postmenopausal women attending a tertiary care centre.

## MATERIALS AND METHODS

**Study design and setting:** This hospital-based descriptive cross-sectional study was conducted in the Department of Pathology in collaboration with the Department of Obstetrics and Gynaecology at tertiary care centre, North India, over period of 2 years from June 2023 to May 2025. The study evaluated the clinical characteristics and spectrum of cytomorphological findings in cervical Pap smears obtained from postmenopausal women attending the gynaecology outpatient department for routine screening or with gynaecological complaints.

**Study population:** Postmenopause was defined as spontaneous amenorrhoea for at least 12 consecutive months without pregnancy, lactation or another pathological cause. Women with an intact cervix who had attained natural menopause and consented to Pap-smear examination were consecutively enrolled. Women with surgical or treatment-induced menopause, previous total hysterectomy, previously diagnosed cervical intraepithelial neoplasia or genital-tract malignancy, prior pelvic radiotherapy, active treatment for cervical disease, or use of intravaginal oestrogen or other vaginal medication during the preceding six weeks were excluded. Smears remaining unsatisfactory after repeat sampling and cases with incomplete clinical information were excluded from analysis.

**Sample size and sampling technique:** The sample size was calculated using the single-population proportion formula, considering the anticipated prevalence of epithelial cell abnormalities in postmenopausal women from previous regional literature, a 95% confidence level and predetermined absolute precision. An additional 10% was added to account for unsatisfactory smears or incomplete records. Accordingly, a minimum of 162 participants was required. Consecutive sampling was used, and all eligible postmenopausal women presenting during the study period were recruited until the required sample size was attained.

**Clinical evaluation and data collection:** After obtaining written informed consent, information was recorded using a predesigned case-record form. Variables included age, residence, parity, age at menopause, duration since menopause, presenting complaints, previous cervical screening, hormone-replacement therapy, diabetes mellitus, hypertension and relevant reproductive history. Presenting symptoms were documented as postmenopausal bleeding, vaginal discharge, vulvovaginal pruritus, dyspareunia, lower abdominal pain, urinary symptoms or absence of symptoms. Per-speculum findings, including cervical erosion, congestion, hypertrophy, discharge, bleeding on touch, ulceration, polypoidal growth or an apparently healthy cervix, were recorded before collecting the smear.

**Pap-smear collection and staining:** Participants were advised, whenever clinically feasible, to avoid sexual intercourse, vaginal douching and intravaginal preparations for 48 hours before sampling. Pap smears were preferably collected when active heavy bleeding was absent. With the participant in the lithotomy position, the cervix was visualised using a sterile, unlubricated Cusco's speculum. Excess mucus was gently removed without scraping the epithelium. Ectocervical material was collected by rotating an Ayre's spatula through 360° over the transformation zone, and endocervical material was obtained using a cytobrush rotated through approximately 90–180°. The collected material was spread uniformly onto separately labelled glass slides and immediately fixed in 95% ethyl alcohol for at least 15 minutes. The slides were subsequently

stained using the conventional Papanicolaou staining method.

**Cytomorphological examination:** All slides were examined under light microscopy by cytopathologists and reported according to the 2014 Bethesda System for Reporting Cervical Cytology. Smear adequacy was assessed before interpretation. A conventional smear was considered satisfactory when it contained approximately 8,000–12,000 well-visualised squamous cells with acceptable preservation and less than 75% obscuration by blood, inflammation or artefact. The presence of a transformation-zone component was recognised by at least 10 well-preserved endocervical or squamous-metaplastic cells.

Satisfactory smears were classified as negative for intraepithelial lesion or malignancy (NILM), epithelial cell abnormality or malignant neoplasm. NILM smears were further categorised as showing an atrophic pattern, inflammation, reactive cellular changes or specific organisms such as bacterial vaginosis, Candida species and Trichomonas vaginalis. Epithelial abnormalities were classified as atypical squamous cells of undetermined significance (ASC-US), atypical squamous cells—cannot exclude HSIL (ASC-H), low-grade squamous intraepithelial lesion (LSIL), high-grade squamous intraepithelial lesion (HSIL), squamous-cell carcinoma, atypical glandular cells or adenocarcinoma.

The maturation pattern was assessed by estimating the proportion of parabasal, intermediate and superficial squamous cells among 100 well-preserved cells. An atrophic smear was characterised by predominance of parabasal cells, relatively uniform nuclear enlargement, increased nuclear-to-cytoplasmic ratio, syncytial cellular groups, degenerative changes, naked nuclei and a granular or inflammatory background. Nuclear pleomorphism, coarse chromatin, irregular nuclear membranes, abnormal keratinisation and atypical mitotic activity were carefully assessed to distinguish genuine epithelial lesions from atrophy-related atypia.

**Quality assurance:** All epithelial abnormalities and unsatisfactory smears were reviewed independently by two cytopathologists. Additionally, 10% of smears initially reported as NILM were randomly selected for blinded review. Discrepant interpretations were resolved through joint microscopic examination and consensus. Women with unsatisfactory smears were advised repeat sampling, while those with epithelial abnormalities were referred for HPV testing, colposcopy and biopsy as clinically indicated.

**Statistical analysis:** Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 20.0. Continuous variables were presented as mean with standard deviation or median with interquartile range, while categorical variables were expressed as frequencies and percentages. Associations between cytomorphological findings and age, duration since menopause, parity, presenting symptoms and cervical appearance were assessed using the chi-square test or Fisher's exact test. Student's t test or the Mann–Whitney U test was used for continuous variables, as appropriate. A two-sided p value below 0.05 was considered statistically significant.

**Ethical considerations:** The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from every participant, confidentiality was maintained, and women with clinically significant cytological abnormalities were referred for appropriate evaluation and management.

## RESULTS

The mean age of the participants was 60.9 ± 8.2 years, with the majority aged 55–64 years (42.0%), followed by 45–54 years (28.4%). Most women were from rural areas (65.4%), and 58.7% had either no formal education or only primary education. High parity was common, with 71.0% having three or more births. The mean age at menopause was 48.3 ± 3.6 years, while the median duration since menopause was 9 years (IQR: 5–16 years). Most participants had never undergone cervical screening (79.0%). Hypertension and diabetes mellitus were present in 38.3% and 23.5%, respectively, whereas only 4.3% reported hormone-replacement therapy [Table 1].

**Table 1: Sociodemographic, reproductive and clinical characteristics of postmenopausal women included in the study (N=162).**

| Characteristic | Category | Frequency (%)/Mean ± SD/Median (IQR) |
|---|---|---|
| Age (years) | Mean Age | 60.9 ± 8.2 |
| | 45–54 years | 46 (28.4) |
| | 55–64 years | 68 (42.0) |
| | 65–74 years | 38 (23.5) |
| | ≥75 years | 10 (6.2) |
| Residence | Rural | 106 (65.4) |
| | Urban | 56 (34.6) |
| Educational status | No formal education | 44 (27.2) |
| | Primary education | 51 (31.5) |
| | Secondary education | 47 (29.0) |
| | Graduate or above | 20 (12.3) |
| Parity | Nulliparous | 5 (3.1) |
| | 1–2 births | 42 (25.9) |
| | ≥3 births | 115 (71.0) |
| Age at menopause (years) | Mean age | 48.3 ± 3.6 |
| Duration since menopause (years) | Median duration | 9 (5–16) |

| | | |
|---|---|---|
| Previous cervical screening | Never screened | 128 (79.0) |
| | Screened >5 years previously | 22 (13.6) |
| | Screened within preceding 5 years | 12 (7.4) |
| Diabetes mellitus | Present | 38 (23.5) |
| Hypertension | Present | 62 (38.3) |
| Hormone-replacement therapy | Current/past use | 7 (4.3) |

IQR: interquartile range. Percentages may not total exactly 100 because of rounding.

Vaginal discharge was the most frequently reported complaint, affecting 38.9% of participants, followed by postmenopausal bleeding (19.1%), lower abdominal or pelvic pain (18.5%), vulvovaginal pruritus or burning (14.8%), and urinary symptoms (13.6%). Approximately one-fifth of the participants (20.4%) were asymptomatic and underwent routine screening. On per-speculum examination, 44.4% had an apparently healthy cervix, while a pale or clinically atrophic cervix was observed in 21.0%. Cervicovaginal discharge and cervical erosion or congestion were noted in 13.6% and 10.5%, respectively. Bleeding on touch and a suspicious cervical growth were documented in 4.9% and 3.1% of women, respectively [Table 2].

**Table 2: Distribution of presenting complaints and per-speculum findings among postmenopausal women (N=162).**

| Clinical variable | Frequency (%) |
|---|---|
| Presenting complaint* | |
| Vaginal discharge | 63 (38.9) |
| Postmenopausal bleeding | 31 (19.1) |
| Lower abdominal or pelvic pain | 30 (18.5) |
| Vulvovaginal pruritus/burning | 24 (14.8) |
| Urinary symptoms | 22 (13.6) |
| Dyspareunia | 16 (9.9) |
| Asymptomatic/routine screening | 33 (20.4) |
| Predominant per-speculum finding | |
| Apparently healthy cervix | 72 (44.4) |
| Pale or clinically atrophic cervix | 34 (21.0) |
| Cervicovaginal discharge | 22 (13.6) |
| Cervical erosion or congestion | 17 (10.5) |
| Bleeding on touch | 8 (4.9) |
| Cervical polyp | 4 (2.5) |
| Suspicious cervical growth | 5 (3.1) |

Presenting complaints were not mutually exclusive; therefore, their percentages exceed 100%. Per-speculum findings represent the predominant cervical finding recorded for each participant.

At initial examination, 156 smears (96.3%) were satisfactory for cytological evaluation, while six (3.7%) were unsatisfactory because of scant cellularity, obscuring blood or marked inflammation. All six became satisfactory following repeat collection, allowing inclusion of all 162 participants in the final analysis. Most smears were reported as negative for intraepithelial lesion or malignancy (91.4%). Epithelial cell abnormalities were identified in 14 women (8.6%), comprising ASC-US in 3.7%, ASC-H in 0.6%, LSIL in 1.9%, HSIL in 1.9% and squamous-cell carcinoma in 0.6%. No atypical glandular cells or adenocarcinoma were identified [Table 3 and Figure 1].

**Table 3: Pap-smear adequacy and final cytological diagnosis according to the 2014 Bethesda System (N=162).**

| Pap-smear characteristic | Frequency (%) |
|---|---|
| Initial smear adequacy | |
| Satisfactory for evaluation | 156 (96.3) |
| Unsatisfactory—scant cellularity | 3 (1.9) |
| Unsatisfactory—obscured by blood | 2 (1.2) |
| Unsatisfactory—obscured by inflammation | 1 (0.6) |
| Satisfactory following repeat collection | 6/6 (100.0) |
| Final Bethesda category | |
| Negative for intraepithelial lesion or malignancy (NILM) | 148 (91.4) |
| Atypical squamous cells of undetermined significance (ASC-US) | 6 (3.7) |
| Atypical squamous cells—cannot exclude HSIL (ASC-H) | 1 (0.6) |
| Low-grade squamous intraepithelial lesion (LSIL) | 3 (1.9) |
| High-grade squamous intraepithelial lesion (HSIL) | 3 (1.9) |
| Squamous-cell carcinoma (SCC) | 1 (0.6) |
| Atypical glandular cells/adenocarcinoma | 0 (0.0) |
| Any epithelial cell abnormality | 14 (8.6) |

NILM: negative for intraepithelial lesion or malignancy; ASC-US: atypical squamous cells of undetermined significance; ASC-H: atypical squamous cells—cannot exclude HSIL; LSIL: low-grade squamous intraepithelial lesion; HSIL: high-

grade squamous intraepithelial lesion; SCC: squamous-cell carcinoma.

Among the 148 NILM smears, an atrophic or parabasal-cell-predominant pattern was the most frequent cytomorphological pattern, occurring in 70.3%. Intermediate-cell predominance was observed in 20.9%, while mixed and superficial-cell-predominant patterns accounted for 7.4% and 1.4%, respectively. Inflammatory changes were present in 47.3% of NILM smears, and reactive or reparative alterations were noted in 16.2%. Cytological features suggestive of bacterial vaginosis were found in 11.5%, while keratinisation or parakeratosis without epithelial atypia was seen in 7.4%. Candida species and Trichomonas vaginalis were identified in 5.4% and 1.4% of smears, respectively [Table 4 and Figure 2].

**Table 4: Cytomorphological maturation patterns and associated benign findings among smears reported as NILM (n=148).**

| Cytomorphological finding | Frequency (%) |
|---|---|
| Predominant squamous-cell maturation pattern | |
| Atrophic/parabasal-cell predominant | 104 (70.3) |
| Intermediate-cell predominant | 31 (20.9) |
| Mixed maturation pattern | 11 (7.4) |
| Superficial-cell predominant | 2 (1.4) |
| Associated benign cytological findings | |
| Acute or chronic inflammatory changes | 70 (47.3) |
| Reactive or reparative cellular changes | 24 (16.2) |
| Bacterial vaginosis-associated cytological changes | 17 (11.5) |
| Keratinisation/parakeratosis without epithelial atypia | 11 (7.4) |
| Candida species | 8 (5.4) |
| Trichomonas vaginalis | 2 (1.4) |

NILM: negative for intraepithelial lesion or malignancy. Associated benign findings could coexist in the same smear; therefore, their percentages do not total 100%. The atrophic pattern was characterised by parabasal-cell predominance, increased nuclear-to-cytoplasmic ratios, degenerative nuclear changes, naked nuclei and a granular or inflammatory background.

Epithelial cell abnormalities were significantly more frequent among women aged 65 years or older than among those younger than 65 years (16.7% versus 5.3%; p=0.029). Similarly, women who had been postmenopausal for 10 years or longer demonstrated a significantly higher prevalence of epithelial abnormalities compared with those who had been postmenopausal for less than 10 years (13.9% versus 4.4%; p=0.047). These findings indicate that advancing age and a longer duration of hypoestrogenic exposure were associated with a greater likelihood of detecting epithelial abnormalities on cervical cytology [Table 5].

**Table 5: Association of age and duration since menopause with epithelial cell abnormalities on Pap smear (N=162).**

| Variable | Total | NILM | Epithelial abnormality | p value |
|---|---|---|---|---|
| | | Frequency (%) | | |
| Age group | | | | |
| <65 years | 114 | 108 (94.7) | 6 (5.3) | 0.029 |
| ≥65 years | 48 | 40 (83.3) | 8 (16.7) | |
| Duration since menopause | | | | |
| <10 years | 90 | 86 (95.6) | 4 (4.4) | 0.047 |
| ≥10 years | 72 | 62 (86.1) | 10 (13.9) | |

Epithelial cell abnormalities included ASC-US, ASC-H, LSIL, HSIL and SCC. NILM: negative for intraepithelial lesion or malignancy.

Epithelial abnormalities were detected in 22.6% of women presenting with postmenopausal bleeding compared with 5.3% of those without bleeding, representing a statistically significant association (p=0.006). The strongest association was observed with a suspicious cervical appearance: 46.2% of women with bleeding on touch or a visible suspicious growth had an epithelial abnormality, compared with 5.4% of women without these findings (p<0.001). Higher proportions of epithelial abnormalities were also observed among rural women, those with vaginal discharge, high parity, diabetes mellitus and no previous cervical screening; however, these associations did not attain statistical significance (p>0.05) [Table 6].

**Table 6: Association of clinical factors with epithelial cell abnormalities among postmenopausal women (N=162).**

| Clinical factor | Category | Total | Epithelial abnormality | p value |
|---|---|---|---|---|
| | | | Frequency (%) | |
| Residence | Rural | 106 | 12 (11.3) | 0.141 |
| | Urban | 56 | 2 (3.6) | |
| Postmenopausal bleeding | Present | 31 | 7 (22.6) | 0.006 |
| | Absent | 131 | 7 (5.3) | |
| Vaginal discharge | Present | 63 | 7 (11.1) | 0.401 |

| | | | | |
|---|---|---|---|---|
| | Absent | 99 | 7 (7.1) | |
| Suspicious cervical appearance | Present | 13 | 6 (46.2) | <0.001 |
| | Absent | 149 | 8 (5.4) | |
| High parity | ≥3 births | 115 | 12 (10.4) | 0.354 |
| | <3 births | 47 | 2 (4.3) | |
| Diabetes mellitus | Present | 38 | 6 (15.8) | 0.097 |
| | Absent | 124 | 8 (6.5) | |
| Previous cervical screening | Never screened | 128 | 13 (10.2) | 0.304 |
| | Previously screened | 34 | 1 (2.9) | |

A suspicious cervical appearance was defined as bleeding on touch or the presence of a visible suspicious growth. High parity was defined as three or more births.

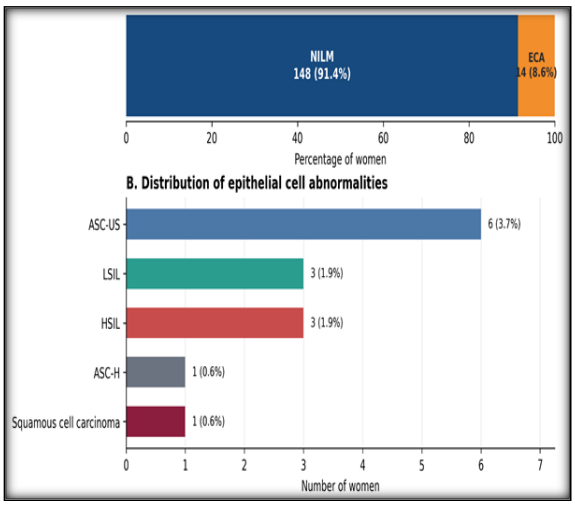



**Figure 1: Cervical cytology outcomes according to the Bethesda System among postmenopausal women (N=162). Panel A shows the overall distribution of negative for intraepithelial lesion or malignancy and epithelial cell abnormalities. Panel B presents individual abnormal categories. NILM: negative for intraepithelial lesion or malignancy; ECA: epithelial cell abnormality; ASC-US: atypical squamous cells of undetermined significance; ASC-H: atypical squamous cells—cannot exclude HSIL; LSIL: low-grade squamous intraepithelial lesion; HSIL: high-grade squamous intraepithelial lesion.**

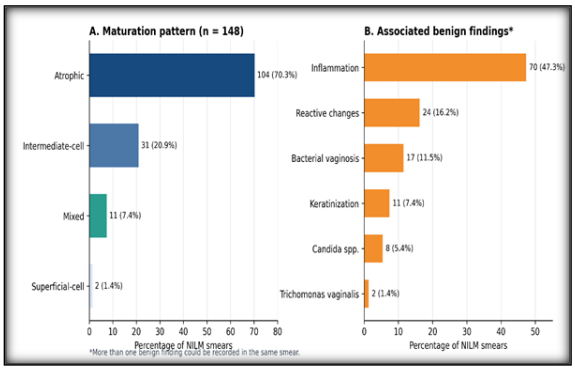



**Figure 2: Cytomorphological maturation patterns and associated benign findings among NILM smears (n=148). Atrophic smears constituted the predominant maturation pattern. Inflammation was the most frequent accompanying benign finding. More than one benign finding could be recorded in an individual smear; consequently, percentages in Panel B are not mutually exclusive. NILM: negative for intraepithelial lesion or malignancy.**

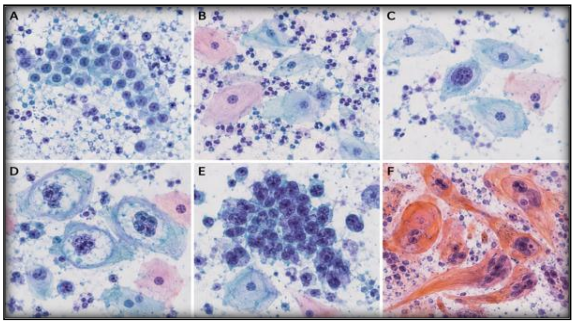



**Figure 3: Pap-smear photomicrographs representing cytomorphological patterns relevant to postmenopausal women. (A) Atrophic smear showing cohesive sheets of parabasal cells with relatively high nuclear-to-cytoplasmic ratios and a granular background. (B) Benign inflammatory/reactive smear with numerous neutrophils and reactive squamous cells. (C) Atypical squamous cells of undetermined significance showing limited nuclear enlargement, mild hyperchromasia and subtle nuclear-contour irregularity. (D) Low-grade squamous intraepithelial lesion demonstrating koilocytosis, perinuclear halos, nuclear atypia and binucleation. (E) High-grade squamous intraepithelial lesion comprising hyperchromatic crowded groups with high nuclear-to-cytoplasmic ratios, coarse chromatin and irregular nuclear membranes. (F) Keratinizing squamous cell carcinoma showing markedly pleomorphic orangeophilic cells, bizarre spindle or tadpole forms and tumour diathesis. N:C, nuclear-to-cytoplasmic ratio; ASC-US, atypical squamous cells of undetermined significance; LSIL, low-grade squamous intraepithelial lesion; HSIL, high-grade squamous intraepithelial lesion; SCC, squamous cell carcinoma.**

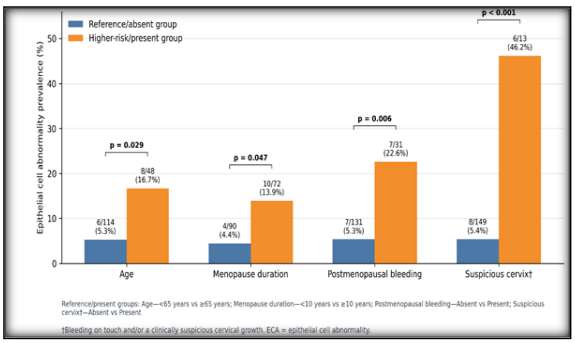



**Figure 4: Prevalence of epithelial cell abnormalities across statistically significant clinical strata. Epithelial abnormalities were more frequent among women aged ≥65 years, those with menopause duration ≥10 years, women reporting postmenopausal bleeding, and women with a clinically suspicious cervix. A suspicious cervix was defined as bleeding on touch and/or a suspicious cervical growth. Displayed p-values are two-sided and should correspond to the chi-square or Fisher's exact test used in the analysis. ECA: epithelial cell abnormality.**

## DISCUSSION

The present study demonstrates a predominantly benign but clinically important spectrum of cervical cytological findings among 162 postmenopausal women. The mean age was 60.9 years; 65.4% were rural residents, 71.0% had parity of at least three, and 79.0% had never undergone cervical screening. This profile reflects the continuing screening gap among older Indian women. Kannan et al., similarly documented a substantial inflammatory burden among postmenopausal Indian women, while Velu et al., showed that clinically important lesions may also occur in asymptomatic postmenopausal women, supporting continued opportunistic screening.[11,12]

Initial smear adequacy was 96.3%, and all six unsatisfactory smears became satisfactory after repeat sampling. This was comparable to the 95.7% adequacy reported by Tokmak et al., in postmenopausal women.[13] indicating that careful ectocervical and endocervical sampling can partly overcome age-related recession of the transformation zone. NILM constituted 91.4% of smears, whereas epithelial abnormalities were present in 8.6%. This prevalence was higher than the 5.36% reported by Mahadik et al., and 4% atypia reported among Brazilian women aged over 60 years by Backes et al., but lower than the 17.2% SIL rate described by Misra et al,.[14–16] These variations may reflect differences in referral patterns, symptom burden, age composition, previous screening and diagnostic thresholds. The distribution—ASC-US 3.7%, LSIL 1.9%, HSIL 1.9%, ASC-H 0.6% and squamous-cell carcinoma 0.6%—suggests that equivocal atypia predominated, although clinically consequential high-grade disease remained detectable.

Atrophic or parabasal-cell predominance was the leading NILM pattern (70.3%), followed by intermediate-cell predominance (20.9%). Cakmak et al., likewise found atrophic changes to increase from 18.3% among women aged 45–64 years to 52.4% after 65 years.[17] Oestrogen withdrawal reduces epithelial glycogen and maturation, producing a thin epithelium dominated by parabasal cells with relatively high nuclear-to-cytoplasmic ratios. Gupta et al., found atrophic changes in 46.6% of women not receiving hormonal therapy but in only 1.66% of hormone users.[18] The very low exposure to hormone-replacement therapy in our cohort (4.3%) may therefore partly explain the high frequency of atrophic smears.

Inflammation was observed in 47.3% of NILM smears, close to the 41% reported by Kannan et al,.[11] Cytological changes suggestive of bacterial vaginosis, Candida and Trichomonas were identified in 11.5%, 5.4% and 1.4%, respectively. Menopause-associated loss of epithelial glycogen and reduced Lactobacillus dominance increase vaginal pH and impair colonisation resistance. Brotman et al., demonstrated significant associations between menopausal stage, vulvovaginal atrophy and low-Lactobacillus microbial community patterns.[19] These changes provide a biological explanation for the inflammatory and altered-flora patterns observed. Nevertheless, Pap cytology is not a definitive microbiological test; organism-specific findings should be correlated clinically and confirmed where necessary.

Epithelial abnormalities were significantly more frequent among women aged ≥65 years than among younger women (16.7% versus 5.3%; p=0.029) and after ≥10 years of menopause (13.9% versus 4.4%; p=0.047). Cakmak et al., similarly found more cytological abnormalities after 65 years (5.1% versus 1.5%; p=0.008).[17] This increase may reflect cumulative HPV persistence, inadequate previous screening and prolonged epithelial atrophy. However, atrophic atypia may also inflate equivocal interpretations. Bulten et al., demonstrated that atypical atrophic smears can mimic high-grade lesions, while Johnston et al., attributed ASC-US overdiagnosis partly to enlarged, grooved and mildly hyperchromatic nuclei in hypoestrogenic smears.[20,21] Among postmenopausal women with ASC-US, Tokmak et al., found CIN1 in 12.2% and CIN2–3 in only 1.8%.[13] Richards et al., reported that vaginal oestrogen normalised 40 of 54 abnormal smears in women with low-oestrogen states, while Piccoli et al., demonstrated improved colposcopic adequacy following local oestrogen therapy.[22,23] Choi et al. further found that postmenopausal status independently increased the likelihood of cytological overrating (adjusted OR=2.77).[24] Therefore, equivocal atrophic smears should be correlated with HPV testing and, when appropriate, repeated after treating marked atrophy, without delaying evaluation of definite high-grade abnormalities.

Postmenopausal bleeding (22.6% versus 5.3%; p=0.006) and a suspicious cervical appearance (46.2% versus 5.4%; p<0.001) were strongly associated with epithelial abnormalities. Although fragile atrophic mucosa can itself cause bleeding, these findings identify women requiring prompt colposcopy and biopsy. Residence, vaginal discharge, high parity, diabetes and screening history were not statistically significant; however, limited subgroup sizes may have reduced statistical power. Overall, these findings emphasise careful cytomorphological interpretation, adequate sampling and targeted follow-up, particularly among older women with prolonged menopause, postmenopausal bleeding or a suspicious cervix.

**Limitations:** This study was limited by its single-centre cross-sectional design and relatively modest sample size, restricting generalisability and causal inference. Conventional cytology may be affected by sampling and interpretive variation, especially in markedly atrophic smears. HPV testing, colposcopic assessment and histopathological confirmation were not uniformly available; therefore, cytological abnormalities could not be correlated with definitive diagnoses. Information on prior screening and

hormone therapy was partly self-reported, introducing recall bias.

## CONCLUSION

Postmenopausal cervical smears demonstrate a broad spectrum of hormonal, inflammatory, infectious and epithelial changes, with atrophic cytomorphology being predominant. Although most smears were NILM, epithelial abnormalities were detected in 8.6%, including high-grade lesions and squamous-cell carcinoma. Women aged 65 years or older, those with at least 10 years since menopause, and those presenting with postmenopausal bleeding or a suspicious cervix had significantly higher abnormality rates. Careful sampling and distinction of atrophy-related atypia from genuine dysplasia are essential to prevent both missed lesions and overdiagnosis. Continued opportunistic screening, HPV-based triage and prompt colposcopic evaluation of clinically suspicious cases may improve cervical-cancer prevention in this underserved population.

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