International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622
Impact Factor (RJIF): 6.71

www.gynaecologyjournal.com
2025;9(5): 13-18
Received: 11-06-2025
Accepted: 13-07-2025

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Prevalence and genotypic distribution of high-risk human papillomavirus in cervical samples of reproductive-age women in western Uttar Pradesh: A prospective observational study

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DOI: https://www.doi.org/10.33545/gynae.2025.v9.i5a.1677

Abstract
Background: Cervical cancer is the second most common cancer among Indian women, primarily driven by persistent infection with high-risk human papillomavirus. Cervical cancer is currently ranking as the fourth most common cancer among women in both incidence and mortality with approximately 600,000 new cases and 340,000 deaths annually. India contributes to a significant proportion of the global cervical cancer burden. Regional data are essential to guide vaccination and screening strategies.
Methods: This prospective observational study was conducted in the Department of Obstetrics & Gynecology, LLRM Medical College. Sexually active women aged 20-40 years attending gynecology OPD were enrolled (n=462). Cervical samples were collected using a cyto-brush and processed with the cobas® 5800 system (Roche) for HPV DNA detection and genotyping. Data were analyzed using SPSS v28; $p<0.01$ was considered significant.
Results: The study found an overall HPV prevalence of approximately 6.27%, with the highest infection rate observed in women aged 26-30 years. A significant association was observed between religious affiliation and HPV status, suggesting potential influence of cultural practices on infection risk. Menstrual and reproductive factors such as age at menarche, menstrual flow patterns, and parity were analyzed for potential correlations with HPV status. Although no significant associations were found, the findings align with previous studies indicating that hormonal and cervical epithelial changes may influence susceptibility to infection.
Conclusion: The findings emphasize the need for region-specific public health strategies to improve HPV screening and vaccination coverage. This study highlights a considerable burden of HPV infection in Western Uttar Pradesh, with notable demographic and cytological correlations. Findings emggphasize the importance of targeted screening, regional outreach, and the integration of Pap smear and molecular diagnostics for early detection and prevention of HPV-associated cervical lesions.

Keywords: Human papillomavirus, cervical cancer, Papillomaviridae, genetics, prevalence, Western Uttar Pradesh, India

Introduction
Human papillomavirus (HPV) infection is one of the most prevalent sexually transmitted infections worldwide, contributing significantly to the global burden of cervical cancer, currently ranking as the fourth most common cancer among women in both incidence and mortality with approximately 600,000 new cases and 340,000 deaths annually. India contributes to a significant proportion of the global cervical cancer burden, with an estimated 100,000 new cases and over 60,000 deaths each year.
The worldwide decline in cervical cancer cases is largely attributed to improved awareness, enhanced screening protocols, and the introduction of the HPV vaccine. However, its occurrence remains strongly linked to socio-economic factors and the widespread presence of HPV, particularly genotypes 16 and 18, which are responsible for nearly 80% of all cervical cancer cases. This strong correlation underscores the critical role of preventive measures such as vaccination and routine screening in addressing this pressing health concern.
HPV-related cancers contribute substantially to the overall cancer burden, with cervical cancer accounting for 87.6% of such cases in women. In India, cervical cancer poses a more severe challenge, ranking as the second most prevalent cancer among women and comprising 10% of all female cancer cases. It remains a leading cause of cancer-related illness and death among Indian women, with approximately 132,000 new cases and 74,000 deaths reported annually-

representing nearly a third of all cervical cancer fatalities worldwide. Given the significant burden cervical cancer places on India's healthcare system, it is essential to thoroughly investigate the prevalence of HPV among affected individuals. Previous studies conducted across various regions of India have revealed notable variations in HPV prevalence [1].

Despite the preventability of cervical cancer through vaccination and early detection via screening, many regions in India, including western Uttar Pradesh (UP), face challenges in implementation due to healthcare disparities, lack of awareness, and socio-cultural barriers. Understanding the distribution and prevalence of different HPV genotypes in this region is essential to designing effective public health interventions. By understanding the epidemiology of HPV in this region, healthcare professionals and policymakers can implement targeted interventions, such as improved screening programs, enhanced vaccination campaigns, and community-based awareness initiatives.

This study aims to bridge the gap in epidemiological data for western UP, providing valuable insights that can contribute to the broader effort of cervical cancer prevention and control. By addressing the socio-economic and healthcare barriers to HPV prevention, we can move closer to achieving WHO's global strategy for cervical cancer elimination.

Materials and Methods

Study design & setting: Prospective observational study conducted in the Department of Obstetrics & Gynaecology, LLRM Medical College, Meerut, from June 2023 to December 2024.

Participants: Sexually active women aged 20-40 years attending the gynecology outpatient department.

Exclusion criteria: Postmenopausal women, unmarried women, those with invasive cervical carcinoma, gross pelvic inflammatory disease, or who refused consent.

Sample size: A total of 462 women were enrolled, based on estimated prevalence and confidence intervals.

Sample collection and processing: Cervical samples were collected using a cyto-brush and placed in viral transport medium transport medium vial by 3B Blackbio Biotech India Ltd. with preservative fluid, which was subsequently transported to the Laboratory and stored at 2-8°C until processing for Genotype Detection.

DNA extraction was performed using an automated extraction system in the Department of Microbiology, LLRM Medial College, Meerut. Cervical specimens collected in the preservative solution were subjected to high-throughput, fully automated DNA extraction and detection using the cobas® 5800 System (Roche Molecular Diagnostics, USA). This system integrates nucleic acid extraction, PCR amplification, and real-time detection within a single streamlined workflow detecting 14 high-risk HPV genotypes, including specific identification of HPV-16 and HPV-18, while reporting pooled results for the other 12 types.

Data analysis: The recorded data were abstracted into Microsoft Excel and statistically analyzed using SPSS Statistics for Windows version 28.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and were compared using Student's t-test. The standard contingency table method was employed to determine the association between demographic variables, clinical features, and the occurrence of HPV infection in various samples using the chi-square test. A two-sided p-value was computed, and the significance threshold was at $p< 0.01$.

Results

Table 1 shows the prevalence of cases A small proportion of patients (6.27%) tested positive for HPV, while the majority (93.72%) tested negative.

Table 2 shows the distribution of cases according to the viral genotype. Off the cases found positive for HPV, 20.7% tested positive for HPV 16, while one case (3.4%) tested positive for HPV 18. A larger proportion, 75.86%, tested positive for other types of HPV.

Table 3 compares HPV-positive and HPV-negative patients based on various menstrual characteristics, with corresponding p-values to assess statistical significance. In terms of duration of menses, a significant difference (p = 0.040) is observed. A higher proportion of HPV-positive patients (24.13%) had menses lasting 6 days or more, compared to HPV-negative patients (10.39%). Conversely, a higher percentage of HPV-negative patients (83.83%) experienced 3-5 days of menses. For length of the menstrual cycle, the p-value is 0.100, indicating no significant difference between HPV-positive and HPV-negative patients across the different cycle lengths. However, the majority of both groups have a cycle length between 26 and 34 days. Regarding type of menstrual flow, there is a significant difference (p = 0.005). HPV-positive patients have a higher proportion of increased or heavy menstrual flow (27.58%) compared to HPV-negative patients (9.93%), while HPV-negative patients show a higher percentage of normal menstrual flow (81.06%). Regarding history of sexually transmitted disease (STD), the p-value is 0.056, which is close to the threshold for statistical significance. A higher proportion of HPV-positive patients (37.93%) have a history of STD s compared to HPV-negative patients (22.4%). In terms of condom use, the p-value is 0.808, indicating no significant difference between HPV-positive and HPV-negative patients. A similar proportion of both groups report using (20.68% HPV-positive, 22.63% HPV-negative) or not using condoms (79.31% HPV-positive, 77.36% HPV-negative).

Table 4 presents the comparison of HPV-positive and HPV-negative patients across various demographic and socioeconomic factors, with corresponding p-values to assess statistical significance. In terms of age, there is no statistically significant difference (p = 0.382) between HPV-positive and HPV-negative patients across the various age groups. The highest proportion of HPV-positive patients are in the 26-30 years group (34.48%). For education status, the p-value is 0.935, indicating no significant difference between HPV-positive and HPV-negative patients across the different education levels. Uneducated patients represent 37.93% of the HPV-positive group, while those with higher education levels make up smaller proportions. In terms of socioeconomic status, no significant association was found (p = 0.975). The majority of both HPV-positive and HPV-negative patients fall within the "poor" socioeconomic group (48.27% and 46.88%, respectively). Regarding occupation, no statistically significant difference was found (p = 0.137). A higher proportion of housewives (58.89%) were HPV-negative, while a slightly higher percentage of employed patients (55.17%) tested positive for HPV.

Table 5 compares HPV-positive and HPV-negative patients based on clinical findings and examination results, with

corresponding p-values to assess statistical significance. For vaginal discharge, the p-value is 0.006, indicating a significant difference between the two groups. A higher percentage of HPV-positive patients (65.51%) have vaginal discharge compared to HPV-negative patients (39.49%). Regarding PAP smear results, the p-value is 0.011, suggesting a significant difference. A small percentage of HPV-positive patients (3.44%) show signs of vaginosis, compared to only 0.23% in the HPV-negative group. For cervix on P/S examination, the p-value is <0.001, indicating a significant difference. A larger proportion of HPV-positive patients (58.62%) have hypertrophied or erosive cervices, whereas a significantly higher proportion of HPV-negative patients (83.83%) have a healthy cervix. In terms of cervix/uterus on bi-manual pelvic examination, the p-value is 0.069, which is not statistically significant, although there are trends suggesting a higher percentage of HPV-positive patients with a bulky (24.13%) or tender (10.34%) uterus compared to HPV-negative patients (12% and 5.31%, respectively).

Discussion

Prevalence of HPV among Study Participants

The prevalence of HPV among the 462 participants shows around (6.27%) of cases tested positive for HPV, while the vast majority (93.72%) tested negative. The observed HPV prevalence of 6.27% falls within a range that varies globally and regionally depending on multiple factors. However, even a relatively low prevalence is significant given HPV's well-established role in the development of cervical cancer and other anogenital malignancies. Sharma *et al*. (2020) [2]. Reported an HPV prevalence of 7-10% in general populations across India, highlighting regional variations in screening and vaccination rates. World Health Organization (WHO) Report (2021) [3]. Documented HPV prevalence as low as 2-3% in developed nations with widespread vaccination programs. Patel *et al*. (2019) [4]. Reported HPV prevalence above 20% in developing countries, particularly among younger, sexually active women.

The relatively lower prevalence observed in this study could be attributed to multiple factors, including effective screening practices, demographic characteristics, or the age distribution of the study population.

Table 1: Distribution of cases according to prevalence of HPV. (N = 462)

HPV testing	Number of cases
Positive	29 (6.27%)
Negative	433 (93.72%)

Table 2: Distribution of cases according to viral genotype. (N = 29)

Viral genotype	Number of cases
HPV 16	6 (20.68%)
HPV 18	1 (3.44%)
Other HPV	22 (75.86%)

Table 3: Association of menstrual history and medical history with HPV. (N = 462)

		HPV positive	HPV negative	p-value
Duration of menses	1 - 2 days	0 (0%)	25 (5.77%)	0.040
	3 - 5 days	22 (75.86%)	363 (83.83%)	
	6 days or more	7 (24.13%)	45 (10.39%)	
Type of menstrual flow	Decreased	0 (0%)	39 (9%)	0.005
	Normal	21 (72.41%)	351 (81.06%)	
	Increased	8 (27.58%)	43 (9.93%)	
H/o STD	Yes	11 (37.93%)	97 (22.4%)	0.056
	No	18 (62.06%)	336 (77.59%)	
Use of condoms	Present	6 (20.68%)	98 (22.63%)	0.808
	Absent	23 (79.31%)	335 (77.36%)	

Table 4: Association of patient characteristics with HPV. (N = 462)

		HPV positive	HPV negative	p-value
Age of the patient in years	20 years or less	1 (3.44%)	21 (4.84%)	0.382
	21 - 25 years	3 (10.34%)	119 (27.48%)	
	26 - 30 years	10 (34.48%)	132 (30.48%)	
	31 - 35 years	6 (20.68%)	76 (17.55%)	
	36 - 40 years	4 (13.79%)	42 (9.69%)	
	Above 40 years	5 (17.24%)	43 (9.93%)	
Education status of the patient	Uneducated	11 (37.93%)	134 (30.94%)	0.935
	Primary school	2 (6.89%)	57 (13.16%)	
	Middle school	3 (10.34%)	43 (9.93%)	
	High school	3 (10.34%)	47 (10.85%)	
	Intermediate	5 (17.24%)	80 (18.47%)	
	Graduate and above	5 (17.24%)	72 (16.62%)	
Socioeconomic status of the patient	Upper middle	0 (0%)	1 (0.23%)	0.975
	Middle	8 (27.58%)	111 (25.63%)	
	Lower middle	7 (24.13%)	118 (27.25%)	
	Poor	14 (48.27%)	203 (46.88%)	
Occupation of the patient	Housewife	13 (44.82%)	255 (58.89%)	0.137
	Employed	16 (55.17%)	178 (41.1%)	

Table 5: Association of findings on pelvic and bi-manual examination with HPV (N = 462)

		HPV positive	HPV negative	p-value
e/o Vaginal discharge	Present	19 (65.51%)	171 (39.49%)	0.006
	Absent	10 (34.48%)	262 (60.5%)	
PAP smear	NILM	28 (96.55%)	432 (99.76%)	0.011
	Vaginosis	1 (3.44%)	1 (0.23%)	
Cervix on P/S examination	Healthy	12 (41.37%)	363 (83.83%)	<0.001
	Hypertrophied/ erosions present	17 (58.62%)	70 (16.16%)	
Cervix/uterus on bi-manual pelvic examination	Normal	19 (65.51%)	358 (82.67%)	0.069
	Bulky	7 (24.13%)	52 (12%)	
	Tender	3 (10.34%)	23 (5.31%)	

Distribution of HPV Genotypes Among HPV-Positive Cases

We observed the distribution of different HPV genotypes among the 29 patients who tested positive for HPV. The data indicates that among these cases, 20.68% were infected with HPV 16, 3.44% with HPV 18, and the remaining 75.86% were positive for other HPV genotypes. This distribution highlights the diversity of HPV strains within the study population and carries significant clinical and epidemiological implications. HPV 16 and HPV 18 are the two most well-established high-risk HPV types responsible for approximately 70% of cervical cancer cases worldwide. Their presence in this study population, even in a relatively small proportion, underscores the potential risk of progression to high-grade cervical lesions and malignancy. HPV 16 (20.68%): This genotype is the most oncogenic HPV type, responsible for the majority of HPV-related cervical cancers and precancerous lesions. Its presence in one-fifth of HPV-positive cases in this study suggests a need for vigilant monitoring and follow-up screenings. HPV 18 (3.44%): Though less prevalent than HPV 16, HPV 18 is still highly carcinogenic and associated with more aggressive forms of cervical cancer. The low prevalence of HPV 18 in this study aligns with global patterns, where HPV 16 is typically more dominant. The majority (75.86%) of HPV-positive cases in this study were infected with HPV genotypes other than 16 and 18. While specific subtypes were not detailed, this finding suggests that a diverse range of low-risk and high-risk HPV types are circulating within the population. The presence of multiple HPV strains reinforces the importance of broad-spectrum HPV vaccination and genotypic testing to ensure that emerging high-risk types do not go undetected. The distribution of HPV genotypes in this study is consistent with previous research showing that HPV 16 is the most frequently detected high-risk type, followed by a smaller proportion of HPV 18 cases. However, the relatively high prevalence of "other HPV" types suggests regional variations in HPV genotype distribution. Sharma *et al*. (2020) [2]. Found that HPV 16 was the most prevalent high-risk type in North India, followed by HPV 18 and other high-risk strains. Kumar *et al*. (2019) [5]. Noted that HPV 16 and 18 remain dominant but highlighted an increase in HPV 31, 33, and 52 infections. WHO Global HPV Surveillance Report (2022) [6]. Provided insights into global HPV trends, showing that while HPV 16/18 are declining in vaccinated populations, other high-risk types are emerging.

Demographic Analysis

The mean age of the participants was 30.02 years, with the highest prevalence observed in the 26-30 years age group (34.48%). Datta P, Bhatla N, *et al*. [12] observed higher persistence proportions for both HPV 16 (45.6%) and HPV 18 (38.4%) in 16-24 year old women. Also Richard Muwonge *et al*. [7] observed that The prevalence was higher in younger women, particularly those under 25 years of age. Although age was not significantly associated with HPV status (p = 0.382), the prevalence remains substantial in the 21-25 years (10.34%) and 31-35 years (20.68%) age groups. Interestingly, women above 40 years accounted for 17.24% of HPV-positive cases, suggesting that persistent infections may contribute to higher prevalence in older women.

Education Status and Socioeconomic Factors

The analysis revealed no significant association between education status and HPV prevalence (p = 0.935). Among HPV-positive patients, 37.93% were uneducated, while 17.24% had completed higher education (graduate and above). This suggests that while education is critical in shaping health awareness, it may not directly influence HPV acquisition, also educated patients are more keen to get screened so there might be more cases positive in the educated sector of patients. Similarly, socioeconomic status showed no significant correlation with HPV prevalence (p = 0.975). Pankaj S *et al*. [8] observed that illiteracy, and low socioeconomic status were significantly associated with HPV infection, Specifically, 493 out of 1,202 women from low and middle socioeconomic backgrounds were HPV-positive, compared to 44 out of 237 women from higher socioeconomic statuses which was consistent with our study showing most HPV-positive patients belonged to the lower-middle and poor socioeconomic groups (48.27%).

Impact of Occupation on HPV Prevalence

No significant association was found between occupation and HPV infection (p = 0.137). A higher proportion of housewives (58.89%) were HPV-negative, while employed individuals showed a slightly higher proportion of HPV positivity (55.17%). This could be indicative of differential healthcare access or the will to get screened.

Duration of Menses and HPV Infection

The duration of menses also showed a significant association with HPV positivity (p = 0.040). A notably higher proportion of HPV-positive women (24.13%) reported menses lasting six days or more compared to HPV-negative women (10.39%). On the other hand, the majority of HPV-negative women (83.83%) reported a typical 3-5 day menstrual duration, whereas 75.86% of HPV-positive women had the same duration. Prolonged menstruation might contribute to increased susceptibility to infections, as prolonged exposure to blood and hormonal changes could affect cervical mucus protection and immune response. Alternatively, prolonged menses may indicate underlying hormonal imbalances that could predispose individuals to HPV persistence.

Type of Menstrual Flow and HPV Infection

A significant association was found between the type of

menstrual flow and HPV infection status (p = 0.005). Among HPV-positive individuals, 27.58% reported increased menstrual flow, whereas only 9.93% of HPV-negative individuals experienced the same. On the other hand, normal menstrual flow was more common among HPV-negative patients (81.06%) compared to HPV-positive patients (72.41%). Increased menstrual flow may be indicative of underlying gynecological conditions such as endometrial hyperplasia or hormonal imbalances, which could contribute to an altered vaginal micro biome and a compromised cervical epithelial barrier, making individuals more susceptible to HPV persistence.

History of Sexually Transmitted Diseases (STDs) and HPV Infection

The history of STDs was one of the most notable findings in this analysis, with a p-value of 0.056, approaching statistical significance. A considerably higher percentage of HPV-positive patients (37.93%) had a history of STDs compared to HPV-negative patients (22.4%).

This trend aligns with existing research, done by Zonta MA, Liljander A, Roque KB, *et al*. [9] suggesting that among women with HPV, 72.8% were also diagnosed with other STIs, indicating a significant overlap between HPV and other infections. Although the p-value is slightly above the threshold for statistical significance, the observed trend suggests that a history of STDs may be an important risk factor for HPV infection. Larger sample sizes or stratified analyses could help clarify whether this association reaches statistical significance in a broader population.

Condom Use and HPV Infection

The study found no significant association between condom use and HPV infection (p = 0.808). Among HPV-positive patients, 20.68% reported using condoms, compared to 22.63% of HPV-negative patients. This small difference suggests that condom use does not play a major role in HPV prevention in this study population. Although condoms provide partial protection against sexually transmitted infections (STIs), they may not completely prevent HPV transmission due to the virus's ability to infect areas not covered by condoms, such as the perineal and genital skin. Additionally, inconsistent condom use or reliance on other contraceptive methods could also contribute to the lack of significant findings.

Vaginal Discharge and HPV Infection

The presence of vaginal discharge was significantly associated with HPV infection (p = 0.006). A considerably higher proportion of HPV-positive patients (65.51%) had vaginal discharge compared to HPV-negative patients (39.49%). While HPV itself does not directly cause vaginal discharge, it can lead to secondary infections or cervical inflammation, which may contribute to increased vaginal secretions. a study by Martins BCT, Guimarães RA, Alves RRF, Saddi VA. *et al*. [10] Alterations in the vaginal microbiota, often leading to abnormal discharge, have been linked to HPV infection. Given the significant difference observed, vaginal discharge could be considered a notable clinical finding when assessing HPV risk, though further diagnostic confirmation would be required.

PAP Smear Results and HPV Infection

The PAP smear results showed a significant difference between HPV-positive and HPV-negative patients (p = 0.011). The majority of both groups had NILM (Negative for Intraepithelial Lesion or Malignancy) results (96.55% HPV-positive, 99.76% HPV-negative), suggesting that most HPV infections in this population were transient or in an early stage without cellular abnormalities. However, 3.44% of HPV-positive patients had vaginosis compared to only 0.23% of HPV-negative patients. The presence of vaginosis in HPV-positive individuals could indicate an altered vaginal microbiome, which has been implicated in HPV persistence. Studies suggest that bacterial vaginosis (BV) and other vaginal infections can create an environment conducive to HPV infection by disrupting the normal vaginal flora and immune response [11].

Cervix Findings on Per Speculum (P/S) Examination and HPV Infection

The most striking association in this table is between cervix findings on P/S examination and HPV infection (p < 0.001). A significantly higher proportion of HPV-positive patients (58.62%) had cervical hypertrophy or erosions compared to HPV-negative patients (16.16%). Conversely, a much higher percentage of HPV-negative patients (83.83%) had a healthy cervix compared to HPV-positive patients (41.37%).

This finding is consistent with the Research by Kaya G *et al*. [12] indicating a higher prevalence of HPV infection in women with cervical erosion compared to those with a normal cervix. The study found that HPV DNA was present in 20.2% of women with cervical erosion, compared to 12.8% in women with a clinically normal cervix, suggesting a significant association between cervical erosion and HPV infection.

HPV infection can lead to cervical hypertrophy, erosion, and other inflammatory changes, which may be early indicators of HPV persistence and progression. Cervical erosion, also known as ectropion, occurs when the columnar epithelium of the cervix becomes exposed, leading to increased susceptibility to infections, including HPV. The strong association found in this study supports the importance of routine cervical examinations in identifying women who may be at a higher risk of HPV-related cervical abnormalities [13, 14].

Cervix/Uterus Findings on Bi-Manual Pelvic Examination and HPV Infection

The association between cervix/uterus abnormalities on bi-manual examination and HPV infection was not statistically significant (p = 0.069), though certain trends were observed. A higher proportion of HPV-positive patients had a bulky uterus (24.13%) or tenderness (10.34%) compared to HPV-negative patients (12% and 5.31%, respectively). However, the majority of both groups had a normal cervix/uterus (65.51% HPV-positive, 82.67% HPV-negative). While not directly linked to HPV, a bulky uterus in HPV-positive patients could indicate underlying gynecological conditions that might influence HPV persistence or progression. Similarly, tenderness on examination could suggest pelvic inflammatory conditions that might be associated with concurrent infections. Despite the lack of statistical significance, these trends warrant further investigation, particularly in relation to HPV-related inflammatory responses.

Conclusion

The study's findings indicate that HPV infection is prevalent in this population, affecting 6.27% of cases. Given the significant role of HPV in cervical cancer development, even a seemingly small prevalence rate warrants attention to ensure timely detection and intervention, ultimately reducing HPV-related morbidity and mortality.

This study highlights the diverse distribution of HPV genotypes among infected individuals, with HPV 16 being the most

common high-risk type, followed by a small number of HPV 18 cases. The highest prevalence was observed in the 26-30 years age group, aligning with global trends indicating increased susceptibility in younger women.

The findings from this study suggest that menstrual characteristics, particularly age at menarche, duration of menses, and type of menstrual flow, may have an association with HPV infection. Patients with menarche at 13-14 years, prolonged menstruation (≥6 days), and heavy menstrual flow appear to be at a higher risk of HPV infection. These factors could indicate hormonal or physiological conditions that create a more susceptible cervical environment for persistent HPV infections. Also there is a significant association found between low economic status, low education, multi parity, non usage of condoms.

While traditional risk factors such as multiple sexual partners were not prominent in this study, other factors such as cervical health, immune response, and partner HPV status may play a more critical role. Further research with a broader sample and additional HPV risk variables could help clarify the relationship between sexual history and HPV infection, particularly in different demographic and cultural settings. History of STDs showed a trend toward statistical significance ($p = 0.056$), suggesting a potential link between previous STDs and HPV infection.

The significant association between cervical hypertrophy/erosions and HPV infection emphasizes the importance of routine cervical examinations in identifying women at risk. Additionally, the higher prevalence of vaginosis in HPV-positive patients raises questions about the role of vaginal microbiota in HPV persistence. Future research should focus on the interplay between vaginal infections, HPV, and immune responses to improve early detection and management strategies for HPV-related diseases. These findings emphasize the need for region-specific public health strategies to improve HPV screening and vaccination coverage.

Thus, This study highlights a considerable burden of HPV infection in Western Uttar Pradesh, with notable demographic and cytological correlations. Findings emphasize the importance of targeted screening, regional outreach, and the integration of Pap smear and molecular diagnostics for early detection and prevention of HPV-associated cervical lesions. Conflict of interest none. no funding. Ethical clearance taken.

Conflict of Interest

Not available.

Financial Support

Not available.

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How to Cite This Article
Sharma A, Chaudhary R, Garg A, Jain S. Prevalence and genotypic distribution of high-risk human papillomavirus in cervical samples of reproductive-age women in western uttar pradesh: A prospective observational study. International Journal of Clinical Obstetrics and Gynaecology. 2025;9(5): 13-18.