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Evaluating Antenatal-Based Cervical Screening as a Strategy to Enhance Cancer Prevention Coverage

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ABSTRACT

Background: Cervical cancer remains the second most common malignancy among Indian women and a major cause of morbidity and mortality, despite being largely preventable through screening and HPV vaccination. Pregnancy provides a crucial window for opportunistic cervical screening, as antenatal visits often represent the first contact of women with healthcare systems. This study evaluates the role of antenatal-based cervical screening in enhancing cancer prevention coverage.

Methods:A prospective observational study was conducted among 287 pregnant women attending the antenatal clinic at Government Doon Medical College, Dehradun, over six months. Women aged 18–45 years with a gestational age ≥20 weeks were included. After obtaining informed consent, both Pap smear cytology and HPV DNA testing were performed. Cytological findings were categorized according to the Bethesda 2001 classification, and high-risk HPV genotypes were identified. Sociodemographic variables and associations with abnormal findings were analyzed using SPSS version 26.0, applying the Chi-square test, with $p < 0.05$ considered significant.

Results: The mean age of participants was 26.5 ± 5.0 years, with most (74.2%) between 21–30 years. Awareness of Pap smear screening was alarmingly low (0.3%) and showed a significant correlation with education level ($p = 0.002$). Pap smear findings were normal in 82.2% of women, while 16.7% showed inflammatory smears and 1.1% had infection-associated inflammation. HPV DNA positivity was found in 4.2% of participants, with genotype 31 being the most frequent (18.2%), followed by types 6, 11, 16, 18, 33, 45, 52, 66, and 68. Early sexual debut (≤20 years) was significantly associated with abnormal cytology ($p = 0.010$).

Conclusion: Integrating cervical cancer screening into routine antenatal care can bridge critical gaps in early detection, particularly in low-resource settings. The negligible awareness levels highlight the urgent need for educational interventions and policy measures to embed cervical screening and HPV vaccination within existing maternal health programs.

Keywords: *Cervical cancer, pregnancy, Pap smear, HPV DNA, antenatal care, screening awareness*

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1. INTRODUCTION

Cervical cancer remains a significant public health concern and is recognized as the second most common cancer after breast cancer among Indian women, with an incidence of 18.3% as reported by the World Health Organization (WHO), and it continues to be a leading cause of mortality in women aged 15–44 years.[1] The global burden of cervical cancer is largely determined by the accessibility and effectiveness of preventive strategies, which primarily include systematic screening programs for precancerous and cancerous cervical lesions, along with the implementation of HPV vaccination programs that have shown a remarkable impact in reducing incidence rates.[2] In the Indian context, pregnancy offers an essential window of opportunity for cervical cancer screening, as it frequently represents the first gynecological consultation for a significant proportion of women who might otherwise not seek routine gynecological care.[3] The estimated incidence of cervical cancer diagnosed during pregnancy or within the first year postpartum accounts for

approximately 1 to 3% of all cervical cancer cases, underlining the importance of early detection in this specific population group.[4]

However, cervical screening during pregnancy is not without its challenges, as hormonal fluctuations during this period can induce physiological changes in the cervix, such as increased vascularity, glandular hyperplasia, and decidual changes, which may mimic or obscure pathological findings. These pregnancy-related cellular changes often complicate the accurate interpretation of cytological and colposcopic findings, making the diagnosis of true dysplastic or malignant lesions more challenging for clinicians.[5]

The primary objectives of this study are to create awareness regarding the importance of cervical cancer screening among pregnant women, to conduct screening using both Pap smear cytology and HPV DNA testing to ensure a higher sensitivity and specificity for detecting precancerous lesions, to identify and analyze risk factors that may be associated with abnormal Pap smear or HPV DNA results, and to ensure proper follow-up and management of patients who are found to have abnormal cytological or HPV DNA findings.

The rationale behind conducting cervical cancer screening in pregnant women lies in the unique opportunity that antenatal visits provide for reaching women who generally do not attend gynecology outpatient departments for routine cervical cancer screening. By integrating screening into antenatal care, a significantly larger proportion of women can be evaluated, which could potentially lead to early detection of precancerous or cancerous lesions, timely intervention, and ultimately a reduction in cervical cancer-related morbidity and mortality in this population.

2. MATERIALS AND METHODS

A prospective observational study was conducted in the Department of Obstetrics & Gynaecology, GDMC, Dehradun for a duration of 6 months. The study commenced after obtaining clearance from the institutional review board and ethics committee.

Sampling method: Simple Random Sampling

Sample Size: The prevalence of pre malignant cervical lesion during pregnancy was found to be 3.4% in a study conducted by Gill et al [6]. Sample size is calculated using the formula

$$n = \frac{Z^2(1-\alpha/2)\,p(1-p)}{d^2}$$

where,

n = required sample size

z= 1.96 at 0.05 level of significance

p= prevalence of pre malignant cervical lesion during pregnancy

d= 5% margin of error

Using the above formula, the minimum sample size was 50 patients.

Inclusion Criteria:

Pregnant women attending ANC

Age 18–45 years

Period of gestation more than or equal to 20 weeks.

Willing to provide informed consent.

Exclusion Criteria:

Antenatal patients with < 20 weeks of period of gestation.

Patients who have undergone pap smear within 3 years or Co-test within 5 years.

History of cervical cancer or prior cervical treatment

History of cervical incompetence or USG showing marginal/placenta previa, active infection or bleeding per vaginum.

Informed Consent: Informed consent was obtained from each couple after a detailed explanation of the study's plan, purpose, and duration in their preferred language.

Pap Smear Procedure: Pap smears were performed similarly to those conducted on non-pregnant patients. The patient was positioned in lithotomy. Using a Cusco's speculum, the cervix was visualized, and scrapings were obtained from the squamo-columnar junction using a cytobrush for the endocervix and an Ayres spatula for the ectocervix with a 360-degree

swipe. The scraping was evenly spread on a glass slide, immediately fixed with 95% alcohol for 30 minutes, and stained with Papanicolaou stain. A pathologist reviewed the slides.

HPV DNA procedure: A cervical swab was collected and stored in transport medium for HPV DNA testing. High risk genotype was identified using PCR-based or rapid molecular tests.

Post-Procedure: Patients were counselled regarding the possibility of slight vaginal bleeding following the procedure and reassured.

Cytology Classification: Results were classified according to the Bethesda System 2001 as:

Negative for Intraepithelial Lesion (NILM)

Atypical Squamous Cells of Undetermined Significance (ASCUS)

Atypical Squamous Cells - Cannot Exclude High Grade (ASC-H)

Low-Grade Squamous Intraepithelial Lesion (LSIL)

High-Grade Squamous Intraepithelial Lesion (HSIL)

Squamous Cell Carcinoma

Atypical Glandular Cells, Not Otherwise Specified (ASC-NOS)

Atypical Glandular Cells, Suspicious for AIS or Cancer (AGC-neoplastic)

Adenocarcinoma In Situ

Management: Women with abnormal cervical findings were managed according to the ASCCP guidelines.

Follow-up: Participants with abnormal pap smear and high risk HPV DNA were followed 03 months after delivery.

Statistical Analysis: All statistical analyses was carried out using SPSS version 26.0. Quantitative data was presented as mean ± SD, and qualitative data presented in frequency tables. Categorical data was analyzed using the Chi-Square Test where appropriate. Statistical significance was set at $p < 0.05$.

3. RESULTS

The study included 287 antenatal care (ANC) attendees. The mean age of participants was 26.5 ± 5.0 years, with an age range of 18 to 55 years. The majority (74.2%) of the respondents were between 21–30 years of age. The mean age at first sexual intercourse was 20.7 ± 3.1 years (range: 14–33 years), with 61.7% reporting sexual debut at or before 20 years of age. **Table 1** summarizes the sociodemographic characteristics of the study population. In terms of educational attainment, most respondents had completed intermediate (35.5%) or high school education (32.8%). Only 4.5% were illiterate, and a small proportion (1.8%) were postgraduates. A total of 39 participants did not disclose their age at first sexual intercourse.

Figure 1 presents the distribution of respondents by gestational age. The majority of women were in the third trimester (≥28 weeks), followed by those in the second trimester (14–27 weeks). Only a small proportion of respondents were in the first trimester (≤13 weeks).

Awareness of cervical cancer screening via PAP smear was extremely low, with only one participant (0.3%) reporting prior knowledge. As shown in Table 2, awareness was significantly associated with educational status ($\chi^2 = 20.87$, $p = 0.002$), with the only aware respondent having completed graduate education. No significant association was observed between awareness and age group, age at first sexual intercourse, or gestational age.

PAP smear findings are detailed in **Table 3,** Most participants had normal cytological findings (82.2%), while 16.7% exhibited inflammatory changes with reactive features, and 1.1% showed inflammatory changes associated with underlying infections. HPV DNA was detected in 12 participants (4.2%), with genotype 31 being the most frequently identified (18.2%), followed by genotypes 6, 11, 16, 18, 33, 45, 52, 66, and 68, each accounting for 9.1% of the positive cases.

Table 4 outlines the association between sociodemographic variables and abnormal PAP smear findings. Although a higher proportion of abnormalities was noted among participants aged ≤30 years, the association was not statistically significant ($p = 0.162$). Abnormal cytology was more common among participants with lower levels of education; however, the difference was not statistically significant ($p = 0.570$). A significant association was observed between age at first sexual intercourse and abnormal cytology ($\chi^2 = 9.16$, $p = 0.010$), with higher rates of abnormal findings in those who initiated sexual activity before 30 years of age. No significant association was found between gestational age and cytological abnormalities ($p = 0.193$).

Table 1: Sociodemographic profile of ANCs

Sociodemographic Variable	Frequency (n)	Percentage
Age of ANC		
≤ 20	27	9.4
21 – 30	213	74.2
31 – 40	43	15.0
41 – 50	3	1.0
>50	1	0.4
Education status		
Illiterate	13	4.5
Primary	13	4.5
Post Primary	35	12.2
High school	94	32.8
Intermediate	102	35.5
Graduate	25	8.7
Postgraduate	5	1.8
Age at 1st sexual intercourse*		
≤ 20	153	61.7
21 – 30	93	37.5
31 – 40	2	0.8

* 39 ANCs did not answer this question

Figure 1: Gestational age of ANC

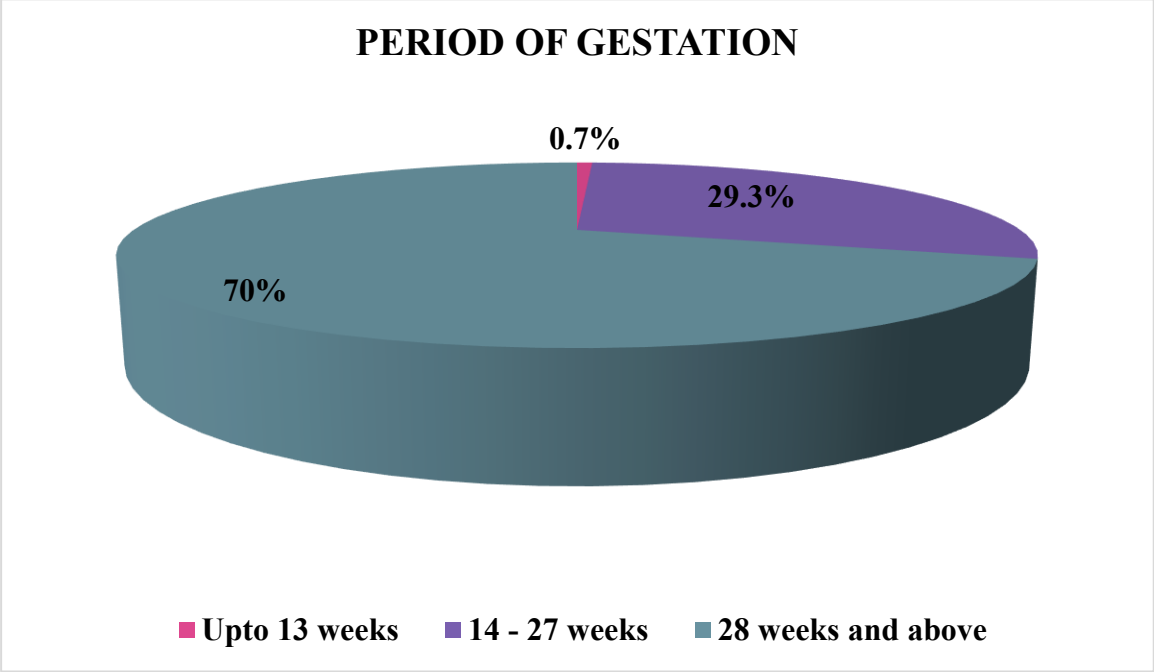

Table 2: Factors associated with awareness of PAP smear for cervical cancer screening

Sociodemographic Variable	Aware n (%)	Not Aware n (%)	χ^2; p value
Age of ANC			
≤ 20	0 (0.0)	27 (100)	0.349; 0.986
21 – 30	1 (0.5)	212 (99.5)	
31 – 40	0 (0.0)	43 (100)	
41 – 50	0 (0.0)	3 (100)	
>50	0 (0.0)	1 (100)	
Total	1 (0.3)	286 (99.7)	
Education status			
Illiterate	0 (0.0)	13 (100)	20.87; 0.002
Primary	0 (0.0)	13 (100)	
Post Primary	0 (0.0)	35 (100)	
High school	0 (0.0)	94 (100)	
Intermediate	0 (0.0)	102 (100)	
Graduate	1 (4.0)	24 (96.0)	
Postgraduate	0 (0.0)	5 (100)	
Age at 1st sexual intercourse			
≤ 20	0 (0.0)	153 (100)	1.67; 0.433
21 – 30	1 (1.1)	92 (98.9)	
31 – 40	0 (0.0)	2 (100)	
Gestational age (weeks)			
Upto 13	0 (0.0)	2 (100)	0.429; 0.807
14 – 27	0 (0.0)	84 (100)	
28 and above	1 (0.5)	200 (99.5)	

Table 3: PAP Smear findings

Variable	Frequency (n)	Percentage
PAP Smear Result		
Normal	236	82.2
Inflammatory smear with reactive changes	48	16.7
Inflammatory smear with underlying infections	3	1.1
HPV DNA		
Negative	275	95.8

Positive	12	4.2
Genotype		
6	1	9.1
11	1	9.1
16	1	9.1
18	1	9.1
31	2	18.2
33	1	9.1
45	1	9.1
52	1	9.1
66	1	9.1
68	1	9.1

Table 4: Factors associated with PAP Smear finding

Sociodemographic Variable	Abnormal n (%)	Normal n (%)	χ^2; p value
Age of ANC			
≤ 20	5 (18.5)	22 (81.5)	6.54; 0.162
21 – 30	40 (18.8)	173 (81.2)	
31 – 40	5 (11.6)	38 (88.4)	
41 – 50	0 (0.0)	3 (100)	
>50	1 (100)	0 (0.0)	
Education status			
Illiterate	5 (38.5)	8 (61.5)	4.795; 0.570
Primary	3 (23.1)	10 (76.9)	
Post Primary	8 (22.9)	27 (77.1)	
High school	18 (19.1)	76 (80.9)	
Intermediate	13 (12.7)	89 (87.3)	
Graduate	3 (12)	22 (88)	
Postgraduate	1 (20.0)	4 (80.0)	
Age at 1st sexual intercourse			
≤ 20	26 (17.0)	127 (83.0)	9.16; 0.010
21 – 30	20 (21.5)	73 (78.5)	
31 – 40	2 (100)	0 (0.0)	
Gestational age (weeks)			
Upto 13	0 (0.0)	2 (100)	3.29; 0.193

14 – 27	20 (23.8)	64 (76.2)	
28 and above	31 (15.4)	170 (84.6)	

4. DISCUSSION

In the present study conducted among 287 antenatal care (ANC) participants, the mean age was 26.5 ± 5.0 years, with a predominant proportion (74.2%) falling within the 21–30-year age group. The mean age at first sexual intercourse was 20.7 ± 3.1 years, and 61.7% of participants reported initiating sexual activity at or before 20 years of age. Educational levels were mainly concentrated at the high school (32.8%) and intermediate (35.5%) stages, whereas only 1.8% had postgraduate education and 4.5% were illiterate. These sociodemographic parameters provide essential context for interpreting the awareness and prevalence of cervical abnormalities during pregnancy.

When compared with prior Indian studies **(Table 1),** the present study demonstrated relatively higher educational attainment among ANC attendees. Priya et al. (2018) reported a slightly younger mean age of 24.6 ± 4.2 years, with 72.1% of women aged 20–30 years, similar to the 74.2% observed in our study[5]. However, their illiteracy rate (8.9%) exceeded ours (4.5%). Gill et al. (2020) documented a mean age of 25.1 ± 4.7 years—comparable to our findings—and a similar high school education rate (38.6%), though their postgraduate proportion (3.2%) was slightly higher[6]. Likewise, Kumari (2023) reported a younger cohort (mean 24.2 ± 3.5 years) with 69.5% educated up to high school[3]. Ghosh et al. (2024) noted a much higher illiteracy rate (29.1%) among rural South Indian women, underscoring regional disparities[2]. Global Cancer Statistics (Sung et al., 2021) further highlighted that early marriage and limited education are key risk factors globally[1]. Howe et al. (2022) reported a comparable mean age of 27.8 years in their pregnant cohort[4], while Ghosh et al. reaffirmed that early sexual debut (<20 years) was commonly associated with poor cervical health outcomes, aligning with our findings[2].

Regarding gestational age distribution **(Figure 1),** 70% of women in our study were in the third trimester (≥28 weeks), 29.3% in the second trimester, and only 0.7% in the first trimester. Priya et al. (2018) observed more women screened during the second trimester (44.5%) and fewer in the third (33.8%)[5], indicating inter-center variation in screening timelines. Gill et al. (2020) found 60% of screenings conducted in the second trimester and 20% in the third[6], while Kumari (2023) reported a near-equal distribution (48% and 42%, respectively)[3]. Such differences may reflect institutional policies or antenatal registration patterns. Ghosh et al. (2024) did not report trimester stratification but emphasized early antenatal screening[2]. Howe et al. (2022) recommended the second trimester for optimal cytological yield[4], while Sung et al. (2021) advocated trimester-independent screening to ensure broader detection[1].

In terms of awareness of Pap smear-based cervical screening **(Table 2),** only one respondent (0.3%) had prior knowledge, reflecting alarmingly poor awareness. A significant association was found between awareness and education ($\chi^2 = 20.87$, $p = 0.002$), with the only aware participant being a graduate. This finding contrasts sharply with Ghosh et al. (2024), who observed 42.3% awareness of cervical screening and 31.2% awareness of Pap smear[2]. Kumari (2023) reported 18.4% awareness[3], while Priya et al. (2018) and Gill et al. (2020) recorded 12.5% and 14.7%, respectively[5,6]. Mallya et al. (2024) found higher awareness (36% rural, 61% semi-urban)[2], whereas Howe et al. (2022) identified low awareness as a key obstacle in early diagnosis[4]. In our cohort, awareness did not vary significantly with age ($p = 0.986$), age at first sexual activity ($p = 0.433$), or gestational age ($p = 0.807$), corroborating findings by Ghosh et al. and Kumari that education remains the strongest determinant[2,3].

Pap smear analysis **(Table 3)** revealed normal cytology in 82.2% of cases, inflammatory smears with reactive changes in 16.7%, and infection-associated inflammation in 1.1%. HPV DNA positivity was found in 4.2% (12 participants), most frequently genotype 31 (18.2%), followed by types 6, 11, 16, 18, 33, 45, 52, 66, and 68 (each 9.1%). These outcomes are consistent with Priya et al. (2018) (80.3% normal, 17.1% inflammatory, 2.6% infections)[5] and Gill et al. (2020) (79% normal, 14% inflammatory, 7% atypical squamous cells)[6]. Kumari (2023) observed 85.5% normal and 12.6% inflammatory smears[3]. Ghosh et al. (2024) and Mallya et al. (2024) found similar inflammatory patterns (20.2% and 19.4%)[2], while HPV positivity in their cohorts was slightly higher (6.1%). Globally, Sung et al. (2021) reported a 6.5% HPV prevalence among reproductive-age women[1], closely aligning with our findings. Howe et al. (2022) emphasized routine HPV screening, especially for types 16 and 18;[4] however, our predominance of genotype 31 may indicate evolving strain patterns in this region.

Analysis of risk factors for abnormal cytology **(Table 4)** revealed abnormalities in 18.8% of women aged 21–30 years and 18.5% of those ≤20 years. The highest abnormality rate (38.5%) was seen among illiterate women, although the association with education was not statistically significant ($p = 0.570$). Early sexual debut (≤20 years) was significantly correlated with abnormal findings ($\chi^2 = 9.16$, $p = 0.010$). Similar associations between early sexual activity, lower education, and higher abnormality rates were reported by Priya et al. (2018)[5], Gill et al. (2020)[6], and Kumari (2023)[3]. Ghosh et al. (2024) found women with early sexual debut had 2.1 times higher odds of inflammatory smears[2], and Howe et al. (2022) reported 62%

of abnormal cases occurred among women with sexual debut before 20 years[4]. Although gestational age was not significantly associated (p = 0.193), inflammatory findings were more common during the second trimester (23.8%) than the third (15.4%), consistent with the mid-trimester predominance observed by Gill et al.[6]

5. CONCLUSION:

Antenatal care visits provide an invaluable opportunity to implement cervical cancer screening among women who might otherwise remain unscreened. The study highlights extremely low awareness and a modest prevalence of cytological and HPV abnormalities. Early sexual debut emerged as a significant risk factor for abnormal cytology. Integrating routine cervical screening and awareness programs into antenatal services can substantially strengthen cervical cancer prevention efforts in India.

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