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Original Article

Factors Associated with Pre-cancerous Cervical Lesions among Women Attending Cervical Cancer Screening Centers in Selected Tertiary Hospitals in Bangladesh: A Case-control Study

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Abstract

Background and objectives: Cervical cancer, driven mainly by persistent high-risk human papillomavirus infection, remains a major public health problem in Bangladesh, with 9,640 new cases and 5,826 deaths in 2022. Early detection of pre-cancerous cervical lesions (PCL) is essential, yet limited evidence exists on factors associated with PCL among Bangladeshi women. This study aimed to identify factors associated with PCL among women attending cervical cancer screening centers at selected tertiary hospitals.

Methods: An age-matched (±5 years) case-control study was conducted in two tertiary hospitals. Cases were women who tested colposcopy-positive for PCL, and controls were visual inspection with acetic acid-negative women attending the same screening centers. A total of 38 cases and 76 controls were included. Data were collected through face-to-face interviews using a structured questionnaire. Multivariable logistic regression identified factors associated with PCL, with significance set at $p < 0.05$.

Results: A history of sexually transmitted infections (adjusted odds ratio (AOR) = 36.73; 95% confidence interval (CI): 3.25–414.83), pelvic infections (AOR = 6.48; 95% CI: 1.24–33.85), not living with a husband (AOR = 4.48; 95% CI: 1.06–18.90), and overweight/obesity (AOR = 3.58; 95% CI: 1.14–11.22) were significantly associated with higher odds of PCL. Menstrual irregularity, genital ulcer history, and number of lifetime sexual partners showed no significant association.

Conclusions: Sexually transmitted infections, pelvic infections, overweight/obesity, and not living with husband were identified as factors associated with PCL. Strengthened infection prevention, lifestyle counseling, and targeted health education may support ongoing cervical cancer prevention efforts in Bangladesh.

Introduction

Cervical cancer remains a major global public health concern, ranking as the fourth most common cancer among women worldwide.[1] In 2020, an estimated 604,127 new cases and 341,831 deaths were recorded globally, with approximately 90% of this burden occurring in low- and middle-income countries.[1,2]

In Bangladesh, cervical cancer constitutes 12% of female cancers and is the second most common cancer among women, with incidence and mortality much higher than the global average statistics (incidence rates: 5.3 vs. 3.1/100,000 women; mortality rates: 4.6 vs. 3.4/100,000 women).[3] However, in 2022, 9,640 new cases and 5,826 deaths occurred in Bangladesh.[4]

Cervical cancer is caused by the sexually transmitted human papillomavirus (HPV), which is one of the most common viral infections of the reproductive tract. Survival of cervical cancer pa-

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tients is strongly determined by stage at diagnosis. Due to the late stage of diagnosis and inadequate management facilities, mortality rates from cervical cancer are very high in Bangladesh. The overall five-year relative survival for early and localized cancers is 73.2%, but can be as low as 7.4% for advanced-stage disease.[5,6]

Cervical cancer usually develops after a prolonged phase of pre-invasive lesions in the cervix.[7] Therefore, early identification and treatment at its pre-invasive stage may benefit patients and decrease the burden of morbidity and mortality resulting from cervical cancer.[8,9]

The high disease burden is exacerbated by limited access to preventive services, delayed diagnosis, and inadequate treatment infrastructure. Facilities for radical surgery and radiotherapy remain restricted to a handful of government institutions, posing major barriers to timely and effective management.[10]

Bangladesh has launched a nationwide Cervical Cancer Surveillance Program, operational in 601 facilities and supported by the National Centre for Cervical and Breast Cancer Screening and Training at BSMMU.[11,12] The program, known as EPBCBSP, provides visual inspection with acetic acid (VIA)-based screening every five years for women aged 30–60, with colposcopy and same-day "see-and-treat" management for screen-positive cases.[13,14] However, treatment of invasive cervical cancer remains costly and limited to a few government centers, underscoring the importance of prevention and the guidance of the National Strategy for Cervical Cancer Prevention and Control (2017–2022).[11,13]

Globally, multiple studies have found that behavioural, reproductive, and socio-demographic factors are strongly associated with pre-cancerous cervical lesions (PCL). For example, a case-control study in the Amhara region, Ethiopia, found that early coitarche, multiple sexual partners, history of sexually transmitted infections (STIs), and use of oral contraceptives were significant risk factors (adjusted odds ratios [AORs] ranging □2.5–4) for precancerous lesions, while higher education and normal body mass index (BMI) were protective against risk.[15] In Addis Ababa, another case-control study reported that women aged 40–49, having multiple lifetime sexual partners, and having a husband with more than one lifetime sexual partner were also associated with higher odds of precancerous lesions.[16] Similarly, among human immunodeficiency virus-positive women in Gondar, Ethiopia, the prevalence of VIA-positive precancerous or cancerous cervical lesions was high, with human immunodeficiency virus infection significantly elevating risk, alongside behavioral factors such as sexual history.[17]

In Bangladesh, though some studies have examined colposcopy findings and histopathological correlations for VIA-positive women, few have rigorously assessed how socio-demographic, behavioral, reproductive, and clinical factors jointly influence the risk of PCL in tertiary hospital settings.[18–20] Moreover, recent case-based data from the national electronic registry show that although millions of women are being screened and many precancerous lesions are identified via DHIS2, follow-up to colposcopy and treatment remains suboptimal, and spatial and facility-level variations exist in VIA positivity, colposcopy uptake, and lesion grade distributions.[21] Therefore, the present case-control study aimed to identify determinants of PCL among women in selected tertiary hospitals in Bangladesh.

Materials and methods

Study design and setting

We conducted an age-matched case-control study at two tertiary care hospitals: Dhaka Medical College Hospital (DMCH) and Sir Salimullah Medical College Mitford Hospital (SSMCH). Both

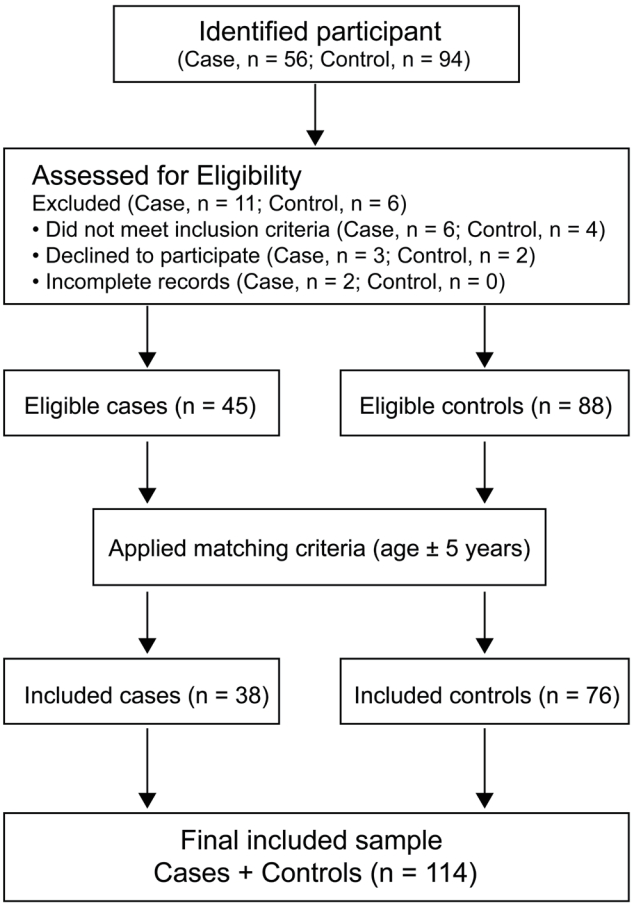

Fig. 1. Participant flow diagram for case–control study.

DMCH and SSMCH serve as major tertiary care centers in Dhaka, providing cervical cancer screening services to large catchment populations. During 2024, a total of 10,245 women were screened across the two hospitals using VIA and colposcopy. At DMCH, 5,754 women were screened with VIA, and 325 underwent colposcopy. At SSMCH, 5,087 women were screened with VIA, and 132 underwent colposcopy. This high screening volume reflected the hospitals' role as referral centers for a large urban and peri-urban population, providing context for the representativeness of the study participants. The study was conducted over an eight-month period, from November 2023 to June 2024.

Study participants

The study population included women attending the VIA and Colposcopy Centers of the selected hospitals for cervical cancer screening. Cases were defined as women diagnosed with PCL (cervical intraepithelial neoplasia (CIN) 1, 2, or 3) confirmed by trained colposcopists through colposcopy. Controls were women who tested negative for pre-cancerous lesions via VIA screening and had no history of gynecological malignancy. Participants were selected purposively, and each case was matched with two controls by age (±5 years) to minimize confounding. Women were eligible if they attended the screening centers, were aged 18 years or above, and provided informed consent. Exclusion criteria included a diagnosis of invasive cervical carcinoma, a history of total hysterectomy, or inability to provide informed consent (Fig. 1).

Sample size

Sample size was calculated using Epi Info version 7, assuming a 95% confidence interval (CI) level, 80% power, and a case-to-control ratio of 1:2. Based on a prior study from Adama, Ethiopia, an AOR of 3.72 for early sexual exposure was considered, with 45.5% of cases and 18.3% of controls reportedly exposed.[22] The minimum required sample size was 114 participants, including 38 cases and 76 controls.

Data collection

Data were collected through face-to-face interviews using a pre-tested semi-structured questionnaire administered by trained data collectors. Interviews gathered information on socio-demographic characteristics, reproductive and sexual history, contraceptive use, and medical history. Anthropometric measurements (weight and height) were also obtained following standardized procedures. Weight was measured using a digital scale (to the nearest 0.1 kg), and height was recorded using a stadiometer (to the nearest 0.1 cm). BMI was calculated as weight in kilograms divided by height in meters squared and classified per World Health Organization guidelines.

Definitions used included:

- *PCL:* Colposcopy-confirmed CIN 1, 2, or 3.
- *Colposcopy-positive:* Women with colposcopy findings suggestive of PCL.
- *VIA negative:* No acetowhite lesion on the cervix upon acetic acid inspection by trained providers.
- *Early sexual exposure:* First sexual intercourse before 18 years.
- *Nutritional status (BMI-based):* Categorized as underweight (<18.5 kg/m^2), normal (18.5–24.9), overweight (25–29.9), and obese (≥30).

The main outcome variable was the presence of PCL. Independent variables included socio-demographic factors, reproductive and obstetric history, contraceptive use, and sexual practices.

Data management

Collected data were entered into a Microsoft Excel spreadsheet, secured on a password-protected device under the investigator's supervision. Data ownership remained with the Institute of Epidemiology Disease Control and Research (IEDCR), and access was restricted to authorized personnel only. All data were stored in compliance with the Ministry of Health and Family Welfare policy for a minimum of five years, ensuring confidentiality and data protection.

Statistical analysis

Data were analyzed using StataIC 17 (64-bit). Descriptive statistics summarized socio-demographic, clinical, and behavioral characteristics, with categorical variables presented as frequencies and percentages and continuous variables as means (±standard deviation) or medians depending on distribution. Associations with PCL were initially assessed using Chi-square or Fisher's Exact tests.

Bivariate logistic regression was performed to estimate crude odds ratios (COR) with 95% CIs, and variables with $p < 0.20$ or biological plausibility were considered for inclusion in the multivariable logistic regression model. Confounders were selected based on bivariate results and prior literature. Backward elimination was used to derive the most parsimonious model, sequentially removing non-significant variables while retaining key confounders. Collinearity between variables was assessed using a correlation matrix; variables with high collinearity (correlation >0.8) were excluded, with parity removed due to collinearity. AORs with 95% CI were reported, and variables with $p < 0.05$ were considered statistically significant. Model fit was evaluated using the Hosmer-Lemeshow test ($\chi^2 = 11.98$, $p = 0.1522$), indicating good fit, and discrimination was assessed via the receiver operating characteristic curve (area under the curve = 0.944), showing excellent ability to distinguish cases from controls. Sensitivity analyses were conducted to assess the robustness of the multivariable model. These included excluding influential observations identified by deviance residuals, recoding BMI as a continuous variable, and performing separate analyses by hospital site (DMCH and SSMCH). AORs remained largely consistent across these alternative specifications, indicating that the findings were robust and not driven by influential observations or site-specific effects.

Quality assurance

Prior to data collection, the questionnaire was piloted among 5% of the target population to assess feasibility and clarity. Necessary adjustments were made based on the pilot findings. Daily review of collected data ensured completeness and consistency. Regular supervision was conducted by the investigator to maintain the quality and integrity of the data.

Ethical considerations

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki (as revised in 2024). Ethical approval was obtained from the Institutional Review Board of IEDCR, Dhaka (Memo No. IEDCR/IRB/2023/14). Written informed consent was obtained from all participants. Participation was voluntary, and confidentiality was strictly maintained throughout the study.

Results

Socio-demographic characteristics

A total of 38 cases and 76 controls were included in the study. The mean age of respondents was comparable between the two groups, with the majority belonging to the 30–39-year age group (44.7% of cases vs. 56.6% of controls). Nearly half of the cases (44.7%) and more than half of the controls (56.6%) had completed education up to the primary level. The majority of respondents were married (89.5% of cases vs. 96.1% of controls) and housewives (92.1% of cases vs. 93.4% of controls). Husbands' education levels varied, with more than one-third having secondary-level education in both groups. Overweight or obesity was more frequent among cases (68.4%) than controls (56.6%). Most respondents reported monthly family expenditure between Bangladeshi Taka 10,001–30,000 in both groups (73.7% vs. 80.3%). A family history of cervical cancer was noted in 15.8% of cases and 10.5% of controls. Compared with controls, a higher proportion of cases were not living with their husbands at the time of the study (36.8% vs. 17.1%) (Table 1).

Reproductive health characteristics

More than half of the cases (52.6%) had irregular or no menstruation, compared to 36.8% of controls. Early marriage was common in both groups, with nearly three-fourths of women married at or before 18 years of age (73.7% of cases and 75.0% of controls). Similarly, early age at first childbirth (≤20 years) was also prevalent (68.4% of cases vs. 75.4% of controls). The majority of participants were multiparous (84.2% of cases and 86.8% of

Table 1. Distribution of socio-demographic characteristics of respondents at tertiary hospitals, Bangladesh, 2023

Variables	Case n(%)	Control n(%)
Age group		
30–39 years	17 (56.58)	43 (56.58)
40–49 years	13 (34.21)	20 (26.32)
50–60 years	8 (21.05)	13 (17.11)
Educational status		
Up to primary education	17 (56.58)	43 (56.58)
Secondary education	13 (34.21)	20 (26.32)
Higher secondary and above	8 (21.05)	13 (17.11)
Marital status		
Married	34 (89.47)	73 (96.05)
Divorced	1 (2.63)	0 (0.0)
Widow	3 (7.89)	3 (3.95)
Occupation		
Housewife	35 (92.11)	71 (93.42)
Govt service	0 (0.0)	2 (2.63)
Private service	1 (2.63)	3 (3.95)
Labor	2 (5.26)	0 (0.0)
Husband's educational status		
No formal education	12 (32.43)	24 (31.58)
Primary education	3 (8.11)	12 (15.79)
Secondary education	13 (35.14)	22 (28.95)
Higher secondary and above	9 (24.32)	18 (23.68)
Nutritional status		
Normal	11 (28.95)	31 (40.79)
Overweight and obese	26 (68.42)	43 (56.58)
Underweight	1 (2.63)	2 (2.63)
Monthly family expenditure (BDT)		
≤10,000	1 (2.63)	1 (1.32)
>10,000–30,000	28 (73.68)	61 (80.26)
>30,000–50,000	9 (23.68)	10 (13.16)
>50,000	0 (0)	4 (5.26)
Family history of cervical cancer		
No	32 (84.21)	68 (89.47)
Yes	6 (15.79)	8 (10.53)
Husband's living status		
Living together	24 (63.16)	63 (82.89)
Not living with husband	14 (36.84)	13 (17.11)

BDT, Bangladeshi Taka.

controls). A higher proportion of cases initiated sexual activity at age 18 years or earlier (81.6%) compared to controls (73.7%) (Table 2).

Table 2. Distribution of reproductive health characteristics of respondents at selected tertiary hospitals, Bangladesh, 2023

Variables	Case n(%)	Control n(%)
Type of menstruation		
Regular	18 (47.37)	48 (63.16)
Irregular and no menstruation	20 (52.63)	28 (36.84)
Age at first marriage		
≤18 years	28 (73.68)	57 (75.0)
>18 years	10 (26.32)	19 (25.0)
Age at first childbirth		
≤20 years	26 (68.42)	52 (75.36)
≥20 years	12 (31.58)	17 (24.64)
Parity		
Nulliparous	0 (0.0)	7 (6.14)
Primi parity	6 (15.79)	3 (3.95)
Multiparty	32 (84.21)	66 (86.84)
Age at first sexual exposure		
≤18 years	31 (81.58)	56 (73.68)
>18 years	7 (18.42)	20 (26.32)

Obstetric history and contraceptive use

Vaginal delivery was the most common type of childbirth in both groups (63.2% of cases vs. 66.7% of controls). A history of abortion was more frequent among cases (60.5%) than controls (50.0%), with induced abortion being predominant in both groups. Regarding management, spontaneous resolution was reported by 43.5% of cases and 26.3% of controls, while others underwent menstrual regulation or dilatation and curettage. Ever-use of contraceptives was slightly lower among cases (78.9%) compared to controls (92.1%), and current contraceptive use was also less frequent (26.3% vs. 42.1%). Oral contraceptive pills were the most widely used method, reported by more than 90% of both groups. Duration of pill use ≥ 5 years was slightly higher among cases (42.9%) than controls (33.3%). Use of injectable contraceptives was less common among cases (36.7%) than controls (50.0%). Implant and other methods (condoms, permanent methods) were infrequent in both groups (Table 3).

Sexual behavior history

Histories of STI, pelvic infection, and genital ulcer were more prevalent among cases compared to controls (18.4% vs. 1.3%, 28.9% vs. 7.9%, and 15.8% vs. 3.9%, respectively). Multiple lifetime sexual partners were reported by 31.6% of cases and 9.2% of controls. Husbands having multiple lifetime partners was also more frequent among cases (18.4%) than controls (13.2%) (Table 4).

Bivariate analysis

In bivariate analysis, women not living with their husbands had higher odds of developing PCL compared to those living with their husbands (COR: 2.82; 95% CI: 1.16–6.87; $p = 0.04$). Multiparity was associated with a lower risk (COR: 0.48; 95% CI: 0.32–0.74; $p < 0.01$). Ever-use of contraceptives showed borderline protection (COR: 0.32; 95% CI: 0.10–1.00; $p = 0.05$). Strong associations were observed between PCL and STI history (COR: 16.93; 95%

Table 3. Distribution of obstetrics and contraceptive use characteristics of respondents at selected tertiary hospitals, Bangladesh, 2023

Variables	Case n(%)	Control n(%)
Delivery type		
Vaginal delivery	24 (63.16)	46 (66.67)
Cesarean section delivery	3 (7.89)	11 (15.94)
Both	11 (28.95)	12 (17.39)
Total	38 (100)	69 (100)
History of abortion		
No	15 (39.47)	38 (50.00)
Yes	23 (60.53)	38 (50.00)
Total	38 (100)	76 (100)
Type of abortion		
Spontaneous	9 (39.13)	11 (28.95)
Induced	14 (60.87)	27 (71.05)
Total	23 (100)	38 (100)
Management taken for abortion		
Abort by itself	10 (43.48)	10 (26.32)
Took tablet	0 (0.0)	10 (26.32)
Menstrual regulation (MR)	5 (21.74)	11 (28.95)
Dilatation and curation (D & C)	8 (34.78)	7 (18.42)
Ever used any contraceptive methods		
No	8 (21.05)	6 (7.89)
Yes	30 (78.95)	70 (92.11)
Total	38 (100)	76 (100)
Ever used oral contraceptive methods		
No	2 (6.67)	7 (10.00)
Yes	28 (93.33)	63 (91.00)
Total	30 (100)	70 (100)
Time of using OCP		
<5 years	16 (57.14)	42 (66.67)
≥5 years	12 (42.86)	21 (33.33)
Total	28 (100.00)	63 (100.00)
Ever used injectable contraceptive		
No	19 (63.33)	35 (50.00)
Yes	11 (63.33)	35 (50.00)
Total	30 (100.00)	70 (100.00)
Ever used any implant contraceptive		
No	28 (93.33)	69 (98.57)
Yes	2 (6.67)	1 (1.33)
Total	30 (100.00)	70 (100.00)
Ever used any other contraceptives		
No	18 (60.00)	37 (52.86)
Yes	12 (40.00)	33 (47.14)
Total	30 (100.00)	70 (100.00)
Currently use any contraceptive methods		
No	28 (73.68)	44 (57.89)
Yes	10 (26.32)	32 (42.11)

OCP, oral contraceptive pill.

Table 4. Distribution of respondents by their history of sexual behavior at selected tertiary hospitals, Bangladesh, 2023

Variables	Case n(%)	Control n (%)
Ever suffered from STI		
No	31 (81.58)	75 (98.68)
Yes	7 (18.42)	1 (1.32)
Total	38 (100.00)	76 (100.00)
History of pelvic infection		
No	27 (71.05)	70 (92.11)
Yes	11 (28.95)	6 (7.89)
Total	38 (100.00)	76 (100.00)
History of genital ulcer		
No	32 (84.21)	73 (96.05)
Yes	6 (15.79)	3 (3.95)
Total	38 (100.00)	76 (100.00)
Number of lifetime sexual partner(s)		
One	26 (68.42)	69 (90.79)
Two or more	12 (31.58)	7 (9.21)
Total	38 (100.00)	76 (100.00)
Husband/partner's lifetime sexual partner(s)		
One	31 (81.58)	66 (86.84)
Two or more	7 (18.42)	10 (13.16)
Total	38 (100.00)	76 (100.00)

STI, sexually transmitted infection.

CI: 1.99–143.46; $p < 0.01$), pelvic infection (COR: 4.75; 95% CI: 1.59–14.12; $p < 0.01$), genital ulcer (COR: 4.56; 95% CI: 1.07–19.38; $p = 0.04$), and having two or more lifetime sexual partners (COR: 4.54; 95% CI: 1.62–12.81; $p < 0.01$) (Table 5).

Multivariate analysis

In multivariate logistic regression, being overweight/obese was independently associated with increased odds of PCL (AOR: 3.58; 95% CI: 1.14–11.22; $p = 0.02$). Women not living with their husbands had a higher likelihood of developing lesions (AOR: 4.48; 95% CI: 1.06–18.90; $p = 0.03$). A history of STI remained a strong predictor (AOR: 36.73; 95% CI: 3.25–414.83; $p = 0.02$), as did pelvic infection (AOR: 6.48; 95% CI: 1.24–33.85; $p = 0.02$). Although genital ulcer and multiple sexual partners showed increased risk in bivariate analysis, their associations were not statistically significant after adjustment. Injectable contraceptive use demonstrated a non-significant protective trend (AOR: 0.29; 95% CI: 0.08–1.07; $p = 0.06$) (Table 6).

Discussion

This case-control study explored determinants of PCL among women screened at tertiary hospitals in Bangladesh. The multivariate analysis identified history of STIs, pelvic infections, not living with one's husband, and overweight/obesity as independent predictors of PCL. These findings highlight the interplay of biological, behavioral, and sociocultural factors in cervical carcinogenesis in Bangladesh.

History of STIs was the strongest predictor, with women reporting a prior STI having substantially higher odds of PCL. This finding is consistent with global evidence that STIs such as herpes simplex virus and *Chlamydia trachomatis* increase susceptibility to HPV persistence and progression to CIN.[15,23,24] Inflammatory changes and impaired cervical immunity caused by STIs may create a permissive environment for high-risk HPV infection, supporting the role of STI prevention and treatment as a cornerstone of cervical cancer control.

Similarly, pelvic infection was significantly associated with PCL. Chronic pelvic inflammatory disease can cause long-standing inflammation and epithelial damage, enhancing the risk of HPV persistence and integration into cervical cells. These findings align with studies from Ethiopia, Uganda, and Bangladesh, where chronic infections were found to promote persistent inflammation and immune suppression, facilitating HPV progression.[25–27] The presence of pelvic infections and genital ulcers could also reflect delayed healthcare-seeking behavior, a common challenge in resource-limited settings.

Overweight and obese women exhibited higher odds of pre-cancerous lesions, corroborating findings from studies in the United States and Europe.[28] Obesity contributes to systemic inflammation and hormonal imbalances, which may facilitate HPV persistence and progression.[29]

Irregular or absent menstruation was significantly associated with increased risk of PCL in bivariate analysis; however, this was not significant in multivariate analysis. Similar associations have been observed in studies from India and sub-Saharan Africa, where menstrual irregularities are linked to underlying hormonal imbal-

Table 5. Bivariate analysis of socio-demographic factors associated with pre-cancerous cervical lesions in women at selected tertiary hospitals, Bangladesh, 2023

Variables	COR (95% CI)	*p*-value
Educational status		
Up to primary education	Ref	
Secondary education	1.64 (0.67–4.02)	0.62
Higher secondary and above	1.55 (0.54–4.42)	0.74
Marital status		
Married	Ref	
Widow	2.14 (0.41–11.19)	0.91
Occupation		
Housewife	Ref	
Govt service	Omitted	
Private service	0.67 (0.06–6.73)	0.73
Husband's educational status		
No formal education	Ref	
Primary education	0.50 (0.11–2.11)	0.34
Secondary education	1.18 (0.44–3.13)	0.73
Higher secondary and above	1.00 (0.34–2.88)	1.00
Husband's occupational status		
Unemployment	Ref	
Govt service	1.00 (0.16–6.05)	1.00
Private service	1 (0.26–3.852)	1.00
Labor	0.81 (0.33–1.96)	0.64
BMI-based nutritional status		
Normal	Ref	
Overweight and obese	1.70 (0.73–3.95)	<0.01
Underweight	1.40 (0.11–17.11)	0.27
Monthly family expenditure (BDT)		
≤10,000	Ref	
>10,000–30,000	0.46 (0.27–7.60)	0.58
>30,000–50,000	0.9 (0.04–16.59)	0.94
Family history of cervical cancer		
No	Ref	
Yes	1.59 (0.51–4.97)	0.42
Husband's living status		
Living together	Ref	
Not living with husband	2.82 (1.16–6.87)	0.04
Type of menstruation		
Regular	Ref	
Irregular and no menstruation	1.90 (0.86–4.19)	0.52
Age at first marriage		
≤18 years	Ref	

(continued)

Table 5. *(continued)*

Variables	COR (95% CI)	*p*-value
>18 years	1.07 (0.44–2.60)	0.87
Age at first childbirth		
≤20 years	Ref	
≥20 years	1.41 (0.58–3.39)	0.52
Parity		
Nulliparous	Omitted	
Primi parity	Ref	
Multiparty	0.48 (0.32–0.74)	<0.01
Age at first sexual exposure		
≤18 years	Ref	
>18 years	0.63 (0.24–1.66)	0.35
Delivery type		
Vaginal delivery	Ref	
Cesarean section delivery	0.52 (0.13–2.05)	0.35
Both	1.75 (0.67–4.56)	0.24
History of abortion		
No	Ref	
Yes	1.51 (0.67–3.39)	0.31
Type of abortion		
Spontaneous	Ref	
Induced	0.81 (0.34–1.97)	0.65
Management taken for abortion		
Abort by itself	Ref	
Took tablet	Omitted	
Menstrual regulation (MR)	0.45 (0.12–1.79)	0.26
Dilatation and curation (D & C)	1.14 (0.29–4.36)	0.84
Ever used any contraceptive methods		
No	Ref	
Yes	0.32 (0.10–1.00)	0.05
Ever used oral contraceptive methods		
No	Ref	
Yes	0.52 (0.20–1.3)	0.59
Time of using OCP		
<5 years	Ref	
≥5 years	1.27 (0.51–3.15)	0.38
Ever used injectable contraceptive		
No	Ref	
Yes	0.57 (0.24–1.39)	0.22
Ever used any implant contraceptive		
No	Ref	
Yes	4.16 (0.36–47.47)	0.25

(continued)

Table 5. *(continued)*

Variables	COR (95% CI)	*p*-value
Ever used any other contraceptives		
No	Ref	
Yes	0.57 (0.25–1.29)	0.17
Currently use any contraceptive methods		
No	Ref	
Yes	0.49 (0.20–1.15)	0.10
Ever suffered from STI		
No	Ref	
Yes	16.93 (1.99–143.46)	<0.01
History of pelvic infection		
No	Ref	
Yes	4.75 (1.59–14.12)	<0.01
History of genital ulcer		
No	Ref	
Yes	4.56 (1.07–19.38)	0.04
Number of lifetime sexual partner(s)		
One	Ref	
Two or more	4.54 (1.62–12.81)	<0.01
Husband/partner's lifetime sexual partner(s)		
One	Ref	
Two or more	1.49 (0.51–4.28)	0.45

BDT, Bangladeshi Taka; BMI, body mass index; CI, confidence interval; COR, crude odds ratios; OCP, oral contraceptive pill; STI, sexually transmitted infection.

ances, such as polycystic ovary syndrome, which may exacerbate HPV persistence.[30,31] Hormonal dysregulation may also impair the cervical epithelial barrier, increasing susceptibility to oncogenic HPV strains.[32,33]

Women not living with their husbands had higher odds of pre-cancerous lesions, possibly due to differences in sexual behaviors, exposure to multiple partners, or reduced healthcare access. This finding aligns with studies in Ethiopia and Nigeria, which identified marital instability as a risk factor.[34,35] Additionally, women with multiple sexual partners at any point in their lifetime were at greater risk, consistent with global evidence linking increased HPV exposure to cervical lesions.[27,36,37] However, no significant association was observed with the husband/partner's number of sexual partners, suggesting that direct sexual behavior of women plays a more prominent role in this context.

The association between contraceptive use and PCL was complex. Injectable contraceptives were associated with lower odds of pre-cancerous lesions, consistent with a study in Ethiopia where long-acting reversible contraceptives were found to provide partial protection due to reduced cervical epithelial disruptions. In contrast, no significant association was observed with oral contraceptive use, differing from other studies that reported increased risk due to prolonged estrogen exposure.[22,38,39] The lack of association in this study might reflect shorter durations of use or differing formulations of contraceptives in Bangladesh.

Longer delivery intervals appeared protective, though not statistically significant. Similar trends have been observed in studies from Jamaica, where shorter intervals were linked to impaired cervical healing.[40] Multiparity showed no significant association in this study, diverging from evidence in other studies where high parity is a known risk factor for cervical cancer due to hormonal and mechanical stress on the cervix.[41,42]

Women aged 31–39 years had a higher number of cases compared to controls, who were predominantly aged 40–49 years. This finding contrasts with some global studies where older women are at increased risk due to cumulative exposure to HPV and lower immune responses with aging. A study from Ethiopia found that women over 40 years had a higher number of cervical abnormalities, suggesting regional differences in age-related risk factors, such as healthcare access and screening uptake.[16,26] In Bangladesh, younger women may face greater risks due to earlier sexual activity, which increases HPV exposure, compounded by insufficient early screening.[25,43,44]

Other factors, such as parity and overall contraceptive use, were not significantly associated, consistent with some earlier Bangladeshi studies, although residual confounding cannot be excluded.[37,45]

Bangladesh has scaled up HPV vaccination, with nationwide campaigns in 2024 achieving coverage of approximately 93% among girls aged 10–14, including out-of-school and marginalized populations.[46,47] Despite high vaccine coverage, VIA-based screening remains underutilized, with only 7–8% of eligible women reporting prior screening.[48] Screening challenges include workforce shortages, inadequate infrastructure, low uptake and follow-up, and incomplete surveillance.[49] Integration of high vaccination coverage with strengthened screening programs is essential to re-

Table 6. Multivariate analysis of selected variables among study participants, Bangladesh, 2023

Variables	COR (95% CI)	AOR (95% CI)	*p*-value
Nutritional status			
Normal	Ref	Ref	
Overweight and obese	1.70 (0.73–3.95)	3.58 (1.14–11.22)	0.02
Underweight	1.40 (0.11–17.11)	3.01 (0.19–47.26)	0.50
Type of menstruation			
Regular	Ref	Ref	
Irregular and no menstruation	1.90 (0.86–4.19)	1.81 (0.62–5.25)	0.2
Husband's living status			
Living together	Ref	Ref	
Not living with husband	2.82 (1.16–6.87)	4.48 (1.06–18.90)	0.03
Ever used injectable contraceptive			
No	Ref	Ref	
Yes	0.47 (0.20–1.09)	0.29 (0.08–1.07)	0.06
Ever suffered from STI			
No	Ref	Ref	
Yes	16.93 (1.99–143.46)	36.73 (3.25–414.83)	0.02
History of pelvic infection			
No	Ref	Ref	
Yes	4.75 (1.59–14.12)	6.48 (1.24–33.85)	0.02
History of genital ulcer			
No	Ref	Ref	
Yes	4.56 (1.07–19.38)	1.91 (0.22–15.96)	0.50
Number of lifetime sexual partner(s)			
One	Ref	Ref	
Two or more	4.54 (1.62–12.81)	3.52 (0.89–13.99)	0.07

CI, confidence interval; COR, crude odds ratios; STI, sexually transmitted infection.

duce the burden of cervical cancer.

Lifestyle interventions complement vaccination and screening. Safer sexual practices, timely STI management, delayed early marriage, family planning, and obesity control are critical preventive measures. Condoms reduce HPV transmission, and targeted outreach to overweight/obese women can improve screening participation.[50,51] Smoking cessation and female hygiene education further support cervical health.[48,52] Public awareness campaigns and community engagement are crucial for improving uptake of preventive interventions and screening services.

These findings carry important implications for cervical cancer prevention in Bangladesh. Addressing preventable determinants such as STIs, pelvic infections, and obesity through health education, sexual health services, and lifestyle modification programs could substantially reduce the burden of PCL. Women not living with their husbands should be specifically targeted in awareness campaigns and screening outreach, as they represent a socially vulnerable subgroup. Ultimately, integrating these interventions with HPV vaccination and VIA-based screening can accelerate progress toward cervical cancer elimination goals.

This study is one of the few hospital-based case–control studies in Bangladesh to systematically examine factors associated with PCL; however, several limitations should be considered. First, as with any observational design, causality cannot be established. Second, although age matching was applied, the limited number of matching variables may have resulted in residual confounding, and unmeasured behavioral factors were not captured. Third, reliance on self-reported histories of sexually transmitted and pelvic infections introduces the potential for recall bias and measurement error. Fourth, the study population was drawn from tertiary hospital screening centers, which may limit generalizability to women in community or rural settings. Fifth, the relatively small sample size may have contributed to wide CIs in the regression analysis. Future studies should include community-based cohorts, incorporate laboratory-confirmed STI and HPV testing, address biological pathways linking obesity and marital circumstances with cervical precancer, and apply more robust adjustments for confounding.

Conclusions

A history of STIs, pelvic infections, not living with a husband, and

being overweight or obese were identified as significant determinants of PCL among Bangladeshi women. These findings are consistent with global evidence and emphasize the need for integrated public health strategies. Strengthening HPV vaccination coverage, promoting safer sexual practices, improving screening and management of reproductive tract infections, and encouraging healthy lifestyle modifications are essential to reduce the risk and burden of cervical pre-cancerous conditions in Bangladesh.

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Conflict of interest

The author declared no conflict of interest.

Author contributions

Study concept and design (MFI, A, QAZ), acquisition of data (MFI, QAZ), analysis and interpretation of data (MFI, QAZ), drafting of the manuscript (MFI), critical revision of the manuscript for important intellectual content (A, QAZ, TS), administrative, technical, or material support (MOQ, QAZ, TS), and study supervision (QAZ). All authors have made significant contributions to this study and have approved the final manuscript.

Ethical statement

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki (as revised in 2024). Ethical approval was obtained from the Institutional Review Board of IEDCR, Dhaka (Memo No. IEDCR/IRB/2023/14). Written informed consent was obtained from all participants.

Data sharing statement

The datasets analyzed in the current study are not publicly available due to data privacy restrictions but are available upon reasonable request from the Institute of Epidemiology, Disease Control and Research, Dhaka, Bangladesh (email: iedcrit@gmail.com).

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