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ABSTRACT

Objectives This study aimed to determine the prevalence of cervical high-risk human papillomavirus (hrHPV) in a community-based setting and its risk factors association in women living in hard-to-reach areas in Bangladesh.

Design A cross-sectional study

Setting The study was carried out in six subdistricts, located in hard-to-reach and climate-impacted regions of Bangladesh.

Participants A total of 8000 married women aged 30–60 years were invited for screening. Women who were unable to give consent, were pregnant or had a hysterectomy with removal of the cervix, previous screening less than 5 years, or treatment of the cervix or had symptoms of potential cervical cancer were excluded.

Interventions A community-based hrHPV self-collected screening for cervical cancer was conducted from June 2022 to July 2023.

Main outcome measures Prevalence of cervical hrHPV and risk factor association.

Results 11 127 women were eligible for screening; 7850 women submitted hrHPV self-swabs, 7828 valid HPV test results were reported and 164 women (2.1%) tested hrHPV positive. Women living in the North were 2.1 times more likely to be hrHPV positive compared with women living in the South (adjusted OR (AOR)=2.1, 95% CI: 1.5 to 3.8, p=0.023) and widowed women were 3.0 times more likely to be hrHPV positive than married women (AOR=3.0, 95% CI: 1.7 to 5.3, p=0.001). Another risk factor associated with testing hrHPV positive was the use of hormonal contraceptives for 5 years and above (AOR=7.0, 95% CI: 2.0 to 24.4, p=0.002).

Conclusion The study identified a low overall prevalence of hrHPV infection (2.1%) among women in hard-to-reach areas in Bangladesh, with some regional variations. Higher prevalence was observed in widowed compared with married women and among women reporting more than 5 years of hormonal contraceptive use. This study shows no evidence of particularly high-risk groups in hard-to-reach areas in Bangladesh. The findings support the feasibility of implementing a nationwide hr-HPV-based self-sampling strategy as a viable approach to reach WHO targets for reducing the burden of cervical cancer. Recommendation for policymakers to support future research to identify hrHPV prevalence among women in comparable groups in other geographically remote areas in Bangladesh.

Trial registration number NCT05234112.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Study areas were hard-to-reach and geographically remote.
⇒ A large sample size, nearly 8000 women, participated in the high-risk human papillomavirus (hrHPV) self-sampling.
⇒ Invited all eligible women in the study areas to participate in screening.
⇒ Data were collected using an electronic medical record platform to reduce manual entry errors.
⇒ Detailed questions about sexual history were not included as they were considered sensitive topics within the participating communities and could not assess the impact of sexual behaviour on hrHPV status.

INTRODUCTION

Human papillomavirus (HPV) is a sexually transmitted virus and is classified into high-risk and low-risk genotypes.[1 2] The global incidence of cervical cancer is largely attributed to infection with high-risk human papillomavirus (hrHPV), with high-risk genotypes HPV 16 and 18 found in 70% of cervical cancer cases.[3] Cervical cancer mortality is preventable by vaccination against hrHPV, screening and early management of precancer and cancer.[4] The WHO declared cervical cancer

a public health problem and developed a global strategy for elimination of cervical cancer by 2120.[5]

The prevalence of hrHPV infection varies between countries and within countries due to differences in type distribution, geographic variations related to exposure of risk factors, socioeconomic disparities, reproductive and sexual behaviour and individual practices.[2 6–11] These factors can influence the persistence of hrHPV infection and increase the risk of developing precancerous lesions and consequently cervical cancer.[2 9 10] Globally, socioeconomic development is inversely correlated with cervical cancer incidence and mortality.[12] Cervical cancer is recorded as the most frequent cancer in 25 counties worldwide and is the leading cause of cancer deaths in 37 countries including many countries in sub-Saharan Africa, South America and South Eastern Asia. In these countries, regional differences in hrHPV prevalence largely reflect different exposures to risk factors and the availability of organised preventive programmes of vaccination against hrHPV, screening and treatment.[7]

Cervical cancer is the second leading female cancer in Bangladesh, a densely populated country, where 64 million women are at risk. The estimated age-standardised incidence and mortality rates in Bangladesh in 2021 were 10.6 and 6.6 per 100 000 women, respectively.[13] The prevalence of hrHPV infection was earlier reported at 3.6% in a cross-sectional survey in Bangladesh with regional variations.[14] Relatively few studies have been carried out in Bangladesh examining the association between the prevalence of hrHPV and its risk factors, and such existing hrHPV prevalence studies have focused mainly on facility-based screening and also included women with cervical precancer or cancer.[15–18]

In this study, we aimed to determine the prevalence of hrHPV in a community-based setting and focused on the relationship between hrHPV infection and sociodemographic characteristics, reproductive risk factors and individual practices of women living in hard-to-reach areas in Bangladesh when introducing hrHPV self-collected sampling. The WHO recommends HPV-based screening as it offers higher sensitivity and negative predictive value, compared with Visual Inspection of cervix with Acetic Acid (VIA)-based screening, which is dependent on the skills of health professionals.[5 19–21] The study is part of the Prevention and Screening Innovation Projects Towards Elimination of Cervical Cancer (PRESCRIP-TEC) research project implemented in four countries (Bangladesh, India, Uganda and Slovakia) and involved disseminating awareness of cervical cancer prevention, community-based hrHPV self-collected sampling, validating of an artificial intelligence decisional support system during VIA screening and ablative treatment or referral.[22]

METHODS

Study design and setting

This cross-sectional study was conducted from June 2022 to July 2023 in five subdistricts of Gaibandha and Kurigram districts in the North and one subdistrict of Satkhira district in the South of Bangladesh. The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB) and Friendship, a national non-governmental organisation (NGO), were engaged in this research.

This study is part of an operational research setting with 8000 women invited. This was a large sample size, which provided sufficient power for the analyses with 95% CIs.

In 2012, Friendship started a cervical cancer screening programme by implementing VIA and cryotherapy in floating hospitals and gradually expanded the screening services. Convenience sampling was conducted to select the subdistricts within the Friendship catchment areas. The study areas were selected in six subdistricts (Gaibandha Sader, Sundarganj, Kurigram Sader, Chilmari, Char Rajibpur and Shyamnagar) based on their distance to the laboratory, population size, the availability of Friendship community health workers (CHWs) trained in mHealth (mobile health application) and existing cervical cancer screening services. mHealth is a software tool developed by Friendship that allows healthcare providers to access and manage healthcare information on mobile devices, promoting health and well-being and recording all relevant medical data.

All study areas are located in hard-to-reach and climate-impacted regions in remote riverine nomadic islands known as *chars* and coastal areas of Bangladesh. According to the classification of the National Strategy for hard-to-reach areas of Bangladesh, northern chars and coastal southern areas are classified as moderate to very hard-to-reach areas considering their geographical locations, adverse hydro-geological conditions, poor communication, socioeconomic conditions and frequent exacerbation of natural disasters.[23]

Study population

The PRESCRIP-TEC project aimed to invite all eligible women in the study areas to participate in screening using hrHPV self-swabs.[22] The local health team provided an updated list of eligible women in their catchment areas, which was used as the sampling frame. CHWs followed up women who did not participate and invited them the following day. If they were not present, then CHW went to the next woman in the list.

Inclusion criteria

As per national guidelines for cervical cancer screening in Bangladesh, women were eligible for screening between the ages of 30 and 60 years.[19] All women who could understand the study information in their local language (Bengali) were able to provide written consent and were willing to provide HPV self-samples were included in this study.

Exclusion criteria

Women who were unable to give consent, were pregnant or had hysterectomy with removal of the cervix, previous

ablative or excisional treatment of the cervix, participated in screening less than 5 years previously or had symptoms of potential cervical cancer were excluded.

Patient and public involvement

Before the commencement of hrHPV self-swab collection, community-based cervical cancer awareness campaigns were implemented. We selected 103 CHWs to distribute hrHPV self-swabs. The selected CHWs were female and trained healthcare workers living in the research areas, who speak the local language and are trusted by the community, enabling them to conduct interviews while adhering to social norms and cultures. They received training on the research protocol, risk factors and symptoms of cervical cancer, and the HPV self-swab collection technique. After obtaining written consent, women were invited to the house of the CHW where the CHW demonstrated the procedure of swab collection to each participant. Following the demonstration, hrHPV swabs were distributed and self-swabs were collected individually in the house of CHWs.

Study procedure

For self-collected sampling, dry FloqSwabs (Copan) were used and submerged in mSwab medium on arrival in the laboratory. This project used two GeneXpert PCR platforms for hrHPV diagnosis and detected HPV genotype 16, 18/45 and 'other types' (31, 33, 35, 39, 51, 52, 56, 58, 59, 66 and 68). Laboratory technologists of Friendship received training by Cepheid, GOB (Government of Bangladesh) and ICDDRB technologist on performing HPV testing. The same Standard Operating Procedure and quality assurance were followed across two laboratories. The research study duration overlapped in part with COVID-19 pandemic restrictions.

Instrument and data collection

The study used the mHealth-based electronic medical record (EMR) for digital data collection. We applied the AWACAN tool in the baseline study to assess the awareness status, including knowledge of risk factors and symptoms among women and decision-makers, and the uptake of existing VIA screening participation.[24 25] This result helped us to prepare the questionnaire for the EMR tool, and we adapted the AWACAN questions for sociodemographic variables and risk factors. Information on the number of sexual partners, partner sexual behaviour and sexually transmitted infection (STI) history was not included due to cultural sensitivities in the communities. We also expanded the questionnaire to include sections related to HPV screening participation, HPV test results, VIA triage participation, treatment and follow-up visits. The questionnaire was developed in both English and translated into Bengali.

Before its implementation in this study, the EMR platform and questionnaire were tested on feasibility, face validity and content validity. The sociodemographic and reproductive risk factors mentioned in tables 1 and 2 obtained from the questionnaire (EMR, Bangladesh) (online supplemental table 1)

Timeline and supervision of data collection

The timeline for hrHPV self-sampling, data collection and testing at the laboratories of nearly 8000 women lasted for almost a year (from June 2022 to July 2023).

Data were collected using an EMR platform to reduce manual entry errors. Accuracy and completeness were regularly checked, and data cleaning was performed using Microsoft Excel 2016. Supervisors of the CHWs at the field level oversaw the entire process, including addressing missing and incorrect data. In addition, a system of weekly quality checks was implemented in collaboration with field CHWs, their supervisors, Friendship and ICDDRB staff. These weekly reviews helped to identify and resolve inconsistencies. There was also a central reporting and dashboard platform for anonymised data monitoring and management by the project data management officer. Any missing, incorrect and inconsistent data were rechecked. The final anonymised data file was shared in the public data repository. Through this multilevel process, it was ensured that the data set was both accurate and standardised, thereby strengthening confidence in the validity of research findings.

Mechanisms to ensure high participation rates

Several strategies were implemented to ensure high participation rates. Awareness and educational sessions were conducted by CHWs and paramedics who visited all intervention communities and households and conducted courtyard sessions multiple times over 1 year to engage women directly. Local awareness campaigns were also organised by involving their husbands and mothers-in-law, to explain about cervical cancer, the importance of screening and the provision of treatment if HPV was detected. Trust-building through direct involvement of CHWs and bringing the service to their own communities was a key factor in increasing participation of hrHPV self-sampling.

Outcome measurement

Prevalence and risk factors were assessed by measuring the number of women screened, the number of hrHPV positive and negative results identified in the laboratory, and the number of women who completed structured interviews of sociodemographic characteristics and risk factors.

Statistical analysis

Descriptive analysis was conducted to determine the prevalence of hrHPV infection. Bivariate analysis was conducted to identify risk factors associated with hrHPV infection. A multivariable logistic regression model was used to estimate the ORs and adjust for potential confounding variables. A p-value of 0.05 or below was considered statistically significant, and ORs with 95% CIs were reported. All statistical analyses were performed using IBM SPSS Statistics (V.24.0).[26]

Table 1 Sociodemographic characteristics of women participating in a community-based hrHPV self-swab screening programme

	hrHPV positive (n=164)	hrHPV negative (n=7664)	Total (n=7828)
Variables	n (%)	n (%)	n (%)
Location			
South of Bangladesh	47 (28.7)	3251 (42.4)	3298 (42.1)
North of Bangladesh	117 (71.3)	4413 (57.6)	4530 (57.9)
Age (years)			
Mean (±SD)	41.1 (±8.6)	40.6 (±8)	40.6 (±8)
30–34	39 (23.8)	1990 (26.0)	2029 (25.9)
35–39	44 (26.8)	1976 (25.8)	2020 (25.8)
40–44	28 (17.1)	1437 (18.8)	1465 (18.7)
45–49	18 (11.0)	942 (12.3)	960 (12.3)
50–54	17 (10.4)	678 (8.8)	695 (8.9)
≥55	18 (11)	641 (8.4)	659 (8.4)
Age at marriage (years)			
Mean (±SD)	15.1 (±2.6)	14.9 (±2.4)	14.9 (±2.1)
<18	131 (79.9)	6472 (84.4)	6603 (84.4)
≥18	33 (20.1)	1192 (15.6)	1225 (17.8)
Monthly family expenditure*			
<5000 BDT	76 (46.3)	3211 (41.9)	3287 (42)
5000–7500 BDT	59 (36)	3208 (41.9)	3267 (41.7)
>7500 BDT	29 (17.7)	1245 (16.2)	1274 (16.3)
Religion			
Islam	144 (87.8)	6913 (90.2)	7057 (90.2)
Hinduism	20 (12.2)	751 (9.8)	771 (9.8)
Marital status			
Married	146 (89.0)	7343 (95.8)	7489 (95.7)
Divorced	3 (1.8)	77 (1.0)	80 (1.0)
Widowed	15 (9.1)	244 (3.2)	259 (3.3)
Educational attainment			
Illiterate	67 (40.9)	2685 (35.0)	2752 (35.2)
Below primary school†	23 (14.0)	1525 (19.9)	1548 (19.8)
Primary	40 (24.4)	1556 (20.3)	1596 (20.4)
Secondary	28 (17.1)	1713 (22.4)	1741 (22.2)
Higher education	6 (3.7)	185 (2.4)	191 (2.4)
Occupation of the respondent			
Housewife	156 (95.1)	7503 (97.9)	7659 (97.8)
Other	8 (4.9)	161 (2.1)	169 (2.2)
Occupation of the husband			
Day labourer	80 (48.8)	3411 (44.5)	3491 (44.6)
Farmer	44 (26.8)	2563 (33.4)	2607 (33.3)
Small businessman	14 (8.5)	722 (9.4)	736 (9.4)
Rickshaw/van puller	5 (3.0)	258 (3.4)	263 (3.4)
Others	21 (12.8)	710 (9.3)	731 (9.3)

*US$1 (US Dollar) = 109.5 BDT (Bangladesh Taka) at 1 July 2023.
†Able to read and write.
hrHPV, high-risk human papillomavirus.

Table 2 Multivariate logistic regression of risk factors and hrHPV positivity among 7828 women in six hard-to-reach subdistricts of Bangladesh

Variables	hrHPV positive (n=164)	hrHPV negative (n=7664)			
	n (%)	n (%)	COR (95% CI)*	AOR (95% CI)*	P value*
Age at marriage (years)					
Mean (±SD)	15.08 (±2.6)	14.9 (±2.4)			
<18	131 (79.9)	6472 (84.4)	1	1	
≥18	33 (20.1)	1192 (15.6)	1.3 (1.1 to 2.0)	2.2 (0.7 to 6.9)	0.207
Total number of marriages (female)					
1	152 (92.7)	7328 (95.6)	1	1	
>1	12 (7.3)	336 (4.4)	1.7 (1.1 to 3.1)	1.0 (0.1 to 7.5)	0.933
Parity					
<3	61 (37.2)	2935 (38.3)	1	1	
≥3	103 (62.8)	4729 (61.7)	1.1 (0.8 to 1.4)	2.5 (0.7 to 9.2)	0.152
History of previous miscarriage					
No	139 (84.8)	6133 (80.0)	1	1	
Yes	25 (15.2)	1531 (20.0)	0.7 (0.5 to 1.1)	A†	
Total number of miscarriages					0.302
1	19 (76.0)	1013 (66.2)	1	1	
>1	6 (24.0)	518 (33.8)	0.6 (0.2 to 1.5)	0.6 (0.2 to 1.6)	0.269
Have you ever used contraceptive					
No	43 (26.2)	2037 (26.6)	1	1	
Yes	121 (73.8)	5627 (73.4)	1.1 (0.7 to 1.4)	A	
Family planning methods					0.344
Injection	42 (34.7)	1875 (33.3)	1	1	
Oral pill	63 (52.1)	3167 (56.3)	0.8 (0.6 to 1.3)	0.6 (0.2 to 1.6)	0.299
Condom	7 (5.8)	171 (3)	1.8 (0.8 to 4.1)	3.2 (0.7 to 14.4)	0.137
Other	9 (7.4)	414 (7.4)	0.9 (0.5 to 2.1)	0.9 (0.2 to 4.6)	0.914
Duration for using contraceptives (yes response)					
<5 year	26 (15.9)	2904 (51.6)	1	1	
≥5 years	**95 (57.9)**	**2723 (48.4)**	**3.8 (2.5 to 6.3)**	**7.0 (2.0 to 24.4)**	**0.002**
History of chewing tobacco					
No	120 (73.2)	5065 (66.1)	1	1	
Yes	44 (26.8)	2599 (33.0)	0.7 (0.5 to 1.0)	0.6 (0.2 to 1.6)	
History of smoking cigarettes					
No	161 (98.2)	7504 (97.9)	1	1	
Yes	3 (1.8)	160 (2.1)	0.8 (0.3 to 2.8)	2.1 (0.3 to 18.6)	0.475

*Significance level: p-value<0.05.
†A, not enough sample size to calculate association.
AOR, adjusted OR; COR, crude OR; hrHPV, high-risk human papillomavirus.

In our analysis, variables that showed a statistically significant association in univariate testing (p-value<0.25) were retained as candidates for the multivariate regression model. This strategy allowed us to include potentially important predictors that may not have reached conventional significance in univariate analysis, while reducing the risk of overfitting by excluding variables with minimal evidence of association. Indeed, some variables had insufficient sample sizes to provide reliable estimates in multivariate analysis. These variables are reported in the results table for transparency, but were not included in the multivariate model to avoid unstable estimates and overfitting. Predictor variables for the regression models were selected based on prior evidence of association with

the outcome and their clinical/public health relevance. To reduce the risk of overfitting, we avoided including highly correlated predictors in the same model (tables 2 and 3). Variables with limited theoretical justification were excluded, even if statistically significant in univariate analysis. This approach aimed to balance model interpretability with statistical stability.

RESULTS

During the study period, 11 127 women were eligible for screening, of which 8223 women (73.9%) provided informed consent; 7850 women (95.5% of consented women) provided hrHPV self-swabs. Among all the provided self-swabs, 7828 valid HPV test results were reported, of which 164 (2.1%) were hrHPV positive. It was not possible to test 22 samples because of a shortage of test kits. A total of 2904 (26.1%) women did not provide consent to participate in the study (online supplemental table 2) and their characteristics were almost similar to those of the women who participated in the study; the main reason was that they were not interested (n=1236, 11.0%), followed by lack of permission from their husband (n=611, 5.50%) (online supplemental table 3). More details on factors associated with uptake will be provided in a separate publication.

Ttable 1 shows the sociodemographic characteristics of the hrHPV positive and hrHPV negative women. The mean age of hrHPV positive and hrHPV negative women was not significantly different at 41.1 and 40.6 years, respectively. The mean age of marriage for hrHPV positive and hrHPV negative women was also similar at 15.1 and 14.9 years, respectively. Most women in both groups were married and reported Islam as their religion. More than half of the women were illiterate or did not complete primary school. The majority of women had a monthly family expenditure below the monthly average of rural household consumption expenditure in Bangladesh, which is 26 207 BDT (US$239.3).[27] Most women were housewives, and their husbands predominately worked as day labourers or farmers.

The prevalence of hrHPV varied by location, ranging from 1.4% (95% CI: 1.0 to 1.8) in the southern region to 2.6% (95% CI: 2.1 to 3.0) in the northern region, as presented in table 4.

The association between risk factors and sociodemographic characteristics among hrHPV positive women is presented in tables 2 and 3. Women living in the North were 2.1 times more likely to be hrHPV positive compared with women living in the South (adjusted OR (AOR)=2.1, 95% CI: 1.5 to 3.8, p=0.023). Widowed women were 3.0 times more likely to be hrHPV positive than married women (AOR=3.0, 95% CI: 1.7 to 5.3, p=0.001). Another risk factor was the use of hormonal contraceptives for more than 5 years (AOR=7.0, 95% CI: 2.0 to 24.4, p .002). Finally, women whose husbands were farmers were less likely to be hrHPV positive (AOR=0.6, 95% CI: 0.4 to 0.9, p=0.015) compared with women having husbands with another occupation.

Cervical cancer screening participation is illustrated in table 5. The majority of women (7534, 96.2%) had heard of cervical cancer from awareness and health education sessions organised by CHWs of Friendship. Additionally, 6.3% of all hrHPV positive women (10 women) and 3.3% of all hrHPV negative women (246 women) had participated previously in VIA screening.

DISCUSSION

This study assessed the prevalence of hrHPV infection and its associated risk factors in women in hard-to-reach areas in three districts of Bangladesh.

In this study, hrHPV prevalence was low, ranging from 1.4% in the southern region to 2.6% in the northern region with the highest prevalence reported in Char Rajibpur at 4%. In addition, hrHPV infection was detected more frequently among widowed women and among women who were using hormonal contraceptives for more than 5 years. We found no association between hrHPV positivity and educational level or household income.

The overall hrHPV prevalence in our study was low (2.1%). These findings are in line with a previous population-based study on HPV conducted in Bangladesh.[28] Here, hrHPV was found in 4.7% of urban women (age 35–44 years) and 2.6% women living in rural areas. Another study in Bangladesh revealed a prevalence of 2.6% of ever married women residing in coastal regions of Bangladesh.[29] In our study, hrHPV self-swab screening was performed at the community level on apparently healthy and asymptomatic women, in contrast with a study where a higher hrHPV prevalence (52%) was reported in women with histologically confirmed cervical intraepithelial neoplasia (CIN) in a hospital-based survey.[30] Other studies reported more prevalent hrHPV infection in women with high-risk behaviour (sex workers).[31 32] In our study, no such risk behaviour was disclosed and the majority of women were housewives. Women in the North had double the risk of hrHPV infection compared with women in the South (AOR: 2.1, 95% CI: 1.5 to 3.8, p=0.001). There were multiple variables which differed between women living in the North and South, but the study was insufficiently powered to explain an association between hrHPV infection and risk factors (online supplemental table 4) due to the relatively small number of hrHPV positive women. The highest prevalence at 4% was recorded in Char Rajibpur compared with the other five subdistricts, where almost 70% of women were found to be illiterate and economically vulnerable (online supplemental table 5).

The present study reported that women whose husbands were farmers were less likely to be hrHPV positive compared with women whose husbands had other occupations. Similar findings were reported in a study from rural Nepal, showing the low prevalence of hrHPV among farmers who stayed in their villages.[33] In a previous

Table 3 Associations between sociodemographic variables and hrHPV positivity among 7828 women in six hard-to-reach subdistricts of Bangladesh

Variables	hrHPV positive (n=164)	hrHPV negative (n=7664)			
	n (%)	n (%)	COR* (95% CI)	AOR* (95% CI)	P value*
Location					
South	47 (28.7)	3251 (42.4)	1	1	
North	**117 (71.3)**	**4413 (57.6)**	**1.8 (1.3 to 2.5)**	**2.1 (1.5 to 3.8)**	**0.023**
Age (years)					
Mean (±SD)	41.1 (±8.6)	40.6 (±8)			
30–34	39 (23.8)	1990 (26)	1	1	
35–39	44 (26.8)	1976 (25.8)	1.1 (0.7 to 1.8)	1.1 (0.7 to 1.8)	0.496
40–44	28 (17.1)	1437 (18.8)	0.9 (0.6 to 1.6)	0.9 (0.6 to 1.6)	0.984
45–49	18 (11.0)	942 (12.3)	0.9 (0.6 to 1.7)	0.9 (0.6 to 1.7)	0.831
50–54	17 (10.4)	678 (8.8)	1.2 (0.6 to 2.4)	1.1 (0.5 to 2.4)	0.641
≥55	18 (11)	641 (8.4)	1.4 (0.8 to 2.5)	1.5 (0.9 to 2.7)	0.595
Monthly family expenditure†					
<5000 BDT	76 (46.3)	3211 (41.9)	1	1	
5000–7500 BDT	59 (36.0)	3208 (41.9)	0.7 (0.5 to 1.1)	0.9 (0.7 to 1.4)	0.805
>7500 BDT	29 (17.7)	1245 (16.2)	0.9 (0.6 to 1.5)	1.1 (0.7 to 1.6)	0.712
Religion					
Islam	144 (87.8)	6913 (90.2)	1	1	
Hinduism	**20 (12.2)**	**751 (9.8)**	**1.3 (0.8 to 2.1)**	**1.6 (1.0 to 2.8)**	**0.049**
Marital status					
Married	146 (89.0)	7343 (95.8)	1	1	
Divorced	3 (1.8)	77 (1)	1.9 (0.6 to 6.3)	1.8 (0.5 to 5.9)	0.316
Widowed	**15 (9.1)**	**244 (3.2)**	**3.1 (1.7 to 5.3)**	**3.0 (1.7 to 5.3)**	**0.001**
Educational attainment					
Illiterate	67 (40.9)	2685 (35)	1	1	
Below primary school‡	23 (14)	1525 (19.9)	0.6 (0.4 to 0.9)	0.7 (0.5 to 1.2)	0.183
Primary	40 (24.4)	1556 (20.3)	1.0 (0.7 to 1.5)	1.2 (0.8 to 1.8)	0.307
Secondary	28 (17.1)	1713 (22.4)	0.6 (0.4 to 1.2)	0.9 (0.6 to 1.4)	0.633
Higher education	6 (3.7)	185 (2.4)	1.3 (0.6 to 3.0)	1.8 (0.7 to 4.5)	0.199
Occupation of the respondent					
Housewife	156 (95.1)	7503 (97.9)	1	1	
Other	8 (4.9)	161 (2.1)	2.3 (1.2 to 4.9)	1.9 (0.9 to 4.1)	0.107
Occupation of the husband					
Day labourer	80 (48.8)	3411 (44.5)	1	1	
Farmer	**44 (26.8)**	**2563 (33.4)**	**0.7 (0.5 to 1.1)**	**0.6 (0.4 to 0.9)**	**0.015**
Small businessman	14 (8.5)	722 (9.4)	0.8 (0.5 to 1.4)	0.8 (0.5 to 1.5)	0.571
Rickshaw/van puller	5 (3.0)	258 (3.4)	0.8 (0.3 to 2.1)	0.9 (0.4 to 2.4)	0.921
Others	21 (12.8)	710 (9.3)	1.2 (0.8 to 2.1)	1.0 (0.6 to 1.7)	0.973

*Significance level: p-value<0.05.
†US$1 (US Dollar) = 109.5 BDT (Bangladesh Taka) at 1 July 2023.
‡Able to read and write.
AOR, adjusted OR; COR, crude OR; hrHPV, high-risk human papillomavirus.

Table 4 Prevalence of hrHPV positivity presented per location

Districts	Sub-districts	hrHPV positive women	hrHPV negative women	Total women	Prevalence
		n	n	n	% (95% CI)
North					
Gaibandha	Gaibandha Sadar	21	1206	1227	1.7 (0.9 to 2.4)
	Sundarganj	15	413	428	3.5 (1.7 to 5.2)
Kurigram	Kurigram Sadar	48	1454	1502	3.1 (2.2 to 4.0)
	Chilmari	20	1034	1054	1.8 (1.1 to 2.7)
	Char Rajibpur	13	306	319	4.0 (1.9 to 6.4)
Total		117	4413	4530	2.6 (2.1 to 3.0)
South					
Satkhira	Shyamnagar	47	3251	3298	1.4 (1.0 to 1.8)
Grand total		164	7664	7828	2.1 (1.8 to 2.4)

n, number of women.
AOR, adjusted OR; COR, crude OR; hrHPV, high-risk human papillomavirus.

study in Bangladesh, women living in rural areas whose husbands lived overseas showed higher risks of hrHPV infection.[28] We assume that in couples who live separately, the chance of having more than one sexual partner is increased, leading to higher risks of HPV infection. Multiple studies have found the same for STIs, including HIV/AIDS.[34 35]

The majority of women in our study were Muslim, which might have contributed to the low prevalence of hrHPV. Religious practice of circumcision in Muslim communities protects against STI transmission.[36–38] A study in India reported a low hrHPV prevalence of 2% in Muslim communities compared with 16% and 14.7% in Christian and Hindu communities, respectively; a suggested reason was widespread circumcision among male partners of the Muslim women.[39] In addition, HIV prevalence in Bangladesh is very low[40] compared with other LMICs, for example in sub-Saharan Africa, where a double burden is observed for both hrHPV and HIV infection.[41]

The legal age of marriage for Bangladeshi women is 18 years. According to the Bangladesh Demographic and Health Survey (BDHS) 2022 report, 52.6% of rural women marry before this age.[42] Age at marriage is considered as a proxy measure at age of first sexual debut.[43] Sexual debut at a younger age (12–20 years) is significantly associated with hrHPV infection, as reported in Bangladesh[15] and in India.[44] This is also supported by the PATRICIA trial (Papilloma Trial Against Cancer in Young Adults, phase III) conducted in multiple regions (Asia Pacific, North America, Latin America, Finland and rest of Europe), which showed significant association between HPV infection and early sexual debut in women below 15 years.[45] In our study, we found early marriage was very common; 84.4% (6603 women) married before the age of 18 years. However, early marriage was not associated with hrHPV positivity in our study; this is probably explained by the low absolute numbers of HPV positivity. Nevertheless, due to the high instances of early marriage, we recommend conducting further studies to evaluate its consequences both from public health and health economics perspectives.[46 47]

Widowed women had a 3.0 times higher likelihood of hrHPV positivity compared with women still living with their husband (AOR=3.0, 95% CI: 1.7 to 5.3, p=0.001).

Table 5 Cervical cancer screening participation previous to the implementation of PRESCRIP-TEC among 7828 hrHPV positive and negative women in Bangladesh

Variables	hrHPV positive (164 women)	hrHPV negative (7664 women)	Total (n=7828)
	n (%)	n (%)	n (%)
Ever heard of cervical cancer			
No	4 (2.4)	290 (3.8)	294 (3.8)
Yes	160 (97.6)	7374 (96.2)	7534 (96.2)
Participated in screening over 5 years prior to study	hrHPV positive (n=160)	hrHPV negative (n=7374)	n=7534
No	150 (93.7)	7138 (96.7)	7288 (96.7)
Yes	10 (6.3)	236 (3.3)	246 (3.3)

hrHPV, high-risk human papillomavirus.

While no study results are available in Bangladesh on widows with hrHPV infection, studies from other countries also suggested that widows had a higher chance of being HPV infected.[43 48] Although the absolute number of hrHPV positive widows was low (15 women), the majority were illiterate housewives with monthly family expenditure below 7500 BDT, making them socioeconomically vulnerable (online supplemental table 6). A study in Bangladesh and India also showed that aged widows were socially and economically vulnerable and deprived.[49 50] Future research is recommended in Bangladesh to address the influence of sociodemographic factors and health-seeking behaviour in widowed and postmenopausal women. Not having a husband, widows might be excluded from participating in screening.[51 52] Widows and health personnel should be educated to include widows in screening and inform them about the importance of screening.[50 53]

In our study, we found that women using hormonal contraceptives for a duration of more than 5 years were seven times more likely to be hrHPV positive (AOR 7.0, 95% CI: 2.0 to 24.4, p=0.002). The women in our study used hormonal contraceptives including combined pills of oestrogen and progesterone, injection of depot medroxy progesterone acetate and progestin implant. Although other studies also reported an increased risk of hrHPV positivity among women using hormonal contraceptives, the exact pathophysiology is not fully understood and the impact on the absolute cervical cancer risk is small.[54–58] Women should be counselled about the importance of cervical cancer screening when provided with hormonal contraceptives and encouraged to participate in VIA screening. In our study population, the reported use of condoms was low, with 5.8% and 3% among hrHPV positive and hrHPV negative women, respectively. A meta-analysis revealed low prevalence of male condom use in Bangladesh as a contraceptive method.[59] Condoms prevent transmission of sexually transmitted diseases.[59] Comprehensive public health awareness campaigns and promotion of condom use are recommended.

Although the overall hrHPV prevalence in Bangladesh is low, the number of women at risk of cervical cancer is large due to the population size, while 80% of cervical cancer cases are present in advanced stage in Bangladesh and accessibility to cancer treatment is very limited.[60] Therefore, a community-based organised national screening programme could help reduce cervical cancer-related morbidity and mortality. Implementing hrHPV-based self-swab screening can aid early detection of precancerous lesions.[46] In Bangladesh, the national screening programme based on visual inspection with acetic acid started in 2004–2005. However, the service depends on opportunistic screening.[61] Additionally, the preventive approach of screening is poorly understood by women, leading to low participation; asymptomatic women do not usually participate in screening.[16]

The aggregated cervical cancer screening data of the national screening programme of 8 years (2014–2022) revealed an inadequate coverage of 11.42% (3.36 million) of the target population of women in Bangladesh.[62] As per Friendship's existing records, 6.9% of women reported as having participated in screening at least once in the 5 years prior to this study (online supplemental table 7). Inadequate knowledge of the importance of screening and lack of awareness of cervical cancer are important contributory factors.[16 25] Community education and sensitisation approaches should emphasise that all sexually active women are at risk and are invited for screening. Adopting a hrHPV-based self-collected sampling approach for screening with VIA triage for follow-up of positive cases nationwide could enable policymakers to reach WHO targets for reducing the burden of cervical cancer in the hard-to-reach areas of Bangladesh.[22 63] Following this approach, no eligible women would remain unscreened despite the low prevalence rate. The limited accessibility to cancer treatment in Bangladesh further underlines the importance of an organised national screening programme.[60]

The present study has limitations. Recall bias is possible in relation to questions about contraceptive use and previous screening participation. The history of using contraceptives was long, more than 5 years, and women did not keep a record. The actual report of adherence to contraceptive use remained difficult. Exposure variables, such as contraceptive use and screening history, were self-reported and subject to recall and social desirability bias. We did not include detailed questions about sexual history as these are considered sensitive topics within the participating communities. Therefore, we could not assess the impact of sexual behaviour on hrHPV status, while it is a known risk factor for persistent hrHPV infection. In addition, a relatively small sample size of hrHPV positive results might have limited the detection of other important risk factors. In addition, genotype-specific prevalence and risk factor associations were not reported as well due to the insufficient sample size. Also, 26.1% of women did not participate in this hrHPV self-collected screening; therefore, we might have missed a potentially high-risk group. Our hrHPV prevalence data are not representative of the whole of Bangladesh due to the specific geographical locations where our study was conducted. This is a cross-sectional study; therefore, our results describing risk factors and HPV infection should be viewed as associations, not proof of causation in either direction.

The strength of this study is that selection bias was minimised as much as possible by a population-based study design, inviting all eligible women to participate in HPV-based screening, allowing an objective and representative insight into the true hrHPV prevalence and risk factors in the study population. In previous studies examining hrHPV prevalence in Bangladesh, hospital-based data were used as proxy for HPV prevalence. To the best of our knowledge, this is the first study in Bangladesh involving the participation of women in remote locations with the implementation of hrHPV self-collected sampling.

Additionally, digital data collection reduced data errors and allowed for real-time monitoring.

CONCLUSIONS

This study assessed the prevalence of hrHPV using a community-based self-collected sampling approach among women residing in hard-to-reach areas in northern and southern Bangladesh. The overall hrHPV prevalence was 2.1%, with higher rates observed in the northern regions, among widowed women compared with married women, and in women reporting more than 5 years of hormonal contraceptive use. These findings indicate that hrHPV self-collected sampling is a practical and effective strategy for cervical cancer screening in resource-constrained and geographically isolated settings. Given the relatively low prevalence, nationwide adoption of self-sampling could allow efficient use of limited health system resources, as only a small number of women would require follow-up diagnosis and treatment. Scaling up hrHPV-based self-sampling within existing public health and community outreach programmes would be a feasible step towards achieving the WHO screening targets and reducing the burden of cervical cancer in Bangladesh. Policymakers are recommended to conduct future research to identify hrHPV prevalence in other geographically remote areas across the country and among women in a similar category.

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REFERENCES

1 Castellsagué X. Natural history and epidemiology of HPV infection and cervical cancer. *Gynecol Oncol* 2008;110:S4–7.
2 Crosbie EJ, Einstein MH, Franceschi S, *et al*. Human papillomavirus and cervical cancer. *The Lancet* 2013;382:889–99.
3 Wei F, Georges D, Man I, *et al*. Causal attribution of human papillomavirus genotypes to invasive cervical cancer worldwide: a systematic analysis of the global literature. *The Lancet* 2024;404:435–44.
4 Canfell K, Kim JJ, Brisson M, *et al*. Mortality impact of achieving WHO cervical cancer elimination targets: a comparative modelling analysis in 78 low-income and lower-middle-income countries. *The Lancet* 2020;395:591–603.
5 Ghebreyesus TA, Jakab Z. *Global Strategy to Accelerate the Elimination of Cervical Cancer as a Public Health Problem.* Geneva:

World Health Organization, 2020. Available: https://www.who.int/publications/i/item/9789240014107
6 Smith JS, Melendy A, Rana RK, *et al*. Age-specific prevalence of infection with human papillomavirus in females: a global review. *J Adolesc Health* 2008;43:S5–25.
7 Bray F, Laversanne M, Sung H, *et al*. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2024;74:229–63.
8 Kombe Kombe AJ, Li B, Zahid A, *et al*. Epidemiology and Burden of Human Papillomavirus and Related Diseases, Molecular Pathogenesis, and Vaccine Evaluation. *Front Public Health* 2020;8:552028.
9 Vinodhini K, Shanmughapriya S, Das BC, *et al*. Prevalence and risk factors of HPV infection among women from various provinces of the world. *Arch Gynecol Obstet* 2012;285:771–7.
10 Bruni L, Albero G, Serrano B, *et al*. Human papillomavirus and related diseases report world. 2023. Available: www.hpvcentre.net
11 Singh D, Vignat J, Lorenzoni V, *et al*. Global estimates of incidence and mortality of cervical cancer in 2020: a baseline analysis of the WHO Global Cervical Cancer Elimination Initiative. *Lancet Glob Health* 2023;11:e197–206.
12 Lin S, Gao K, Gu S, *et al*. Worldwide trends in cervical cancer incidence and mortality, with predictions for the next 15 years. *Cancer* 2021;127:4030–9.
13 Bruni L, Albero G, Serrano B, *et al*. Bangladesh: human papillomavirus and related diseases, summary report 2023. 2023. Available: www.hpvcentre.net
14 Nessa A, Begum SA, Munshi SU, *et al*. High-risk Human Papillomavirus Infection among Urban and Rural Women in Bangladesh. *Cancer Screen Prev* 2024;3:36–46.
15 Sharmin S, Sabikunnahar B, Aditya A, *et al*. Genotypic distribution and prevalence of human papillomavirus infection in an apparently healthy female population in Bangladesh. *IJID Reg* 2021;1:130–4.
16 Islam RM, Bell RJ, Billah B, *et al*. Lack of Understanding of Cervical Cancer and Screening Is the Leading Barrier to Screening Uptake in Women at Midlife in Bangladesh: Population-Based Cross-Sectional Survey. *Oncologist* 2015;20:1386–92.
17 Jahan M, Islam T, Sultana S, *et al*. Distribution of high risk Human Papilloma Virus genotypes among cervical cancer patients in a tertiary level hospital in Bangladesh. *Bangladesh Med Res Counc Bull* 2019;45:86–92.
18 Rahman T, Tabassum S, Jahan M. Risk of cervical cancer associated with HPV infection among the gynae outdoor patients. *Bangladesh med j Khulna* 2013;46:3–6.
19 Holme F, Kapambwe S, Nessa A, *et al*. Scaling up proven innovative cervical cancer screening strategies: Challenges and opportunities in implementation at the population level in low- and lower-middle-income countries. *International Journal of Gynecology and Obstetrics* 2017;138:63–8.
20 Ogilvie G, Nakisige C, Huh WK, *et al*. Optimizing secondary prevention of cervical cancer: Recent advances and future challenges. *International Journal of Gynecology and Obstetrics* 2017;138:15–9.
21 Mekuria SF, Timmermans S, Borgfeldt C, *et al*. HPV self-sampling versus healthcare provider collection on the effect of cervical cancer screening uptake and costs in LMIC: a systematic review and meta-analysis. *Syst Rev* 2023.
22 Sultanov M, Zeeuw J, Koot J, *et al*. Investigating feasibility of 2021 WHO protocol for cervical cancer screening in underscreened populations: PREvention and SCReening Innovation Project Toward Elimination of Cervical Cancer (PRESCRIP-TEC). *BMC Public Health* 2022.
23 Government of the People's Republic of Bangladesh. National strategy for water and sanitation hard to reach areas of bangladesh. 2012.
24 Moodley J, Scott SE, Mwaka AD, *et al*. Development and validation of the African Women Awareness of CANcer (AWACAN) tool for breast and cervical cancer. *PLoS One* 2019;14:e0220545.
25 Nazrul N, Fouw M, Beltman JJ, *et al*. Understanding cervical cancer awareness in hard-to-reach areas of Bangladesh: A cross-sectional study involving women and household decisionmakers. *PLoS One* 2024.
26 IBM Corp. IBM spss statistics for windows, version 24.0. IBM Corp; 2016. Available: https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-24
27 Bangladesh Bureau of Statistics. Household income and expenditure survey hies 2022. Dhaka; 2023. Available: www.bbs.gov.bd
28 Nahar Q, Sultana F, Alam A, *et al*. Genital human papillomavirus infection among women in Bangladesh: findings from a population-based survey. *PLoS One* 2014;9:e107675.
29 Chakraborty S, Nessa A, Ferdous N-E, *et al*. Prevalence and genotypic distribution of high-risk human papillomavirus (HPV) among ever-married women in coastal regions of Bangladesh. *PLoS One* 2024;19:e0313396.
30 Shahida SM, Chowdhury M, Shajahan F, *et al*. Distribution of High-Risk Human Papillomavirus Genotypes among Women with Colposcopic Diagnosis of Cervical Intraepithelial Neoplasia in Bangladesh. *JCT* 2023;14:277–90.
31 Sultana T, Huq M, Alam A, *et al*. Prevalence and Genotyping of Human Papillomavirus (HPV) in Female with High-Risk Behaviour in Dhaka, Bangladesh. *Bangla J Microbiol* 1970;25:65–8.
32 Peng RR, Li HM, Chang H, *et al*. Prevalence and genotype distribution of cervical human papillomavirus infection among female sex workers in Asia: a systematic literature review and meta-analysis. *Sex Health* 2012;9:113–9.
33 Shakya S, Syversen U, Åsvold BO, *et al*. Prevalence of human papillomavirus infection among women in rural Nepal. *Acta Obstet Gynecol Scand* 2017;96:29–38.
34 DecosasJ, Kane F, Anarfi JK, *et al*. Migration and aids. In: *The Lancet*. Indiana University Press, 1995.
35 Deane KD, Parkhurst JO, Johnston D. Linking migration, mobility and HIV. *Trop Med Int Health* 2010;15:1458–63.
36 Morris BJ, Wamai RG, Henebeng EB, *et al*. Estimation of country-specific and global prevalence of male circumcision. *Popul Health Metrics* 2016;14.
37 Morris BJ, Castellsague X. The Role of Circumcision in Preventing STIs. *Sexually Transmitted Infections and Sexually Transmitted Diseases* 2011;715–39.
38 Arora P, Nagelkerke NJD, Jha P. A Systematic Review and Meta-Analysis of Risk Factors for Sexual Transmission of HIV in India. *PLoS ONE* 2012;7:e44094.
39 Parwez A, Singh S, Kumar R, *et al*. Determination and evaluation of HR-HPV genotype in different communities of Bihar, India. *Int J Health Sci (Qassim)* 2022;16:40–8.
40 Hasan MN, Tambuly S, Trisha KF, *et al*. Knowledge of HIV/AIDS among married women in Bangladesh: analysis of three consecutive multiple indicator cluster surveys (MICS). *AIDS Res Ther* 2022;19:68.
41 Okoye JO, Ofodile CA, Adeleke OK, *et al*. Prevalence of high-risk HPV genotypes in sub-Saharan Africa according to HIV status: a 20-year systematic review. *Epidemiol Health* 2021;43:e2021039.
42 National Institute of Population Research and Training (NIPORT), ICF. Bangladesh demographic and health survey 2022 key indicators report. Dhaka; 2023.
43 Thulaseedharan JV, Malila N, Hakama M, *et al*. Socio demographic and reproductive risk factors for cervical cancer - a large prospective cohort study from rural India. *Asian Pac J Cancer Prev* 2012;13:2991–5.
44 Sharma K, Kathait A, Jain A, *et al*. Higher prevalence of human papillomavirus infection in adolescent and young adult girls belonging to different Indian tribes with varied socio-sexual lifestyle. *PLoS One* 2015;10:e0125693.
45 Roset Bahmanyar E, Paavonen J, Naud P, *et al*. Prevalence and risk factors for cervical HPV infection and abnormalities in young adult women at enrolment in the multinational PATRICIA trial. *Gynecol Oncol* 2012;127:440–50.
46 World Health Organization, Training in Human Reproduction. WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention. 2021.
47 Sung H, Ferlay J, Siegel RL, *et al*. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin* 2021;71:209–49.
48 Franceschi S, Rajkumar R, Snijders PJF, *et al*. Papillomavirus infection in rural women in southern India. *Br J Cancer* 2005;92:601–6.
49 Islam M. Socio- Economical Conditions of Aged Widow in Bangladesh. *ABC res alert* 2020;8:84–98.
50 Agrawal G, Keshri K. Morbidity patterns and health care seeking behavior among older widows in India. *PLoS One* 2014.
51 Moeti C. Cultural beliefs influencing the uptake of cervical cancer screening among women in a community healthcare centre. 2019. Available: http://hdl.handle.net/2263/76012
52 Lu D, Sundström K, Sparén P, *et al*. Bereavement Is Associated with an Increased Risk of HPV Infection and Cervical Cancer: An Epidemiological Study in Sweden. *Cancer Res* 2016;76:643–51.
53 Minkin MJ. Sexually transmitted infections and the aging female: placing risks in perspective. *Maturitas* 2010;67:114–6.
54 Cotton SC, Sharp L, Seth R, *et al*. Lifestyle and socio-demographic factors associated with high-risk HPV infection in UK women. *Br J Cancer* 2007;97:133–9.

55 Maucort-Boulch D, Plummer M, Castle PE, *et al*. Predictors of human papillomavirus persistence among women with equivocal or mildly abnormal cytology. *Int J Cancer* 2010;126:684–91.
56 Iversen L, Fielding S, Lidegaard Ø, *et al*. Contemporary hormonal contraception and cervical cancer in women of reproductive age. *Int J Cancer* 2021;149:769–77.
57 Gadducci A, Cosio S, Fruzzetti F. Estro-progestin Contraceptives and Risk of Cervical Cancer: A Debated Issue. *Anticancer Res* 2020;40:5995–6002.
58 Cervical cancer and hormonal contraceptives: collaborative reanalysis of individual data for 16 573 women with cervical cancer and 35 509 women without cervical cancer from 24 epidemiological studies. *The Lancet* 2007;370:1609–21.
59 Hossain S, Akter T, Mohsin M, *et al*. Contraceptive uses among married women in Bangladesh: a systematic review and meta-analyses. *J Health Popul Nutr* 2024;43:10.
60 Haque N, Uddin A, Dey BR, *et al*. Challenges to cervical cancer treatment in Bangladesh: The development of a women's cancer ward at Dhaka Medical College Hospital. *Gynecol Oncol Rep* 2017;21:67–72.
61 Ahmed T A, Rahman J. Development of a visual inspection programme for cervical cancer prevention in Bangladesh. *Reprod Health Matters* 2008;16:78–85.
62 Nessa A, Hossain MS, Uddin SMN, *et al*. Electronic aggregated data collection on cervical cancer screening in Bangladesh since 2014: what the data tells us? *BMC Public Health* 2024;24:270.
63 Wentzensen N, Schiffman M, Palmer T, *et al*. Triage of HPV positive women in cervical cancer screening. *J Clin Virol* 2016;76 Suppl 1:S49–55.
64 Koot J, de Zeeuw J, van der Schans J. Department of bio technical research india m of s and t. prescrip-tec client-related factors (crf) for cervical cancer screening. In: Dataverse NL, ed. *Global Health Unit D of HS*. 2024.