

CERVICAL CANCER SCREENING AWARENESS, KNOWLEDGE, AND WILLINGNESS AMONG WOMEN ATTENDING HOSPITALS IN OKARA AND LAHORE, PAKISTAN: A COMPARATIVE CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Cervical cancer is preventable through human papillomavirus (HPV) vaccination, high-performance screening, and timely treatment, yet screening and HPV awareness remain limited in many low- and middle-income settings. This study compared cervical-cancer knowledge, screening awareness, previous screening, barriers, and willingness to screen among women attending two hospitals in Punjab, Pakistan.

Methods: We conducted a comparative cross-sectional study among 422 women attending two public-sector hospitals in Punjab, Pakistan: DHQ Hospital Okara (n=211) and Services Hospital Lahore (n=211). Data were collected from October 2025 to March 2026. Categorical variables were compared using Pearson chi-square tests, age using Welch's independent-samples t-test, and ordinal/count variables using the Mann-Whitney U test. Crude odds ratios (ORs) were calculated for site comparisons, and multivariable binary logistic regression was used to identify factors independently associated with adequate knowledge and willingness to undergo screening. Adequate knowledge was defined as a knowledge score of at least 5 out of 8. Statistical analyses were performed using IBM SPSS Statistics version 25.0. Ethical approval was obtained from the institutional ethics committee before data collection, and written informed consent was obtained from all participants. Age-at-marriage was excluded from inferential analyses because 80 records contained implausible values greater than current age.

Results: The mean age of participants was 33.9 ± 9.2 years; 57.8% lived in rural areas and 69.4% were housewives. Overall, 50.9% had heard of cervical cancer, 19.7% were aware of HPV, 5.2% were aware of HPV vaccination, 39.3% had heard of cervical screening, and 12.3% had previously undergone screening. Nevertheless, 71.3% were willing to undergo screening. Adequate knowledge was present in 23.0% overall and was higher at the Lahore site than the Okara site (34.1% vs 11.8%; OR 3.85, 95% CI 2.33-6.39; $p < 0.001$). Participants at the Lahore site also more frequently reported HPV awareness (26.5% vs 12.8%), receiving information from a health worker (46.9% vs 24.6%), and willingness to screen (80.1% vs 62.6%). In adjusted analyses, adequate knowledge was independently associated with Lahore site (adjusted OR [aOR] 2.44, 95% CI 1.37-4.32), prior campaign exposure (aOR 4.24, 95% CI 2.45-7.33), and information from a health worker (aOR 4.77, 95% CI 2.80-8.13). Willingness to screen was independently associated with adequate knowledge (aOR 6.72, 95% CI 2.82-16.06) and Lahore site (aOR 1.74, 95% CI 1.08-2.80). Lack of information was the most frequently reported barrier (31.8%).

Conclusion: Cervical-cancer and HPV knowledge and previous screening were low, whereas willingness to undergo screening was comparatively high. The marked site differences and the strong associations of adequate knowledge with campaign exposure and health-worker information support locally tailored, provider-led education linked directly to accessible screening pathways. These findings are timely as Pakistan expands HPV vaccination and strengthens cervical-cancer prevention services.

KEYWORDS: cervical cancer; screening; human papillomavirus; HPV vaccine; awareness; knowledge; Pakistan; Lahore; Okara

1. INTRODUCTION

Cervical cancer remains a major cause of preventable morbidity and mortality among women. Global estimates for 2020 documented approximately 604,000 incident cases and 342,000 deaths, with the greatest burden concentrated in countries with limited access to vaccination, screening, diagnosis, and treatment [1]. Updated GLOBOCAN 2022 estimates continue to show a substantial worldwide burden, with more than 660,000 new cases and nearly 350,000 deaths [2]. Persistent infection with oncogenic HPV is the necessary causal pathway for

almost all cervical cancers, making the disease unusually amenable to prevention through vaccination and detection of precancerous lesions [3-5].

The World Health Organization (WHO) global elimination strategy calls for 90% HPV vaccination coverage among girls by age 15 years, 70% screening coverage with a high-performance test by ages 35 and 45 years, and treatment of 90% of women with identified cervical disease [3]. WHO guidance increasingly favors HPV nucleic-acid testing as the primary screening approach, with recent guidance further addressing genotype-based risk stratification [4,6]. However, global screening remains highly unequal. In 2019, only about one third of women aged 30-49 years had been screened within the preceding five years, and lifetime screening coverage in lower-middle-income countries was estimated at only 9% [8]. Modeling suggests that vaccination alone will not achieve rapid elimination in high-burden settings; scaling screening and treatment alongside vaccination is essential [9]. Evidence supporting simplified one-dose HPV vaccination schedules also offers an opportunity to improve coverage and equity [5,10,11].

Pakistan has historically had limited population-level cervical-screening infrastructure. The WHO 2021 country profile reported no organized national screening programme and extremely low screening coverage [7]. The policy environment has since changed substantially. Pakistan launched its first large-scale HPV vaccination campaign on 15 September 2025, targeting girls aged 9-14 years in the first phase [12,14]. Early implementation evidence has documented encouraging but incomplete coverage, substantial refusal, misinformation, and operational challenges, with further phased expansion planned [13,15]. These developments make adult women's understanding of cervical cancer, HPV, vaccination, and screening especially important because adolescent vaccination does not replace screening for adult cohorts already at risk.

Recent Pakistani studies continue to identify important knowledge and uptake gaps. Surveys from Pakistan, including studies in Karachi, have reported limited understanding of cervical-cancer prevention, low screening uptake, and very low HPV-vaccine uptake, while structured educational outreach can improve knowledge and preventive intentions [16-18]. A 2025 survey in tertiary-care gynecology clinics in Islamabad likewise reported substantial deficits in cervical-screening knowledge and practice [19], while a Pakistan-Afghanistan study highlighted socioeconomic and residential differences in awareness [20]. A Lahore study documented low screening awareness and uptake despite generally favorable attitudes toward screening [21], and even among female healthcare providers, HPV-vaccination uptake has remained low [22]. Across South Asia, pooled and review evidence identifies limited HPV-vaccine uptake and recurring barriers related to awareness, health-system capacity, cost, modesty, and access [23-25].

Punjab contains highly heterogeneous urban and non-metropolitan populations and health-service environments. Comparative evidence between major metropolitan Lahore and the smaller district setting of Okara can help identify whether awareness gaps are uniform or site-specific. The present analysis therefore aimed to: (1) describe cervical-cancer, HPV, and screening awareness; (2) compare knowledge, screening history, willingness, and barriers between women attending DHQ Hospital Okara and Services Hospital Lahore; and (3) identify factors independently associated with adequate knowledge and willingness to undergo screening.

2. METHODS

2.1 Study design and setting

This comparative cross-sectional study was conducted at two public-sector hospitals in Punjab, Pakistan: DHQ Hospital Okara and Services Hospital Lahore. Data collection took place from October 2025 to March 2026. The analytical dataset included 211 participants from each hospital, giving a total sample of 422 women. The recruitment frame, sampling technique, response rate, and specific clinic locations within each hospital were not available in the analytical file and should be confirmed against the original study protocol if required by the target journal.

2.2 Participants and variables

All 422 records in the provided dataset were included. Variables included age, residence, marital status, education, occupation, monthly household income category, gravida, parity, awareness of cervical cancer, source of information, HPV awareness, HPV-vaccine awareness, awareness of cervical screening, Pap-smear awareness, visual inspection with acetic acid (VIA) awareness, understanding that screening may be needed before symptoms, previous screening, screening method, prior exposure to a cervical-cancer campaign, receipt of information from a health worker, willingness to undergo screening, perceived main barrier, knowledge score, and an adequate-knowledge classification.

The knowledge score ranged from 0 to 8. The dataset classified a score of 5 or higher as adequate knowledge, and this rule was internally consistent for all records. Because the source questionnaire and scoring key were not supplied, the score was analyzed as provided rather than reconstructed from individual items.

2.3 Data quality and missing data

Participant identifiers were unique, and there were no missing values for the main outcomes or covariates used in the regression models. Age ranged from 18 to 49 years. Age-at-marriage was structurally missing for all 89 single participants, but among married participants 80 values exceeded current age and were therefore implausible. Age-at-marriage was excluded from inferential analyses and should be checked against source records before any future use. Parity did not exceed gravida in any record. Previous-screening status and screening method were internally consistent: all 52 previously screened participants had a recorded method, while all 370 participants without previous screening were coded as not applicable for method.

2.4 Outcomes

The primary analytical outcome was adequate knowledge (knowledge score $\geq 5/8$). Secondary outcomes were awareness indicators, previous cervical screening, and willingness to undergo screening. Site (Lahore versus Okara) was the principal exposure for comparative analyses. Main reported barriers and information sources were summarized descriptively and by site.

2.5 Statistical analysis

Continuous age was summarized using mean and standard deviation and compared between sites using Welch's independent-samples t-test. Gravida, parity, and knowledge score were summarized using median and interquartile range (IQR) and compared using the Mann-Whitney U test. Categorical variables were summarized as frequencies and percentages and compared using Pearson chi-square tests. For binary awareness and practice outcomes, crude ORs with 95% confidence intervals (CIs) compared Lahore with Okara.

Two multivariable binary logistic-regression models were fitted. For adequate knowledge, covariates were hospital site, age per five-year increase, urban residence, marital status, education level (ordinal), income category (ordinal), housewife status, previous cervical-cancer campaign exposure, and receipt of information from a health worker. For willingness to screen, covariates were hospital site, age per five-year increase, urban residence, marital status, education level, income category, housewife status, adequate knowledge, and previous screening. Adjusted odds ratios (aORs), 95% confidence intervals (CIs), and two-sided p values are reported. Statistical significance was set at $p < 0.05$. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

2.6 Ethical considerations

Ethical approval was obtained from the relevant institutional ethics committee before commencement of data collection. All participants were informed about the purpose of the study, and written informed consent was obtained before enrolment. Participation was voluntary, confidentiality was maintained, and the analytical dataset used for this manuscript was anonymized. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

3. RESULTS

3.1 Participant characteristics

A total of 422 women were included, with 211 participants from each hospital site. The mean age was 33.9 ± 9.2 years. Overall, 244 (57.8%) participants lived in rural areas, 333 (78.9%) were married, and 293 (69.4%) were housewives; 219 (51.9%) reported a monthly household income below PKR 50,000. Age, occupation, income, gravida, and parity did not differ significantly between sites. In contrast, residence ($p < 0.001$), marital status ($p = 0.032$), and educational level ($p = 0.021$) differed by site. Compared with Okara, the Lahore group included a higher proportion of urban women and a lower proportion of women with no formal education (Table 1).

3.2 Awareness, knowledge, and previous screening

Overall, 215 (50.9%) participants had heard of cervical cancer, 83 (19.7%) were aware of HPV, and only 22 (5.2%) were aware of HPV vaccination. Cervical-screening awareness was reported by 166 (39.3%) participants; 102 (24.2%) were aware of the Pap smear, 59 (14.0%) were aware of visual inspection with acetic acid (VIA), and 192 (45.5%) knew that screening may be needed before symptoms develop. Only 52 (12.3%) participants reported previous cervical screening. Among those previously screened, 26 (50.0%) reported a Pap smear, 12 (23.1%) VIA, 7 (13.5%) an HPV test, and 7 (13.5%) an unknown screening method.

The median knowledge score was 3 (IQR 2-4), and 97 (23.0%) participants met the predefined criterion for adequate knowledge. The median score was higher at the Lahore site than at the Okara site (4 [IQR 3-5] vs 3 [IQR 2-4]; $p < 0.001$). Adequate knowledge was also more common in Lahore (34.1% vs 11.8%; OR 3.85, 95% CI 2.33-6.39; $p < 0.001$). Participants at the Lahore site had significantly greater awareness of HPV, cervical screening, and Pap smears; were more likely to understand the need for screening before symptoms; and more frequently reported prior campaign exposure and information from a health worker. Previous screening was more frequent in Lahore than Okara (15.2% vs 9.5%), although this difference was not statistically significant ($p = 0.076$) (Table 2).

3.3 Willingness, information sources, and barriers

Despite limited knowledge and low previous screening, 301 (71.3%) participants reported willingness to undergo cervical screening. Willingness was higher at the Lahore site than at the Okara site (80.1% vs 62.6%; OR 2.41, 95% CI 1.55-3.73; $p < 0.001$). The most frequently reported source of information was a doctor or other health worker (38.2%), followed by social media/internet (24.9%), family/friends (22.5%), and television/radio (14.5%); the overall distribution of information sources did not differ by site ($p = 0.810$). Lack of information was the leading reported barrier to screening (31.8%), followed by fear (19.9%), cost (15.4%), embarrassment (14.2%), absence of symptoms (12.8%), and other reasons (5.9%). The distribution of barriers did not differ significantly between the two sites ($p = 0.256$) (Table 3).

3.4 Factors associated with adequate knowledge and willingness

In multivariable analysis, three factors were independently associated with adequate knowledge. Attendance at the Lahore site was associated with greater adjusted odds of adequate knowledge than attendance at the Okara site (aOR 2.44, 95% CI 1.37-4.32; $p = 0.002$). Previous exposure to a cervical-cancer campaign (aOR 4.24, 95% CI 2.45-7.33; $p < 0.001$) and receipt of information from a health worker (aOR 4.77, 95% CI 2.80-8.13; $p < 0.001$) were also independently associated with adequate knowledge. Urban residence showed a positive but non-significant

association (aOR 1.63, 95% CI 0.96-2.78; $p=0.070$). Age, marital status, education level, income, and housewife status were not independently associated with adequate knowledge in the adjusted model (Table 4). In the multivariable model for willingness to undergo screening, adequate knowledge was the strongest independent correlate (aOR 6.72, 95% CI 2.82-16.06; $p<0.001$). Attendance at the Lahore site also remained independently associated with willingness (aOR 1.74, 95% CI 1.08-2.80; $p=0.022$). Previous screening, age, residence, marital status, education level, and income were not statistically significant. Housewife status showed a positive but non-significant association (aOR 1.55, 95% CI 0.96-2.49; $p=0.072$) (Table 4).

Table 1. Participant characteristics by hospital site

Characteristic	Overall (N=422)	Okara (n=211)	Lahore (n=211)	p-value
Age, years, mean $\pm$ SD	33.9 $\pm$ 9.2	34.5 $\pm$ 8.6	33.3 $\pm$ 9.8	0.197
Residence				<0.001
Rural	244 (57.8%)	144 (68.2%)	100 (47.4%)	
Urban	178 (42.2%)	67 (31.8%)	111 (52.6%)	
Marital status				0.032
Married	333 (78.9%)	176 (83.4%)	157 (74.4%)	
Single	89 (21.1%)	35 (16.6%)	54 (25.6%)	
Education level				0.021
No formal education	52 (12.3%)	36 (17.1%)	16 (7.6%)	
Primary	84 (19.9%)	40 (19.0%)	44 (20.9%)	
Secondary	113 (26.8%)	52 (24.6%)	61 (28.9%)	
Intermediate	91 (21.6%)	49 (23.2%)	42 (19.9%)	
Graduate or above	82 (19.4%)	34 (16.1%)	48 (22.7%)	
Occupation				0.894
Housewife	293 (69.4%)	145 (68.7%)	148 (70.1%)	
Employed	65 (15.4%)	33 (15.6%)	32 (15.2%)	
Student	40 (9.5%)	22 (10.4%)	18 (8.5%)	
Other	24 (5.7%)	11 (5.2%)	13 (6.2%)	
Monthly income (PKR)				0.727
<50,000	219 (51.9%)	113 (53.6%)	106 (50.2%)	
50,000-100,000	138 (32.7%)	68 (32.2%)	70 (33.2%)	
>100,000	65 (15.4%)	30 (14.2%)	35 (16.6%)	
Gravida, median (IQR)	3 (0-5)	3 (1-5)	2 (0-5)	0.077
Parity, median (IQR)	1 (0-3)	1 (0-3)	1 (0-2)	0.069

Notes: p values are from Welch's t-test for age, Mann-Whitney U tests for gravida/parity, and Pearson chi-square tests for categorical variables. Age-at-marriage is not shown because of implausible values in 80 records.

Table 2. Cervical-cancer awareness, screening practice, willingness, and knowledge

Outcome	Overall yes, n (%)	Okara yes, n (%)	Lahore yes, n (%)	Crude OR (95% CI)	p-value
Heard of cervical cancer	215 (50.9%)	97 (46.0%)	118 (55.9%)	1.49 (1.02-2.19)	0.041
Aware of HPV	83 (19.7%)	27 (12.8%)	56 (26.5%)	2.46 (1.48-4.09)	<0.001
Aware of HPV vaccine	22 (5.2%)	7 (3.3%)	15 (7.1%)	2.23 (0.89-5.59)	0.080

Outcome	Overall yes, n (%)	Okara yes, n (%)	Lahore yes, n (%)	Crude OR (95% CI)	p-value
Heard of cervical screening	166 (39.3%)	73 (34.6%)	93 (44.1%)	1.49 (1.01-2.21)	0.046
Aware of Pap smear	102 (24.2%)	42 (19.9%)	60 (28.4%)	1.60 (1.02-2.51)	0.041
Aware of VIA	59 (14.0%)	28 (13.3%)	31 (14.7%)	1.13 (0.65-1.95)	0.674
Screening needed before symptoms	192 (45.5%)	82 (38.9%)	110 (52.1%)	1.71 (1.16-2.52)	0.006
Previously screened	52 (12.3%)	20 (9.5%)	32 (15.2%)	1.71 (0.94-3.09)	0.076
Campaign exposure	108 (25.6%)	38 (18.0%)	70 (33.2%)	2.26 (1.44-3.56)	<0.001
Health-worker information	151 (35.8%)	52 (24.6%)	99 (46.9%)	2.70 (1.79-4.09)	<0.001
Willing for screening	301 (71.3%)	132 (62.6%)	169 (80.1%)	2.41 (1.55-3.73)	<0.001
Adequate knowledge	97 (23.0%)	25 (11.8%)	72 (34.1%)	3.85 (2.33-6.39)	<0.001
Knowledge score, median (IQR)	3 (2-4)	3 (2-4)	4 (3-5)	—	<0.001

Notes: OR compares Lahore with Okara. Binary outcomes were tested using Pearson chi-square tests. Knowledge score was compared using the Mann-Whitney U test.

Table 3. Information sources and reported barriers to cervical screening

Variable	Category	Overall n (%)	Okara n (%)	Lahore n (%)	p-value
Source of information	Doctor/health worker	161 (38.2%)	82 (38.9%)	79 (37.4%)	0.810
	Social media/internet	105 (24.9%)	53 (25.1%)	52 (24.6%)	
	Family/friends	95 (22.5%)	49 (23.2%)	46 (21.8%)	
	TV/radio	61 (14.5%)	27 (12.8%)	34 (16.1%)	
Main barrier	Lack of information	134 (31.8%)	56 (26.5%)	78 (37.0%)	0.256
	Fear	84 (19.9%)	44 (20.9%)	40 (19.0%)	
	Cost	65 (15.4%)	32 (15.2%)	33 (15.6%)	
	Embarrassment	60 (14.2%)	34 (16.1%)	26 (12.3%)	
	No symptoms	54 (12.8%)	30 (14.2%)	24 (11.4%)	
	Other	25 (5.9%)	15 (7.1%)	10 (4.7%)	

Notes: p values represent overall Pearson chi-square tests for the distribution of categories by hospital site.

Table 4. Multivariable logistic-regression models

Outcome	Predictor	aOR	95% CI	p-value
Adequate knowledge	Lahore site	2.44	1.37-4.32	0.002
	Age (per 5 years)	1.06	0.92-1.22	0.408
	Urban residence	1.63	0.96-2.78	0.070
	Married	1.03	0.54-1.95	0.930
	Education (per level)	1.01	0.82-1.24	0.931
	Income (per level)	0.90	0.63-1.29	0.575
	Housewife	1.34	0.75-2.39	0.328
	Campaign exposure	4.24	2.45-7.33	<0.001

Outcome	Predictor	aOR	95% CI	p-value
	Health-worker information	4.77	2.80-8.13	<0.001
Willingness to screen	Lahore site	1.74	1.08-2.80	0.022
	Age (per 5 years)	1.02	0.90-1.16	0.724
	Urban residence	1.39	0.86-2.24	0.174
	Married	0.77	0.43-1.37	0.374
	Education (per level)	1.00	0.84-1.19	0.999
	Income (per level)	0.99	0.73-1.34	0.949
	Housewife	1.55	0.96-2.49	0.072
	Adequate knowledge	6.72	2.82-16.06	<0.001
	Previous screening	0.94	0.47-1.86	0.852

Notes: aOR, adjusted odds ratio; CI, confidence interval. Education and income were modeled as ordinal variables. Reference groups: Okara site, rural residence, single marital status, non-housewife occupation, no campaign exposure, no health-worker information, inadequate knowledge, and no previous screening as applicable.

4. DISCUSSION

This comparative study identified a substantial cervical-cancer prevention gap across both hospital populations. Only about half of participants had heard of cervical cancer, fewer than one in five were aware of HPV, only about one in twenty knew about HPV vaccination, and 12.3% reported previous cervical screening. These findings are important in the context of the WHO elimination strategy, which depends on high vaccination, screening, and treatment coverage [3-6]. At the same time, more than seven in ten participants expressed willingness to undergo screening. The coexistence of low knowledge and low prior screening with high stated willingness suggests an actionable gap in which improved information, service availability, and navigation may help translate preventive intent into screening uptake.

The 12.3% prevalence of previous screening observed in this study is low but consistent with evidence from Pakistan and other lower-middle-income settings. WHO profiling has documented extremely limited cervical-screening coverage in Pakistan [7], and recent Pakistani hospital-based studies continue to report low awareness and uptake [18,19,21]. In a Karachi gynecology outpatient study, 33.6% of women were aware of cervical screening and 15.9% had previously been screened [18]. Similarly, the Lahore study by Haleem and colleagues reported that 34.8% were aware of screening methods and only 14.8% had ever undergone screening, despite generally favorable attitudes toward screening [21]. These findings parallel global evidence showing that screening coverage is markedly lower in lower-middle-income countries than in high-income settings [8].

The difference between hospital sites was one of the most prominent findings. Participants at the Lahore site had greater awareness of HPV, screening, and Pap smears; more frequent exposure to cervical-cancer campaigns and health-worker information; higher knowledge scores; and greater willingness to undergo screening. Although the two groups differed in urban residence, marital status, and education, the association between Lahore site and adequate knowledge persisted after adjustment for measured covariates. This residual site association may reflect differences in access to tertiary-care counseling, health communication, media exposure, or preventive services, but these mechanisms were not directly measured and should therefore be interpreted cautiously.

The associations between knowledge and direct health communication are particularly relevant. Previous campaign exposure and receipt of information from a health worker were each associated with approximately four- to five-fold greater adjusted odds of adequate knowledge. This finding is consistent with Pakistani evidence showing that structured educational outreach can improve cervical-cancer knowledge and preventive intentions [17], and with South Asian reviews identifying provider engagement, community education, and integration into existing services as important facilitators of screening [24,25]. Evidence among female healthcare providers in Pakistan likewise suggests that inadequate awareness and counseling contribute to very low HPV-vaccination uptake [22]. Health workers may therefore have an important dual role as both service providers and trusted communicators who can connect education directly with vaccination and screening opportunities.

Adequate knowledge was also the strongest independent correlate of willingness to undergo screening, with more than six times the adjusted odds of willingness compared with inadequate knowledge. Because the study is cross-sectional, this association cannot establish that greater knowledge causes willingness; reverse directionality and unmeasured confounding remain possible. Nevertheless, the finding is compatible with regional evidence linking better knowledge with preventive intentions and HPV-vaccine uptake [20,23]. Formal educational level itself was not independently associated with either adequate knowledge or willingness in the adjusted models. Within this sample, this may indicate that direct exposure to relevant health information is more important than general educational attainment, although limited measurement granularity and residual confounding should be considered.

The reported barriers were also consistent with wider evidence from low- and middle-income settings. Lack of information was the most common barrier, followed by fear, cost, embarrassment, and the belief that screening is unnecessary in the absence of symptoms. Systematic reviews have repeatedly identified limited knowledge, emotional concerns, affordability, access constraints, sociocultural norms, and health-system barriers as major determinants of low screening uptake [26,30,35]. A systematic scoping review among immigrant Muslim women additionally highlighted modesty-related concerns, beliefs, and the importance of clinician recommendation [31]. These findings suggest that education alone is unlikely to be sufficient; communication should be paired with affordable, convenient, privacy-sensitive services and clear explanations that cervical screening is intended for asymptomatic individuals within the recommended age groups.

Several evidence-based strategies may help address these barriers. A systematic review and meta-analysis of interventions in low- and middle-income countries found that reminders, subsidized services, community-based HPV testing, and self-sampling can increase screening uptake, although the certainty of evidence varies by intervention [27]. HPV self-sampling may be particularly useful where embarrassment, travel, clinician availability, or examination-related concerns limit participation. Systematic reviews and randomized trials have shown higher screening participation when self-collection is offered to under-screened women [28,32-34]. Integration of cervical screening into reproductive, maternal, HIV, and primary-care services may further improve reach, provided that trained personnel, referral pathways, treatment capacity, and quality assurance are available [29]. In Punjab, pragmatic models could combine brief health-worker counseling, eligibility assessment, appointment navigation, and validated HPV-based screening or self-sampling pathways where feasible.

The very low HPV-vaccine awareness in this adult sample is especially notable because data collection began shortly after Pakistan's national HPV-vaccination campaign was launched on 15 September 2025 [12,14]. Early implementation reports have described incomplete coverage, substantial refusal, misinformation, and operational challenges during rollout [13,15]. Adult women are often parents, caregivers, and family decision-makers for adolescent girls; improving their understanding of HPV vaccination may therefore have intergenerational benefits even when they are outside the primary target age. A South Asian meta-analysis found HPV-vaccine uptake to be low and identified knowledge as an important determinant of uptake [23]. Strong evidence for durable protection from a single HPV-vaccine dose [10,11], together with WHO recommendations [5], provides a basis for clear, concise public messaging on vaccine effectiveness and schedule simplicity.

These findings have several practical implications. First, the lower levels of knowledge, campaign exposure, health-worker information, and willingness observed at the Okara site suggest a need for more intensive local outreach. Second, health-worker counseling could be standardized so that eligible clinical encounters include brief information on cervical cancer, HPV, asymptomatic screening, and available screening methods. Third, awareness campaigns should be linked to a clear service pathway, such as same-day eligibility assessment or scheduled HPV-based screening, because information alone may not translate into completed screening. Fourth, communication should directly address fear, embarrassment, cost, and the misconception that screening is needed only after symptoms develop. Finally, local programs should monitor completed screening, follow-up of positive results, treatment linkage, and vaccination coverage in addition to awareness, in line with the WHO elimination framework [3,4,6].

4.1 Strengths and limitations

Strengths include a balanced sample from two distinct hospital sites, complete data for the main analytical variables, multiple indicators spanning knowledge, previous screening, willingness, information exposure, and barriers, and the use of multivariable models to distinguish site effects from measured sociodemographic differences. The analysis also includes a transparent data-quality audit rather than silently using implausible values.

Several limitations should be considered. First, the cross-sectional design prevents causal inference; associations between knowledge, campaigns, health-worker information, and willingness may be bidirectional or influenced by unmeasured factors. Second, the hospital-based sample may not represent women in the wider communities of Okara, Lahore, or Punjab. Third, the recruitment frame, sampling technique, response rate, and questionnaire-validation details were not available in the analytical file, limiting assessment of selection and measurement bias. Fourth, the knowledge score was provided without the item-level scoring key, so its internal consistency and construct validity could not be independently assessed. Fifth, age-at-marriage contained implausible values in 80 records and was therefore excluded from inferential analyses. Sixth, willingness represents an intention rather than completed screening behavior. Seventh, data collection occurred from October 2025 to March 2026, immediately after initiation of Pakistan's national HPV-vaccination campaign; awareness may therefore have changed during the study period. Finally, multiple bivariate comparisons were performed without adjustment for multiplicity, so individual p values should be interpreted alongside the overall pattern of findings rather than in isolation.

5. CONCLUSION

Women in this two-site Punjab dataset demonstrated low cervical-cancer, HPV, and screening knowledge and low previous screening, despite substantial willingness to be screened. Lahore participants consistently showed stronger awareness and willingness than those in Okara. Direct exposure to cervical-cancer campaigns and information from health workers was strongly associated with adequate knowledge, and adequate knowledge was strongly associated with willingness to screen. These findings support a service-linked communication strategy:

culturally appropriate education delivered by trained health workers, intensified outreach in lower-awareness settings, explicit correction of symptom-based misconceptions, cost and privacy accommodations, and convenient HPV-based screening pathways. As Pakistan expands HPV vaccination, strengthening adult screening awareness and access in parallel will be essential for progress toward cervical-cancer elimination.

Declarations

Ethics approval and consent to participate: Ethical approval was obtained from the relevant institutional ethics committee before data collection. Written informed consent was obtained from all participants before enrolment. Participation was voluntary, confidentiality was maintained, and the dataset used for analysis was anonymized. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication: Not applicable. The manuscript contains no identifiable individual-level information.

Availability of data and materials: The dataset analyzed in this study is held by the study investigators and may be made available from the corresponding author on reasonable request, subject to institutional and ethical requirements.

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