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Research Article

Determinants of Human Papillomavirus (HPV) Vaccine and Factors of Hesitancy to Vaccinate Adolescent Girls against HPV Faced by their Parents in Pakistan: A Community-Based Study

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ABSTRACT
Background: Human papillomavirus (HPV) vaccination is a highly effective strategy for preventing cervical cancer, yet parental vaccine hesitancy remains an important barrier to achieving adequate vaccination coverage. Evidence regarding the factors of parental HPV vaccine hesitancy in Pakistan remains limited.
Objective: To assess determinants of HPV vaccine hesitancy among parents of adolescent girls in Pakistan and evaluate the factors associated with reluctance or refusal to vaccinate.
Methods: A community-based cross-sectional study was conducted among 500 parents of adolescent girls in Islamabad, Pakistan. Data were collected using a structured questionnaire assessing sociodemographic characteristics, HPV-related knowledge, vaccine perceptions, information sources, reasons for hesitancy, and factors of delayed or refused vaccination. Factors associated with HPV vaccine hesitancy were evaluated using multivariable logistic regression, with adjusted odds ratios (aORs) and 95% confidence intervals (CIs) reported.
Results: HPV vaccine hesitancy was identified among 293 (58.6%) parents. The most frequently reported concerns were vaccine safety (61.1%), inadequate knowledge (56.0%), adverse effects (48.8%), and infertility (43.7%). Adequate HPV knowledge was independently associated with lower odds of hesitancy (aOR 0.39, 95% CI 0.25–0.61), whereas safety concerns (aOR 2.71, 95% CI 1.78–4.12), infertility concerns (aOR 2.34, 95% CI 1.53–3.59), and misinformation (aOR 2.08, 95% CI 1.38–3.14) were associated with greater hesitancy.
Conclusion: Parental HPV vaccine hesitancy was common and was driven predominantly by modifiable knowledge, safety, misinformation, and counselling-related factors. Targeted healthcare-provider counselling and culturally appropriate community education may improve vaccine acceptance.

Keywords: Adolescent, Human Papillomavirus, Immunization, Parents, Vaccine Hesitancy.

INTRODUCTION

Human papillomavirus (HPV) infection is one of the most common viral infections globally, and the primary causative agent of cervical cancer. Almost all cervical cancer cases are related to persistent infection with high-risk HPV types, while other anogenital malignancies and oropharyngeal malignancies may also contribute to high-risk HPV types (1). Cervical cancer continues to be a global public health

problem, especially in low- and middle-income countries where adequate coverage with vaccination, screening, early diagnosis and treatment services is still lacking. Cervical cancer is highly preventable and yet continues to be a burden, and effective primary prevention needs to be coupled with sustained efforts to roll out HPV vaccination – a central strategy to prevent HPV disease (2).

The highest efficacy of the HPV vaccine in the prevention of infection with oncogenic HPV types is observed, which is why it is indicated for routine vaccination in girls with an attitude which lends musings ages from 9 to 14 (3). Vaccination before HPV exposure represents an important window of opportunity to confer protection and is a key element of the World Health Organization's cervical cancer elimination framework. However, just because a vaccine is available, it does not mean that coverage is optimally meeting needs. In the case of adolescent vaccination, parents/guardians serve as the key decision-maker, and therefore parental knowledge, attitudes, perceptions, and confidence are important factors in determining vaccine uptake (4, 5).

Human papillomavirus vaccination uptake is less than optimal, and much of this can be explained by vaccine hesitancy, a multifactorial barrier. Due to insufficient knowledge about HPV and cervical cancer, vaccine safety and adverse effects concerns, fear of infertility, misinformation, mistrust of healthcare systems, sociocultural and religious beliefs, and others, parents may hesitate to vaccinate their children (6, 7). Since HPV is a sexually transmitted virus, some parents may also wonder why girls need to be vaccinated at such a young age or have false beliefs about vaccination and future sexual activity. Practical barriers to VPD vaccination, such as access to vaccination services, cost, transport, and vaccine uncertainty (who is eligible and so on), may exacerbate delays in VPD vaccination (8, 9).

As HPV infection, cervical cancer, and knowledge regarding the preventive vaccine is scarce in Pakistan, these issues assume special relevance in our setting. Prior studies have identified that there are prevalent knowledge gaps in adolescent HPV vaccination and that parental attitudes are an important predictor of HPV vaccine uptake (10, 11). Despite the availability of vaccines, the reluctance or refusal to vaccinate threatens the vaccination programmes due to numerous factors, including misconceptions regarding vaccine safety, fertility, and perceptions of necessity. It is important to understand these community-specific issues to design and develop culturally appropriate messages and community-based interventions.

In September 2025, Pakistan implemented its first national HPV vaccination campaign with a focus on girls aged 9–14 years, making strides to bolster cervical cancer prevention in the country. This programme will rely on the availability of a vaccine, as well as parental confidence and acceptability in the community. Yet evidence discussing the factors identifying parental HPV vaccine reluctance and the impact of vaccinating adolescent girls in Pakistan remains minimal. Hence, this community-based study was conducted to determine the predictors of HPV vaccine hesitancy among parents of school-going adolescent girls in Pakistan and investigate the outcomes of hesitation or refusal to vaccinate. These findings can be utilized in devising targeted health education, parental counseling, community mobilization, and vaccination strategies to enhance HPV vaccine uptake and cervical cancer prevention in Pakistan.

METHODS

Study design and setting

A community-based cross-sectional study was conducted to assess factorsof HPV vaccine hesitancy and the factorsof reluctance to vaccinate adolescent girls among their parents in Pakistan. The study was conducted in Islamabad, Pakistan, with recruitment coordinated through the community outreach activities associated with HBS Medical and Dental College, Islamabad. The study focused on parents or legal guardians of adolescent girls within the age group eligible for HPV vaccination. A cross-sectional design was selected because it allowed simultaneous assessment of parental sociodemographic characteristics, knowledge, perceptions, attitudes, vaccine-related concerns, vaccination decisions, and factors associated with HPV vaccine hesitancy.

Study Population

The study population included parents or legal guardians of adolescent girls who were eligible for HPV vaccination. Suitable candidates were mothers and fathers. In households with more than one eligible adolescent girl, one parent or guardian was selected to provide a response to

avoid clustering of responses from the same household. A structured recruitment method was used to recruit parents from the community, aimed at achieving diversity along sociodemographic lines.

Eligibility Criteria

Eligibility criteria for parents or legal guardians included having at least one currently eligible daughter (aged 9-14 years) to receive HPV vaccination, residing in the study area, and being able to understand and provide answers to the study questionnaire. Eligible participants were those who could complete the questionnaire, but were excluded if they were unable to provide informed consent, complete the questionnaire adequately or provided a debilitating medical or cognitive illness that precluded reliable participation. The principal analysis excluded questionnaires with major missing data on the primary outcome.

Sampling and Recruitment

Participants were approached through community-based recruitment channels associated with the study area. The recruitment strategy aimed to minimize selection based on parental attitudes toward vaccination by approaching eligible parents irrespective of their prior HPV vaccination decision. Potential participants were informed about the purpose of the study, the voluntary nature of participation, confidentiality of responses, and their right to withdraw at any stage without consequence. Written informed consent was obtained before administration of the questionnaire. The participant recruitment process, eligibility assessment, consent procedure, exclusions, and final analytical classification according to HPV vaccine acceptance or hesitancy are summarized in **Figure 1**.

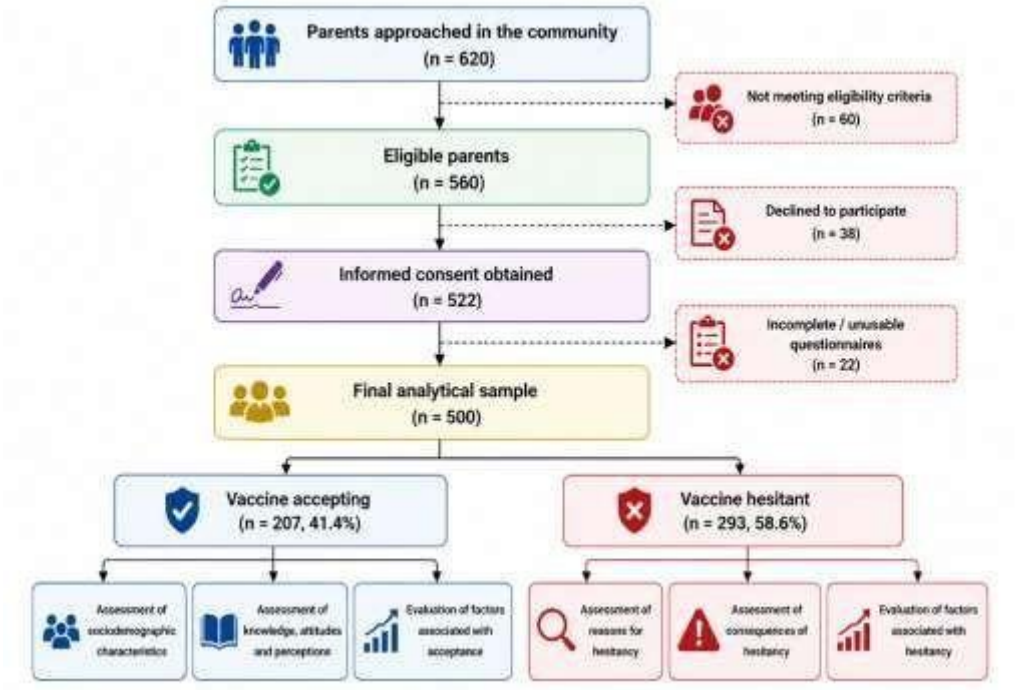

Figure 1. Participant recruitment, eligibility assessment, and analytical classification of study participants

Data collection instrument

Data were collected through a structured, interviewer-administered/self-administered questionnaire devised subsequent to review of published literature on HPV infection, cervical cancer prevention, HPV vaccination, and vaccine hesitancy. The following four units were included in the questionnaire: parental sociodemographic characteristics, knowledge about HPV and cervical cancer, attitudes and perceptions towards HPV vaccination, and vaccination decision-making.

The sociodemographic section included parental age, sex, educational attainment, occupation, place of residence, socioeconomic characteristics (which include the household wealth index), number and age of daughters. The questions on the knowledge domain consisted of the awareness of HPV infection, mode of transmission, relation to cervical

cancer, availability of HPV vaccination, recommended age for vaccination, effectiveness of vaccination, and preventive role of vaccination.

The domain of attitude and perception measured parent confidence for HPV vaccination, susceptibility of daughters to HPV-related disease, benefit of vaccination, risks of vaccination, concerns about adverse effects, fertility-related concerns, misinformation, concerns due to social or cultural factors, and confidence to healthcare providers and the vaccination programme.

We examined the practical barriers of availability of vaccination services, accessibility, cost-related concerns, transportation, information source, and previous interaction with health providers regarding HPV vaccination on the questionnaire as well.

Assessment of HPV vaccine hesitancy

The primary outcome was parental HPV vaccine hesitancy. Hesitancy was assessed according to the parent's reported intention or decision regarding HPV vaccination for the eligible adolescent daughter. Parents who expressed uncertainty, delay, reluctance, or refusal despite availability or recommendation of vaccination were considered hesitant. Parents who reported clear willingness to vaccinate or whose daughters had already received the vaccine were considered accepting, subject to the predefined study classification.

The questionnaire additionally explored the intensity and underlying reasons for hesitancy. Participants were permitted to identify more than one reason where applicable because vaccine hesitancy may result from multiple interacting factors rather than a single determinant.

Assessment of factors of hesitancy

Potential factorswere grouped into six categories: sociodemographic factors; knowledge-related; attitudinal; sociocultural; informational and healthcare-access factors. Stereotypical sociodemographic factorsthat included parental age, sex, educational qualification, occupational structure, and family socioeco Based on the above inclusion and exclusion criteria, data analysis was done among 138 respondents who met the criteria, using analysis of variance method, which was to assess the correlation between two interval scales. Factorsrelated to knowledge were awareness of HPV and cervical cancer, HPV transmission, availability of vaccine, recommended age, and vaccine effectiveness. Attitudinal factorsalso had a largely similar impact, including perceived susceptibility to HPV-related disease, perceived vaccine benefits, adverse effects and fertility concerns, health professional HPV vaccine safety confidence, and trust in health professionals. Informational factorsconsisted of social media, healthcare professionals, television, family members, newspapers, friends, and other information sources (items adapted from the awareness section of the surveys). Sociocultural factors identified included influences from family, perceptions from their communities, religious or cultural concerns, and misconceptions about adolescent HPV vaccination.

Factors of vaccine hesitancy

The study separately assessed factorsassociated with parental HPV vaccine hesitancy. These included delayed vaccination, complete non-vaccination, missed opportunities for vaccination, uncertainty regarding future vaccination, reduced intention to vaccinate, and reluctance to recommend HPV vaccination to other eligible families. Parents were also asked whether concerns or misinformation had resulted in postponement or refusal of vaccination and whether they had subsequently sought additional information or counselling from healthcare professionals. This distinction between factorsand factorswas maintained during analysis to avoid interpreting reasons for hesitancy as outcomes of hesitancy.

Data quality assurance

Before commencement of formal data collection, the questionnaire was reviewed for clarity, relevance, and comprehensibility. The data collection team was briefed regarding participant recruitment, informed consent, standardized administration of the questionnaire, and procedures for maintaining confidentiality. Completed questionnaires were reviewed for completeness before data entry. Data were checked for inconsistencies, duplicate entries, implausible values, and missing observations. Personally identifying information was not included in the analytical dataset.

Statistical analysis

IBM SPSS Statistics was used to enter, clean, and analyze the data. Graphical methods and

appropriate tests of normality were used to assess the distribution of continuous variables. Continuous variables were summarized as mean ± standard deviation for normally-distributed data, and median (interquartile range) for skewed data. Frequencies and percentages were used to summarize categorical variables.

Prevalence of HPV vaccine hesitancy was computed along with the respective 95% confidence interval. We initially compared the differences in characteristics, knowledge, beliefs, and other explanatory factors between groups with vaccine acceptance and groups with vaccine hesitancy using the chi-square test or Fisher's exact test for categorical variables. Continuous variables were compared using the independent-samples t-test for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables.

Variables that were clinically or statistically relevant in univariable analysis were assessed in a multivariable logistic regression. A binary logistic regression model was built with HPV vaccine hesitancy as the outcome variable. Fifty-six variables related to sociodemographics, parental knowledge, perceptions of the vaccine, safety concerns, solicited information sources, sociocultural factors, and healthcare-access were included as candidate predictors. Adjusted odds ratios (aORs) with 95% confidence intervals were used to quantify the independent association between possible factorsand vaccine hesitancy. Statistical significance was defined as a p-value < 0.05 (two-sided).

Multicollinearity among explanatory variables was evaluated (in a subset of cases where appropriate) before constructing the final regression model. Goodness-of-fit measures were used (model adequacy) and the number of variables included in the final model was taken into account with respect to the number of hesitancy events observed to limit overfitting of the model. We analyzed missing observations for pattern and extent, and where prespecified analytical justification was not available for imputing outcome values, these values were not replaced.

Factorsanalysis compared vaccination delay, complete refusal, skipped opportunity for vaccination and decreased future vaccination intention between relevant parental groups. Adjusted regression models were used where there was an a priori rationale to assess whether the outcomes were independently associated with parental hesitancy.

Ethical considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional ethics review committee of HBS Medical and Dental College, Islamabad, before commencement of participant recruitment. All participants were informed about the study objectives, procedures, potential benefits, and their right to decline participation or withdraw without providing a reason. Written informed consent was obtained from each participant before data collection. Confidentiality and anonymity were maintained throughout data collection, data entry, analysis, and reporting.

RESULTS

Participant characteristics

A total of 500 parents of adolescent girls were included in the study. The mean age of participants was 39.8 ± 7.2 years, and mothers comprised 58.4% of the study population. Most participants had completed at least secondary education, while 31.6% had a university-level qualification. Approximately two-thirds of participants (64.2%) were from urban areas. Overall, 293 (58.6%) parents were classified as hesitant toward HPV vaccination, whereas 207 (41.4%) demonstrated vaccine acceptance. Sociodemographic characteristics according to vaccination status are presented in **Table 1**.

Table 1. Sociodemographic characteristics of parents according to HPV vaccine hesitancy

Characteristic	Overall (n=500)	Vaccine accepting (n=207)	Vaccine hesitant (n=293)	*P* value
Age, years, mean ± SD	39.8 ± 7.2	38.6 ± 6.8	40.7 ± 7.4	0.002
Parent sex, n (%)				
Mother	292 (58.4)	137 (66.2)	155 (52.9)	0.004
Father	208 (41.6)	70 (33.8)	138 (47.1)	
Residence, n (%)				
Urban	321 (64.2)	148 (71.5)	173 (59.0)	0.005
Rural/peri-urban	179 (35.8)	59 (28.5)	120 (41.0)	

Education, n (%)				
Primary/none	76 (15.2)	21 (10.1)	55 (18.8)	<0.001
Secondary	266 (53.2)	96 (46.4)	170 (58.0)	
University	158 (31.6)	90 (43.5)	68 (23.2)	
Employed, n (%)	216 (43.2)	102 (49.3)	114 (38.9)	0.024
≥2 daughters, n (%)	238 (47.6)	91 (44.0)	147 (50.2)	0.183

SD: standard deviation.

HPV-related knowledge and information sources

Vaccine-hesitant parents had substantially lower levels of knowledge about HPV and cervical cancer. Overall, 314 (62.8%) had heard of HPV and 223 (44.6%) had correctly identified persistent high-risk HPV infection as the major cause of cervical cancer. Two hundred eighty-seven(57.4%) participants reported awareness of HPV vaccination, but only 199(39.8%) knew that vaccination is recommended in early adolescents. Two hundred forty-seven (49.4%) participants reported knowledge of vaccination against cervical cancer with HPV. More knowledgeable parents were significantly more likely to agree to vaccination. Forty-two point eight percent (42.8%) of the respondents reported that their source of HPV information was healthcare professionals, while 52.2% were able to mention social media as a source of HPV information. (Table 2)

Table 2. Knowledge and sources of information regarding HPV and vaccination

Knowledge/information variable	Overall n (%)	Accepting n (%)	Hesitant n (%)	*P* value
Heard of HPV	314 (62.8)	155 (74.9)	159 (54.3)	<0.001
Knew HPV is associated with cervical cancer	273 (54.6)	137 (66.2)	136 (46.4)	<0.001
Correctly identified persistent HPV infection as major cause	223 (44.6)	124 (59.9)	99 (33.8)	<0.001
Aware of HPV vaccine	287 (57.4)	143 (69.1)	144 (49.1)	<0.001
Knew vaccination is recommended in early adolescence	199 (39.8)	113 (54.6)	86 (29.4)	<0.001
Knew HPV vaccination can prevent cervical cancer	247 (49.4)	139 (67.1)	108 (36.9)	<0.001
Received information from healthcare professional	214 (42.8)	112 (54.1)	102 (34.8)	<0.001
Obtained information through social media	261 (52.2)	94 (45.4)	167 (57.0)	0.012
Family/friends as major information source	182 (36.4)	62 (30.0)	120 (41.0)	0.014

Reasons for HPV vaccine hesitancy

Among the 293 parents classified as vaccine-hesitant, concerns about vaccine safety were the most frequently reported reason, affecting 179 (61.1%) participants. This was followed by inadequate knowledge regarding HPV and cervical cancer in 164 (56.0%), fear of adverse effects in 143 (48.8%), concerns regarding infertility in 128 (43.7%), and exposure to misinformation in 122 (41.6%). 101 (34.5%) participants reported uncertainty regarding the necessity of vaccination at a young age, while 80 (27.3%) reported cultural or religious concerns. Limited access to vaccination services and cost-related concerns were reported by 20.8% and 16.0% of hesitant parents, respectively. Multiple responses were permitted. **(Figure 2)**

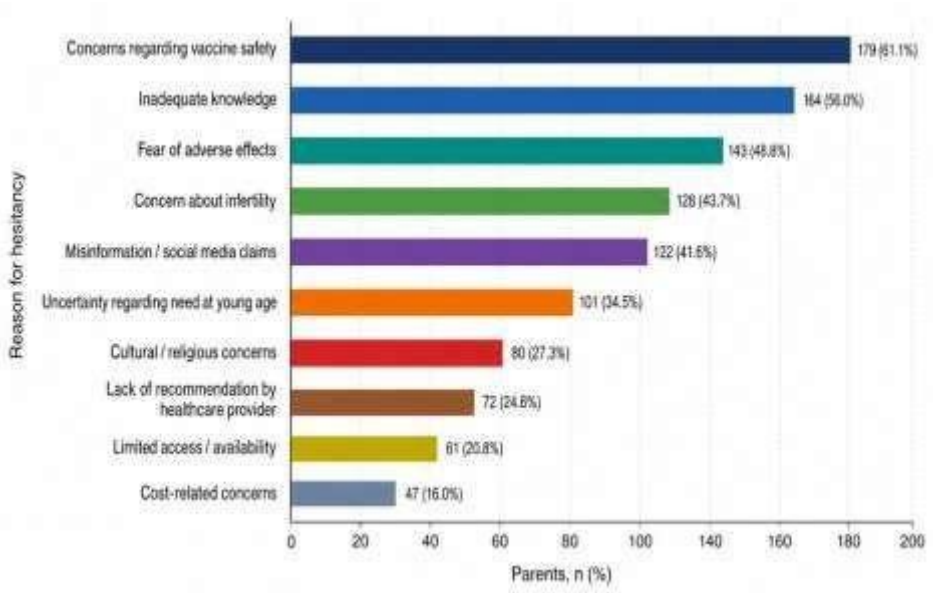

Figure 2. Reasons for HPV vaccine hesitancy among parents

Factorsof parental vaccine hesitancy

Among parents with vaccine hesitancy, 136 (46.4%) reported that HPV vaccination had been postponed because of uncertainty or concerns, while 112 (38.2%) reported complete refusal. A total of 97 (33.1%) remained uncertain about future vaccination, and 84 (28.7%) reported having missed an opportunity for vaccination. Eighty parents (27.3%) stated that they would reconsider vaccination following additional counselling from a healthcare professional. Only 71 (24.2%) hesitant parents reported that they would recommend HPV vaccination to other families, whereas 159 (54.3%) stated that they would not recommend it. **(Table 2).**

Table 2. Factorsassociated with parental HPV vaccine hesitancy

Determinants	Vaccine hesitant (n=293), n (%)
Vaccination delayed/postponed	136 (46.4)
Vaccination completely refused	112 (38.2)
Uncertain about future vaccination	97 (33.1)
Missed an opportunity for vaccination	84 (28.7)
Would reconsider after professional counselling	80 (27.3)
Would recommend vaccination to others	71 (24.2)
Would not recommend vaccination to others	159 (54.3)

Factors independently associated with HPV vaccine hesitancy

Lower parental education, insufficient HPV-related knowledge, lack of healthcare-provider counselling, vaccine safety worries, fear of infertility, exposure to misinformation, and cultural or religious worries were independently associated with hesitancy towards HPV vaccination in the multivariate logistic regression analysis. Those with university education were less likely to hesitate compared to primary or no formal education (aOR 0.48, 95 % CI 0.28–0.83; P=0.009). Although the adults in the study sample were found to have adequate HPV knowledge, the adults were also found to have an independent negative association with HPV hesitancy (aOR 0.39; 95% C.I. 0.25–0.61; P<0.001). Conversely, fears about vaccine safety (aOR 2.71, 95% CI 1.78–4.12; P<0.001), worries about infertility (aOR 2.34, 95% CI 1.53–3.59; P<0.001), and exposure to misinformation (aOR 2.08, 95% CI 1.38–3.14; P=0.001) were statistically significant positively correlated with hesitancy. (Table 3)

Table 3. Multivariable logistic regression analysis of factorsof HPV vaccine hesitancy

Predictor	Adjusted OR	95% CI	*P* value
Age ≥40 years	1.42	0.97–2.09	0.071
Male parent	1.51	1.02–2.23	0.039
Rural/peri-urban residence	1.67	1.10–2.54	0.016
Secondary education	1.39	0.91–2.13	0.128
University education	0.48	0.28–0.83	0.009
Adequate HPV knowledge	0.39	0.25–0.61	<0.001
No healthcare-provider counselling	1.86	1.24–2.80	0.003
Vaccine safety concern	2.71	1.78–4.12	<0.001
Fear of infertility	2.34	1.53–3.59	<0.001
Exposure to misinformation	2.08	1.38–3.14	0.001
Cultural/religious concern	1.79	1.15–2.78	0.009

OR: odds ratio; CI: confidence interval.

Overall predictors of vaccine hesitancy

The multivariable model demonstrated that vaccine hesitancy was independently associated with both modifiable and sociodemographic factors. Knowledge deficits and absence of professional counselling were associated with reduced vaccine acceptance, whereas concerns about vaccine safety, infertility, misinformation, and sociocultural factors were associated with increased odds of hesitancy. The adjusted effect estimates and their corresponding 95% confidence intervals are presented in **Figure 3**.

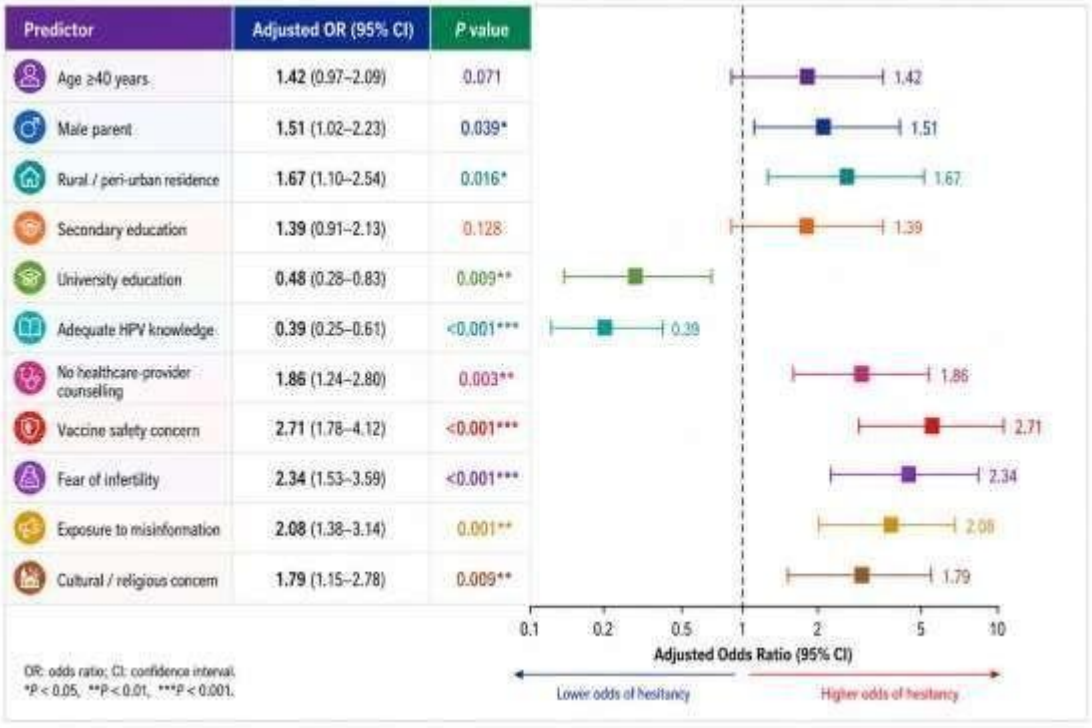

Figure 3. Forest plot of independent factorsof HPV vaccine hesitancy

The forest plot presents adjusted odds ratios and 95% confidence intervals for the independent predictors included in the final multivariable logistic regression model, with an adjusted odds ratio of 1.0 representing the null association.

DISCUSSION

This community-based study found that parental HPV vaccine hesitancy was common, with 58.6% of parents classified as hesitant. This proportion is higher than the pooled global prevalence of 39.6% reported in a recent systematic review and meta-analysis of 23 studies involving 203,818 parents across 13 countries. The authors identified low perceived vaccine safety, limited perceived benefits,

reduced trust in healthcare providers, and misinformation as important contributors to hesitancy (12). The relatively high level of hesitancy observed in our study is particularly relevant in Pakistan, where parental acceptance will be central to achieving effective adolescent HPV vaccination coverage.

The principal reasons for hesitancy in our study were concerns regarding vaccine safety, inadequate knowledge, fear of adverse effects, concerns about infertility, and exposure to misinformation. These findings are consistent with a large systematic review and meta-analysis involving 840,838 parents, in which physician recommendation was the strongest factor associated with HPV vaccine uptake, while safety concerns were negatively associated with acceptance (13). The prominence of safety concerns in our population suggests that improving vaccine availability alone may be insufficient; vaccination programmes should directly address parental concerns through clear, evidence-based communication.

Inadequate HPV-related knowledge was another important determinant. Only 44.6% of parents correctly identified persistent high-risk HPV infection as the major cause of cervical cancer, while fewer than 40% recognized the recommended early-adolescent vaccination window. Parents with adequate HPV knowledge had substantially lower odds of hesitancy in the multivariable analysis. Similar knowledge gaps have been documented in Pakistan. Shamsi et al. reported that only 65.2% of Pakistani adults had heard of HPV, while 53.3% recognized its association with cancer, highlighting substantial gaps in HPV-related knowledge (14). These findings support community-based education focusing on HPV transmission, cervical cancer prevention, vaccine effectiveness, and the rationale for vaccination during early adolescence.

Safety and fertility concerns deserve particular attention because they may persist even among parents who have some awareness of HPV vaccination. In our analysis, vaccine safety concerns and fear of infertility were independently associated with greater odds of hesitancy. Importantly, current evidence does not support an increased risk of premature ovarian insufficiency following HPV vaccination. A systematic review and meta-analysis including more than 1.25 million participants found no significant increase in premature ovarian insufficiency following HPV vaccination compared with unvaccinated or other-vaccine controls (15, 16). Addressing fertility concerns explicitly during parental counselling may therefore be particularly important in communities where reproductive safety is a major consideration.

In our study, we found that misinformation was also associated with vaccine hesitancy independently. Over half of hesitant parents were exposed on social media, indicating that digital information environments may be a significant driver of vaccine hesitancy. Social media serves as a source of conflicting information for HPV vaccination, and communication patterns may be relevant for vaccine attitudes and decisions. Therefore, this study creates a case for healthcare professionals and public health programmes to promote credible digital platforms to provide accessible, culturally appropriate information and to proactively counter common misconceptions.

The independent association between absence of healthcare-provider counselling and vaccine hesitancy is particularly important. In our study, fewer than half of participants reported receiving HPV-related information from a healthcare professional. This finding is consistent with evidence demonstrating that physician recommendation is one of the strongest predictors of HPV vaccine uptake (13, 17). More recent evidence among vaccine-hesitant parents found that the adjusted odds of HPV vaccination were more than four times higher when parents received a healthcare-provider recommendation (18). These findings support strengthening provider-initiated counselling as a central component of HPV vaccination strategies in Pakistan.

Our study also showed that vaccine hesitancy may have downstream effects, potentially taking the form of an immediate decision to accept or refuse vaccination. Nearly half of hesitant parents reported delaying vaccination (47·3%), 38·2% reported outright refusal, and 28·7% reported a vaccine opportunity missed. Importantly, over one in four stated that they would change their mind about vaccination following professional reassurance. This result is promising since hesitancy could reflect uncertainty and not definitive refusal. In another study of previously unvaccinated parents nationally, 45% accepted HPV vaccination, and an additional 24% reported intentions to vaccinate in the next 12 months. Subsequent acceptance was independently

associated with follow-up counselling received from a healthcare provider (19).

The relation of parental characteristics to hesitancy also indicates the need for tailoring interventions to the decision-making group. Male sex, rural/peri-urban residence, and university-level education were all independently associated with either increased or decreased odds of hesitancy. Our findings suggest HPV vaccination programs should not solely target adolescent girls but also include parents and other influential family members. Communication must be made specifically accessible to parents with lower health literacy, linking to concerns in culturally relevant language and through trusted community channels.

Some strengths of the study are: The focus on parents as main decision-makers for adolescent HPV vaccination; The use of both factorsand factorsof hesitancy directly; The use of multivariable analysis to identify independent predictors. However, some limitations must be taken into account. Because of its cross-sectional design, we cannot determine whether the identified factors actually preceded the vaccine hesitancy behaviour. Limited to one geographical region, it may not apply to other regions in Pakistan or to the rural population. All information related to knowledge, misinformation, vaccination intentions and hesitancy was self-reported and may have been affected by recall or social-desirability bias. Multicentre studies may more reliably assess whether interventions are effective if they employ standardized measures of HPV vaccine hesitancy, account for differences between rural and urban populations, and prospectively evaluate whether provider counselling, community engagement and misinformation-targeted interventions lead to greater uptake of the HPV vaccine.

CONCLUSION

Parental HPV vaccine hesitancy was common and was primarily driven by inadequate knowledge, safety and infertility concerns, misinformation, limited healthcare-provider counselling, and sociocultural factors. Strengthening provider-led counselling, correcting misinformation, and delivering culturally appropriate community education should be prioritized to improve parental confidence and HPV vaccine uptake among adolescent girls in Pakistan.

REFERENCE

1. Okunade KS. Human papillomavirus and cervical cancer. J Obstet Gynaecol. 2020;40(5):602-8.
2. Hull R, Mbele M, Makhafola T, Hicks C, Wang SM, Reis RM, et al. Cervical cancer in low and middle-income countries. Oncol Lett. 2020;20(3):2058-74.
3. Kamolratanakul S, Pitisuttithum P. Human Papillomavirus Vaccine Efficacy and Effectiveness against Cancer. Vaccines (Basel). 2021;9(12).
4. Luu XQ, Jun JK, Suh M, Oh JK, Yu SY, Choi KS. Cervical Cancer Screening, HPV Vaccination, and Cervical Cancer Elimination. JAMA Netw Open. 2025;8(8):e2526683.
5. Shapiro GK. HPV Vaccination: An Underused Strategy for the Prevention of Cancer. Curr Oncol. 2022;29(5):3780-92.
6. Zheng L, Wu J, Zheng M. Barriers to and Facilitators of Human Papillomavirus Vaccination Among People Aged 9 to 26 Years: A Systematic Review. Sex Transm Dis. 2021;48(12):e255-e62.
7. Kaundal A, Renjhen P, Sharma S, Prasad S, Marwaha PD, Kaur H. Human Papillomavirus Vaccine Hesitancy and Barriers in Achieving 100% Vaccine Coverage: A Web-based Cross-sectional Study. Ann Afr Med. 2025;24(3):591-7.
8. Patel PR, Berenson AB. Sources of HPV vaccine hesitancy in parents. Hum Vaccin Immunother. 2013;9(12):2649-53.
9. Fields EJ, Hopfer S, Warren JR, BeLue R, Lebed J, Hecht ML. Motivators and Barriers to HPV Vaccination: A Qualitative Study of Underserved Women Attending Planned Parenthood. Vaccines (Basel). 2022;10(7).
10. Victory M, Do TQN, Kuo YF, Rodriguez AM. Parental knowledge gaps and barriers for children receiving human papillomavirus vaccine in the Rio Grande Valley of Texas. Hum Vaccin Immunother. 2019;15(7-8):1678-87.
11. Simonetti V, Cicolini G, Tomietto M, Forastefano B, Pastore F, Ballerini P, et al. The association between adolescents' knowledge and perception of HPV vaccination and parents' characteristics: A cross-sectional study. Applied Nursing Research. 2025;81:151899.
12. Wang M, Tian X, Zeng Y, Yue Y, Zhu Z, Li Z, et al. International prevalence and associated factors of parental vaccine hesitancy in human papillomavirus

vaccination: A systematic review and meta-analysis. Int J Nurs Stud. 2025;172:105239.

13. Newman PA, Logie CH, Lacombe-Duncan A, Baiden P, Tepjan S, Rubincam C, et al. Parents' uptake of human papillomavirus vaccines for their children: a systematic review and meta-analysis of observational studies. BMJ Open. 2018;8(4):e019206.
14. Shamsi U, Zahid F, Abdul Jabbar AB, Musharraf MD, Gauhar F, Akbar I, et al. Human Papillomavirus Vaccine Awareness and Acceptability for Primary Prevention of Cervical Cancer in Pakistan: A Cross-Sectional Study. Asian Pac J Cancer Prev. 2024;25(3):813-20.
15. Torella M, Marrapodi MM, Ronsini C, Ruffolo AF, Braga A, Frigerio M, et al. Risk of Premature Ovarian Insufficiency after Human Papilloma Virus Vaccination: A PRISMA Systematic Review and Meta-Analysis of Current Evidence. Vaccines (Basel). 2023;11(1).
16. Bednarczyk RA. Addressing HPV vaccine myths: practical information for healthcare providers. Hum Vaccin Immunother. 2019;15(7-8):1628-38.
17. Chido-Amajuoyi OG, Osaghae I, Onyeaka HK, Shete S. Barriers to the assessment and recommendation of HPV vaccination among healthcare providers in Texas. Vaccine X. 2024;18:100471.
18. Willis DE, Moore R, Selig JP, Shafeek Amin N, Li J, Watson D, et al. Pediatric HPV vaccination: Provider recommendations matter among hesitant parents. Vaccine. 2024;42(25):126166.
19. Kornides ML, McRee AL, Gilkey MB. Parents Who Decline HPV Vaccination: Who Later Accepts and Why? Acad Pediatr. 2018;18(2s):S37-s43.