

Original Research

Received 09 April 2026

Revised 12 May 2026

Accepted 25 June 2026

Natural Resources for Human Health 2026, Vol. 6 (3s): 292–301

KEYWORDS:

HPV vaccine, parental acceptance, cervical cancer, North Karnataka, predictors, cross-sectional study, vaccine hesitancy.

Shielding the Next Generation: Predictors of Parental Acceptance of the HPV Vaccine against Cervical Cancer: A Cross-Sectional Study from North Karnataka

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ABSTRACT:

Introduction: Cervical cancer remains the second most common cancer among women in India, despite being largely preventable through HPV vaccination. Parental acceptance is critical for vaccine uptake, particularly in rural areas where awareness, access, and sociocultural influences strongly shape health decisions. This study examines the sociodemographic, attitudinal, and contextual predictors of parental acceptance of the HPV vaccine in rural North Karnataka.

Methods: A community-based cross-sectional study was conducted among parents of children aged 8–14 years in selected rural regions of Belagavi, Karnataka (October 2024–January 2025). Using systematic household sampling, 321 consenting parents completed a structured and interviewer-administered questionnaire assessing HPV-related knowledge, attitudes, perceived barriers, facilitators, and vaccine acceptability. Reliability testing yielded a Cronbach's alpha of 0.80. Data were analysed using descriptive statistics, ROC curve analysis, and stepwise multiple logistic regression to identify independent predictors of high vaccine acceptability.

Results: Perceived barriers were the strongest predictor of high acceptability (AUC = 0.735, $p < 0.0001$), followed by facilitators (AUC = 0.694, $p < 0.0001$), number of children (AUC = 0.701, $p < 0.0001$), and parental attitude (AUC = 0.652, $p < 0.0001$). Regression analysis showed significantly higher odds of acceptance among Muslim parents (AOR = 5.49, $p = 0.012$), parents with two to four children (AOR range 12.38–15.14, $p < 0.05$), those with positive attitudes (AOR = 4.37, $p = 0.013$), low perceived barriers (AOR = 17.11, $p < 0.0001$), and strong facilitators (AOR = 5.77, $p = 0.0001$). Higher knowledge levels were inversely associated with acceptance (AOR = 0.03, $p < 0.0001$). Monthly income also showed a negative association with acceptance.

Discussion: Psychosocial and contextual influences—specifically perceived barriers, facilitators, and attitudes—play a more decisive role in HPV vaccine acceptance than demographic factors or knowledge alone. These findings align with global evidence indicating that misinformation, fear, and structural barriers reduce vaccine uptake, while strong provider recommendations and community support enhance acceptance. The inverse association between knowledge and acceptability suggests that increased exposure to misinformation or conflicting narratives may shape parental perceptions in rural settings.

Conclusion: Improving HPV vaccine uptake in rural India requires targeted strategies that address perceived barriers, strengthen positive attitudes, and enhance supportive factors rather than focusing solely on knowledge dissemination. Implementing culturally sensitive, community-based, and provider-driven interventions could substantially increase HPV vaccine acceptability and contribute to cervical cancer prevention in underserved regions.

INTRODUCTION

Cervical cancer is the fourth most prevalent cancer worldwide in terms of both incidence and mortality, yet it ranks second in India.¹ Although incidence rates are declining, cervical cancer remains the second most common cancer among women in India, constituting 10% of all female cancers.²⁻³ This type of cancer is associated with lower socioeconomic status and a high prevalence of human papillomavirus (HPV).⁴ In India, HPV types 16 and 18 are responsible for four out of every five reported cases of cervical cancer.⁵⁻⁷

Screening and HPV vaccination are among the most effective primary prevention strategies. The WHO advises vaccinating girls aged 9–14 years, ideally before sexual debut. As adolescents in this age group typically do not make independent healthcare decisions, parental understanding, attitudes, and acceptance are paramount for successful vaccine uptake. In India, vaccines such as Cervavac and Gardasil are available to target various high-risk HPV strains. Countries such as Australia have integrated HPV vaccination into their national immunisation programs, achieving over 80% coverage and leading to a 90% reduction in HPV infections among vaccinated groups. Despite the global recognition of HPV vaccination efficacy and its widespread introduction in many developed nations, India, with its significant cervical cancer burden, continues to face substantial challenges in achieving widespread vaccine uptake. This disparity highlights the unmet need to understand the localised barriers impeding successful implementation.⁹ Understanding the specific predictors of parental acceptance, rather than just general awareness, is therefore critical for developing targeted interventions to improve HPV vaccination rates in regions such as North Karnataka.

In 2020, The United Nations Children's Emergency Fund (WHO/UNICEF) published estimates of national HPV immunization coverage from 2010 to 2019. According to this publication, 107 (55%) of the 194 WHO Member States had introduced HPV vaccination.¹⁰ America and Europe are by far the WHO regions with the most introductions, and 85% and 77% of their countries, respectively, have already introduced the HPV vaccination, with almost one-third of the programs (33 out of 107) being gender-neutral.¹⁰ Many countries have recognised the value of HPV gender-neutral vaccination programs to achieve the goal of eliminating not only cervical cancer but all HPV-related diseases (European Cancer Organization).¹¹ According to the latest data published by the European Cancer Organization in 2020, 26 countries in the European region of the WHO are or will be including boys in their national HPV vaccination programs.¹¹ This represents almost half (48%) of all the countries in this region (European Cancer Organization).

Vaccination programs in India are affected by many factors, including costs, health priorities, lack of awareness, vaccine safety concerns, and diverse cultural and sociological factors. While these barriers are recognized nationally, there is a critical knowledge gap regarding the specific predictors and relative importance of these factors influencing parental acceptance of the HPV vaccine within distinct regional and rural settings, such as North Karnataka. Understanding these localised determinants is crucial for developing effective and tailored interventions. Several strategies can be implemented to overcome these barriers to HPV vaccination, including active community involvement to increase community awareness and knowledge of vaccine benefits, safety, and effectiveness.^{9,12}

Concurrently, the ministry is finalising capacity-building programmes for frontline workers to deliver effective HPV vaccination. Concurrently, the ministry is finalising capacity-building programmes, and new indigenous vaccines are being introduced to enhance availability. However, the success of these national initiatives hinges on a nuanced understanding of community-level perceptions and acceptance, particularly among parents in under-served rural areas.

Currently, there is an unmet need for robust, region-specific data to precisely identify the drivers and deterrents of parental HPV vaccine acceptance. Such data would enable policymakers to refine and target their strategies for equitable access and

uptake in areas like North Karnataka. Achieving robust monitoring, community engagement, and equitable access will be crucial in determining the feasibility of cervical cancer elimination by 2030.

Given these challenges and the crucial role of parental decisions, a comprehensive understanding of the factors influencing parental acceptance of the HPV vaccine in rural North Karnataka is urgently required. Therefore, this study aims to analyze the relationship between parental sociodemographic characteristics and their willingness to vaccinate their adolescents."

Objectives

To analyse the relationship between parental sociodemographic characteristics and their willingness to vaccinate their adolescents.

METHODS

A cross-sectional, survey-based study was conducted in selected rural regions of Belagavi city, North Karnataka, India, between October 2024 and January 2025. Ethical clearance was obtained from the Institutional Ethics Committee on Human Subjects (Approval No. KAHHER INS/24-25/IEC-07), dated 14 September 2024 which assured compliance with all ethical guidelines. Furthermore, the study was conducted in accordance with the ethical norms of the Declaration of Helsinki.

Rural regions within Belagavi City were purposively selected based on high female illiteracy rates and low health program uptake. Within these selected regions, a systematic approach was employed, where every third household on a randomly selected street was approached until the target number of parents was reached. Parents were initially identified through door-to-door screening for eligible children

A total of 341 parents of children aged 8–14 years, of whom 321 provided informed consent and participated in the study. Following eligibility verification, participants were informed of the study's aims and methodology and provided written consent. They then completed a standardized questionnaire to determine their understanding and acceptance of cervical cancer prevention and HPV vaccination.

Sample Size

By using the below statistical formula, the sample size was calculated at a 95% confidence interval, 6% tolerable error, and 10% attrition

$$N = Z^2 \cdot P \cdot Q / (d)^2 \cdot 1.1$$

$$N = 320.1$$

Required sample size = 321

Figure 1. Participant Flow Diagram

Inclusion and Exclusion Criteria

A total of 341 parents were invited to participate in the study. Of these, 321 consented and were enrolled through a house-to-house survey using a purposive sampling technique. The inclusion criteria for the study were being a parent of a child aged between 8 and 14 years and expressing a willingness to participate in the study. Once eligibility was determined, an informed consent form was administered, reviewed, and signed by the participants. The participants then completed a survey that captured their HPV vaccine acceptability for cervical Cancer and HPV vaccination.

Baseline data

Characteristics of the mothers and fathers, Age at Marriage, Religion, Marital Status, No number of children, Family H/o cancer, Education and occupation of parents, Monthly Income, Food habits.

HPV vaccine acceptability

HPV vaccine acceptability was assessed using a 5-point Likert scale (13 items), ranging from 5 (strongly agree) to 1 (Strongly Disagree); opposite scoring was used for negative statements.

The questionnaires were pre-tested on 30 parents from a comparable population. For the main study, parents scoring 4 or 5 on at least 8 out of 13 items were categorized as having 'high acceptability'.

Cronbach's alpha was used to determine the reliability of the questionnaire ($r = .80$). This indicates that the questionnaires were valid and reliable.

Facilitators for HPV vaccination

Facilitators were assessed using a 7-item Likert scale (1 = Strongly disagree to 5 = Strongly agree). The item scores were summed (range: 7–35). For interpretability, we classified participants by mean item score: low facilitators = mean ≤ 2.5 (total 7–17), moderate facilitators = mean > 2.5 to ≤ 3.5 (total 18–24), and high facilitators = mean > 3.5 (total 25–35).

Barriers to HPV vaccination

Perceived barriers to HPV vaccination were assessed using a 6-item Likert scale (1 = Strongly disagree, 5 = Strongly agree). The items covered concerns regarding cost, access, side effects, social discouragement, communication with healthcare providers, and perceived vaccine redundancy. The total score ranged from 6 to 30, with higher scores indicating greater perceived barriers. Scores were classified using mean item thresholds: low barriers (≤ 2.5), moderate barriers (> 2.5 – 3.5), and high barriers (> 3.5). Internal consistency was assessed using Cronbach's α values.

Ethical issues

The Study received approval from the institutional Ethics Committee on Human Subjects, indicating that all ethical Standards have been adhered to in the study design (KAHER INS/24-25/IEC-07) dated on 14th September 2024

Statistical analysis:

Data were entered into a spreadsheet (Microsoft Office Excel 2019) and imported into SPSS Software Version 20•0 for analysis. The data were subjected to exploratory analysis to ensure consistency and completeness. Descriptive statistics were analysed to describe vaccine acceptability, and each response was assigned a numerical value.

Bias

Several methodological safeguards were implemented to minimise potential biases. Selection bias was reduced by including all eligible parents from the selected rural area using house-to-house visits, ensuring a broad representation within the target community. Although purposive sampling was used, efforts were made to approach every household with eligible adolescents to enhance the sample's inclusiveness. Recall bias was minimised by framing questions in a short reference time frame and using a structured, interviewer-administered questionnaire. The instrument was pre-tested in a comparable population to refine the item clarity and reduce misinterpretations. The interviewers were trained to maintain a neutral tone and avoid leading questions, which further helped minimise interviewer bias. Despite these efforts, limitations related to the cross-sectional design and non-random sampling remain and are acknowledged in this discussion.

RESULTS

Sociodemographic characteristics of parents

The respondents were predominantly mothers (60%) rather than fathers (40%). Among fathers, the majority reported their age at marriage as being between 31 and 40 years (28.66%), followed by ≥ 41 years (10.90%). The majority of participants were Hindu (70.99%), followed by Muslim (6.54%) and Christian (3.46%) participants. Most participants were married (70.99%), while a smaller proportion were divorced (8.65%) or widowed (3.89%). A large proportion of participants reported no family history of cancer (70.99%), whereas 29.01% reported a positive family history. Many parents had primary education (17.3% fathers, 23.36% mothers) or informal education (19.04% fathers, 18.6% mothers). A small number of parents were illiterate (3.03% fathers and 1.8% mothers). None of the parents had an education beyond secondary school.

Figure: Table 1: Area Under the Curve (AUC) for Predictive Factors of Parental Acceptance of HPV Vaccine

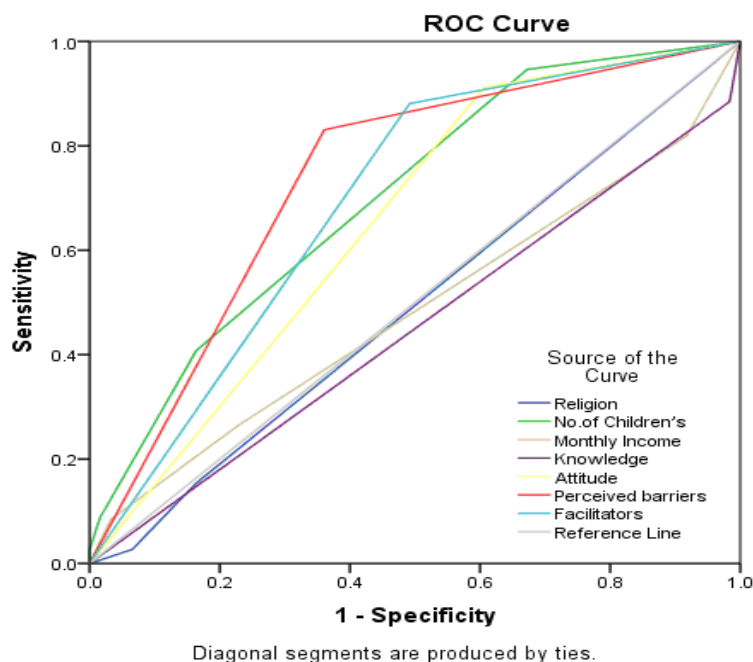


Table 2: Stepwise Multiple Logistic Regression Analysis of Factors Predicting Parental Acceptance of HPV Vaccine

Test Result Variable(s)	Area	Std. Error	P-value	Asymptotic 95% Confidence Interval	
Lower Bound	Upper Bound				
Religion	0.492	0.042	0.848	0.41	0.574
No. of Children's	0.701	0.038	0.0001*	0.626	0.775
Monthly Income	0.484	0.038	0.693	0.41	0.558
Knowledge	0.451	0.039	0.229	0.375	0.526
Attitude	0.652	0.043	0.0001*	0.568	0.737
Perceived barriers	0.735	0.039	0.0001*	0.659	0.811
Facilitators	0.694	0.042	0.0001*	0.613	0.776

* $p < 0.05$

The analysis of the ROC curve and corresponding AUC values provided valuable insights into the predictive factors of high acceptability. Among the assessed variables, *perceived barriers* emerged as the strongest predictor (AUC = 0.735, $p < 0.0001$), indicating that individuals who perceive fewer obstacles—such as cost, accessibility, or fear—are more likely to demonstrate high acceptability. *Facilitators* (AUC = 0.694, $p < 0.0001$) and *attitude* (AUC = 0.652, $p < 0.0001$) also showed significant predictive power, suggesting that supportive factors and a positive outlook substantially influence acceptance. Additionally, the *number of children* (AUC = 0.701, $p < 0.0001$) was a statistically significant factor, which may reflect the varying health priorities or experiences among larger families. Conversely, variables such as *religion* (AUC = 0.492), *monthly income* (AUC = 0.484), and *knowledge* (AUC = 0.451) were not significant predictors, highlighting that sociodemographic characteristics and awareness alone do not necessarily translate into behavioral acceptance. These findings underscore the importance of addressing psychological and structural barriers while enhancing enabling factors and attitudes to improve acceptability outcomes.

Table: Step wise multiple logistic regression analysis of parental acceptance of the HPV vaccine

Factors	Adj. OR	95% Ci for OR	p-value	
Lower	Upper			
Religion				
Hindu	Ref.			
Muslim	5.49	1.45	20.86	0.0120*
Christian	0.05	0.01	0.3	0.0010*
No.of Children's				
1	Ref.			
2	12.76	3.58	45.48	0.0001*
3	15.14	3.68	62.34	0.0001*
4	12.38	1.22	125.9	0.0340*
5	-	-	-	-
Monthly Income				
<5000	Ref.			
5001-10000	0.16	0.04	0.62	0.0080*
10001-15000	0.06	0.01	0.33	0.0010*
>=15001	0.11	0.01	0.99	0.0490*
Knowledge				
Low	Ref.			
High	0.03	0.01	0.18	0.0001*
Attitude				
Low	Ref.			
High	4.37	1.37	13.91	0.0130*
Barriers				
Low	Ref.			
High	17.11	6.44	45.48	0.0001*
Facilitators				
Low	Ref.			
High	5.77	2.24	14.88	0.0001*

* $p < 0.05$

Stepwise logistic regression analysis identified key predictors of high HPV vaccine acceptability among parents. The significantly higher odds of acceptance among Muslim parents compared to Hindu parents (AOR = 5.49, $p = 0.012$) and lower odds among Christian parents (AOR = 0.05, $p = 0.001$) warrant further investigations. These differences might stem from cultural or religious interpretations or community leadership influence. Having more children was associated with greater acceptability, with parents of two to four children showing significantly higher odds than those with one child ($p < 0.05$). Lower-income families (<₹5000) reported higher acceptability, whereas those with higher incomes showed decreased odds ($p < 0.05$). The finding that higher knowledge levels were inversely related to acceptability (AOR = 0.03, $p = 0.0001$). This noteworthy finding, which contradicts some prior studies, could potentially stem from misinformation associated with increased awareness or greater exposure to vaccine hesitancy narratives among parents with higher knowledge. In contrast, a positive attitude (AOR = 4.37, $p = 0.013$), low perceived barriers (AOR = 17.11, $p = 0.0001$), and strong facilitators (AOR = 5.77, $p = 0.0001$) were strong positive predictors of HPV vaccination. These findings emphasise that psychosocial and contextual factors, rather than demographic characteristics or knowledge alone, play a substantial role in influencing parental HPV vaccine acceptance.

DISCUSSION

This study was conducted to assess the knowledge and willingness to receive the HPV vaccine and associated factors among parents of children aged 8–14 years in selected rural areas of Belagavi.

Parental involvement in the decision to administer the HPV vaccine to their children is crucial for both vaccine acceptance and uptake. However, different factors, such as parents' age, educational status, occupation, family history of STD, and fear of HPV infection, were significantly associated with knowledge and willingness to use the HPV vaccine.

The present study demonstrated that perceived barriers 14-16 turned out to be the best indicator of vaccine acceptability, which is in line with earlier research showing that parents' mistrust of pharmaceutical companies, worries about vaccine safety, side effects, and cost are major deterrents.¹⁵⁻²²

Notably, *facilitators* such as physician recommendation, school-based programs, and ease of access were positively associated with uptake, as seen in global studies.^{14,23-25} Most of the mothers recommended school-based strategy, making the vaccine available for free as well as health education and awareness about cervical cancer prevention and HPV vaccine.^{22,26-27}

In the present study, a significant statistical association was found between the level of facilitators and other factors such as parental age at marriage, monthly income, parents' occupation, health insurance, vaccine acceptability, attitude about cervical cancer and HPV vaccine acceptability, and perceived barriers. These results are in line with other studies^{14,28-29}

In addition, we found that HPV knowledge and vaccine acceptance varied by several factors, such as religion, habits, monthly income, parental education, HPV vaccine acceptability, and parental attitude.³⁰⁻³³ These results highlight the need for “tailored” interventions, carefully designed to respond to the specific concerns and beliefs of the target population to reduce social inequalities in vaccination.

This review shows that HPV knowledge and vaccine acceptance vary widely across different studies and countries.³⁰ In general, figures are still modest and lower than those for other routine vaccines. Safety concerns remain the main barrier to vaccination, and a lack of HPV and vaccine knowledge has been identified, which is even greater for male vaccination. In contrast, main drivers to vaccination are the perception of efficacy of HPV vaccine and social responsibility

A recent review^{30,34} showed that informational strategies may influence the intent to vaccinate by increasing HPV-related knowledge and awareness; however, the effect on HPV vaccine behaviour is minimal. The most effective strategy for changing vaccination behaviour is multifaceted. This is consistent with a previous review that also stressed the effectiveness of interventions targeting both providers and patients.

While this study offers valuable insights into HPV vaccine acceptability among rural parents in North Karnataka, the findings may not be fully generalisable to all regions of India, especially urban areas or states with differing sociocultural contexts, health infrastructure, and education levels. However, given the similarities in vaccine hesitancy and access issues across many rural settings in low- and middle-income countries, these results may be cautiously extrapolated to inform broader public health strategies in similar contexts in the future.

LIMITATIONS

This study measured HPV vaccine acceptability using a Likert scale for stated willingness. However, this self-reported intention may not perfectly translate into actual vaccine uptake behaviour, as various real-world barriers (e.g. logistical challenges and last-minute hesitancy) can influence the final decision. Future research should incorporate observational data or follow-up studies to assess actual vaccination rates.

The study relied on voluntary participation, with parents providing informed consent. This recruitment method might have introduced a degree of selection bias, as individuals who were more open to discussing health-related topics or who had a certain level of awareness might have been more likely to participate. Consequently, the findings may not fully capture the perspectives of the most hesitant or disengaged segments of the rural parent population.

Given the sensitive nature of the topic and the prevalence of cultural misconceptions, the quantitative cross-sectional design, while providing broad insights, may not have fully captured the depth and complexity of parents' beliefs, fears, and decision-making processes. Incorporating qualitative methods, such as in-depth interviews or focus group discussions, could provide a richer contextual understanding of the nuanced barriers to HPV vaccine acceptance.

CONCLUSION

Despite these limitations, this study offers important insights into the factors influencing parental acceptance of the HPV vaccine in rural India. These findings emphasise that perceived barriers, facilitating factors, and parental attitudes play a more critical role in shaping vaccine acceptability than demographic characteristics or knowledge alone. These results highlight the need for targeted, culturally sensitive public health interventions that go beyond awareness campaigns to address the behavioural and contextual influences. Strengthening these strategies could significantly enhance HPV vaccination uptake and contribute to cervical cancer prevention in underserved populations.

Funding

This study was funded by the **KLE Academy of Higher Education and Research (KAHER)** as part of the institutional academic research support. The funding body had no role in the study design, data collection, analysis, interpretation, or preparation of the manuscript.

Conflict of Interest

The authors declare no competing interests

Data Availability Statement

Due to the sensitive nature of the participant data, the datasets are not publicly available

Acknowledgements

The authors gratefully acknowledge the KLE Academy of Higher Education and Research (KAHER) for providing financial support for this study. The authors would like to thank the parents who participated in this study for their valuable time and cooperation. We also extend our gratitude to the local community health workers for their assistance in facilitating data collection

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