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HPV vaccine acceptability among parents of adolescent girls in a rural area Mysore, India

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Abstract

Study objective: The purpose of this study was to examine factors predicting human papillomavirus (HPV) vaccine acceptability among parents of adolescent girls in a rural area in Mysore district, India.

Design: Cross-sectional.

Setting: Mysore, India.

Participants: Parents of school-going adolescent girls.

Interventions: Parents completed a validated self-administered questionnaire.

Main Outcome Measures: Parental willingness to vaccinate their daughters with HPV vaccine.

Results: Of the 831 parents who participated in this study, 664 (79.9%) were willing to vaccinate their daughter with HPV vaccine sometime soon if they were invited to receive it. Higher odds of parental willingness to vaccinate their daughters with HPV vaccine was observed among those who believed that HPV vaccine is safe (adjusted odds ratio [aOR], 2.11; 95% confidence interval [CI], 1.01-4.45); their daughter might become sexually active (aOR, 1.84; 95% CI, 1.08-3.13); they have support of other family members to vaccinate their daughter (aOR,2.86; 95% CI, 1.47-5.57); and that HPV infection causes severe health problems (aOR, 1.64; 95% CI, 1.04-2.57). In contrast, parents who believed that there is low risk that their daughter will get cervical cancer (aOR, 0.52; 95% CI, 0.29-0.95); that the family will disapprove of getting their daughter vaccinated (aOR, 0.45; 95% CI, 0.22-0.76); that the injection might cause pain (aOR, 0.53; 95% CI, 0.31-0.89), and were older-age parents (aOR, 0.96; 95% CI, 0.93-0.99) had lower odds of willingness to vaccinate daughters with HPV vaccine.

Conclusions: Acceptance of HPV vaccination for daughters was high among rural parents in Mysore, India. However, health education to reduce the belief that injection is painful and that daughters are at low risk to get cervical cancer is important to further improve parental HPV vaccine acceptability in Mysore. Public health education should target older-aged parents and extended family members.

Key words: HPV, vaccine, acceptability, India, Mysore, Parents, Rural.

Introduction

Cervical cancer is the second leading cause of cancer death among women in India.[1] Every year, approximately 122,844 women are diagnosed with the disease and 67,477die of it.[1] The country ranked first in terms of the incidence of the disease among south Asian countries in 2012.[2] To effectively control cervical cancer, the Indian Academy of Pediatrics Committee on Immunization approved human papillomavirus (HPV) vaccination for girls aged 10-12 years, who can afford the vaccine, in 2008.[3] Nevertheless, introducing HPV vaccine in India has had unique challenges because of unconfirmed concerns about the efficacy and safety of the vaccine.[4] The death of 7 girls reported during a demonstration program in India conducted in 2009 raised several concerns.[4] The Indian parliament attributed the deaths to the HPV vaccine leading to suspension of the demonstration program in 2010.[5] However, subsequent studies and investigations confirmed that the deaths were not related to the HPV vaccine.[6]

In 2014, the government of India decided to include HPV vaccine in the National Immunization Programme.[7,8] The vaccine, currently, is used by private practitioners indifferent regions of the country.[6,9,10] However, uptake of HPV vaccination in general has been low because of misperceptions about HPV infection, cervical cancer, and HPV vaccine, and because of cultural reasons in India.[7,11-14] Further investigation of factors that are related to HPV vaccine acceptability among parents in India might help improve uptake and reduce the burden of cervical cancer in this country. Identifying factors associated with vaccine acceptance will also help clinicians and public health advocates to better design evidence-based strategies to achieve maximum HPV vaccine coverage in the target groups. Much of the research to date about HPV vaccine acceptability in India has been limited to urban areas with very limited information being available from rural India where 60% of the Indian population resides.[11-14]The purpose of this study was therefore to examine factors predicting HPV vaccine acceptability among parents of adolescent girls in rural India in the south Indian state of Karnataka.

Materials and Methods

Study setting

Between September and October, 2011, a cross-sectional survey was conducted among parents of adolescent girls living in villages of Mysore Taluk, in the Indian state of Karnataka. Karnataka ranks ninth in terms of population (61million) with most residents living in rural areas.[15] The age-standardized cervical cancer mortality rate in Karnataka was 16.5 per 100,000 in 2010.[16]

Ethical considerations

This study was conducted after review and approval by the institutional review boards at Florida International University and Public Health Research Institute of India. In addition, permission to conduct the study was obtained from the Block Education officer and school administrators. Parents participated in the study after they provided writ-ten informed consent.

Study participants

A total of 831 parents of adolescent girls (ages 11-15 years) attending seventh through 10th grades in a cluster of 11 schools located in rural Mysore subdistrict were included in this study. One private and 10 government schools were selected from a group of 43 schools available in the study area on the basis of probability proportionate-to-size sampling. A program announcement was sent home with all eligible girls (n=1725) in the 11 schools (44-137 students from each school), explaining the objective of the study and inviting parents to participate. Of the 1725, 850 were randomly selected and provided a

questionnaire in Kannada to complete within a week's time. The number of female students needed from each school was determined on the basis of multistage proportionate-to-size sampling. All (along with assigned number) eligible female students from each school were enumerated and listed in an excel sheet separately for each school. Using a computer program, the assigned number of students from each school were selected using a random sampling technique. Each selected and interested participant was provided with a questionnaire to take home to their parents, where 1 parent per household could complete it and return within 7 days along with a signed consent form. Most parents (97.8%) who received the questionnaire completed the questionnaire and returned it along with their signed consent form.

Questionnaire and measures

The items included in the questionnaire were adapted from previous studies.[11,17,18] The questionnaire was validated in Kannada (local language in the study area) and has been used in another study[14] before it was used in this study. Because some of the parents living in a rural region were illiterate and might have lacked knowledge about HPV, cervical cancer, and HPV vaccine, we included some basic information in the questionnaire (Table 1) to enable parents to answer some questions related to attitudes and beliefs about HPV vaccine and willingness to accept HPV vaccination. The questionnaire contained 126 items, 59 of which were used to measure psychosocial factors that have been shown to influence HPV vaccine acceptability indifferent countries including India.

The current study was guided by the conceptual frame-work of factors that influence HPV vaccination proposed by Fernandez et al.[19] Of 126 items, 59 items representing different constructs that could potentially influence willingness to vaccinate were selected for the analysis.[19] The constructs included sociodemographic characteristics, awareness about HPV, sources of information about HPV vaccine, perceived susceptibility to HPV and cervical cancer, perceived severity of HPV and cervical cancer, perceived facilitators and barriers to vaccination in general and specific to HPV vaccine, social norms that influence HPV vaccine acceptability, and willingness to accept HPV vaccine.[19]

Awareness about HPV was assessed with 1 question (Have you ever heard of HPV?) with a 'yes' or 'no' response. Sources of information were assessed using 7 items asking parents where they got information about HPV vaccine (Cronbach α=0.75). Perceived susceptibility, which measures parental beliefs toward susceptibility of their daughters to getting HPV infection and cervical cancer, was assessed using 4 items (α=0.78). Similarly, perceived severity measured parental beliefs about severity of HPV infection and cervical cancer using 4 items (α=0.73).Response to all of the items that measured perceived susceptibility and severity constructs were recorded on a 3-point scale (1=disagree, 2=do not know, 3=agree). Items that had a response of 'Don't know' were assumed to be ordinally neutral.[20]

Questions used to assess parental beliefs and attitudes about HPV vaccine were grouped into 2 constructs: perceived facilitators/benefits and perceived barriers to HPV vaccination. Perceived facilitators were measured using 8 items to assess the reasons why parents wanted to have their daughter's HPV vaccination (α=0.67). Similarly, perceived barriers to HPV vaccination construct was measured using 8 items to assess reasons why parents might not want to have their daughters receive HPV vaccine (α=0.68). Responses to the 16 items were coded on a 3-point scale (1=not important all, 2=important, 3=very important). Likewise, perceived facilitators (α=0.59) and perceived barriers (α=0.58) to vaccination in general were assessed using 6 and 5 items, respectively. These 11 items were recorded on a 3-point scale (1=no, 2=not sure, 3=yes). Social norms were assessed using 7 items (α=0.75) by asking parents whose opinion such as doctors, spouse, friends, father and mother, other relatives, in-laws, and neighbors might influence their decision in getting their daughter vaccinated.

Responses were recorded on a 3-point scale (1=no, 2=don't know, 3=yes). Finally, the construct for willingness to accept HPV vaccine was assessed by asking parents "If your daughter was invited to get HPV vaccine, would you agree to have it sometime soon?" Responses were coded on a 4-point Likert scale (1=definitely not, 2=probably not, 3=probably yes, 4=definitely yes). This variable was converted into a dichotomous variable as acceptors (who responded as "probably or definitely" yes) and nonacceptors (who responded as "probably or definitely" not) during dataanalysis.[18]

Data analysis

Data were analyzed using Stata software version 14 (StataCorp). Reliability/internal consistency of items forming each construct was assessed using Cronbach α. The outcome variable was "HPV vaccine acceptability." The calculated internal reliabilities (Cronbach α) for the items forming the constructs were substantial or moderate. Thus, a composite score was developed by adding values of responses to the items that formed each of the constructs.[19]

Percentages were used to describe the demographic status and the frequency of responses of parents to the questions addressing willingness to receive HPV vaccine, as well as beliefs and attitudes about HPV infection, cervical cancer, and HPV vaccine.c2tests were performed to check whether parental intention to accept HPV vaccine for their daughter was related to demographic characteristics, as well as beliefs and attitudes of parents about HPV, cervical cancer, and HPV vaccine. Multiple logistic regression was used to assess factors associated with HPV vaccine acceptance. To account for potential clustering of HPV acceptance by the school that the daughters attended, analysis was performed using the generalized estimating equations (GEE) in Stata using the xtgee command. The estimated within-school correlation matrix value for HPV vaccine acceptability was 0.0078. While fitting the regression models, factors that were included in the regression model were checked for multicollinearity. Because there were missing values for some of the items (missing range, 0.48%-3.61%) included in the regression model, a multiple imputation method (using chained equation) on the basis of 20iterations was used to estimate the missing values before fitting the generalized estimating equations.[21]

Results

Of the 850 parents who were contacted, 831 agreed to participate and returned the completed questionnaire within7 days. The mean age of the parents was 37.16.67 years. Almost all study participants were Hindu by religion (99.0%) and married (91.5%). Most respondents were mothers (76.8%), working part-time (43.0%), and lacked formal education (63.4%). Most had heard about HPV (75.4%). Most of the parents got information about HPV vaccines from their daughter's school (86.6%), doctor (83.6%), television (76.2%), auxiliary nurse midwife or anganwadi teacher (72.0%). Of the 831 parents, 79.9% (yes probably=30.2%, yes definitely=49.7%) were willing to vaccinate their daughter with HPV vaccine sometime soon if they were offered the vaccine for their daughter (Table 2). Compared with mothers, fathers were more likely to be educated (55.4% vs 30.9%), employed (92.2% vs 46.2%), and older than 35 years of age (87.6% vs34.3%). However, the proportion of parents who were Hindu, married, and were willing to vaccinate their daughter with HPV vaccine were similar between fathers (99.5%, 94.3%, and77.7%, respectively) and mothers (98.9%, 90.6%, and 80.6%, respectively).

Parents who were willing to vaccinate their daughter with HPV vaccine reported the following characters as main rea-sons for their willingness: recommendation from doctor or nurse (96.2%), belief that HPV vaccine will prevent cervical cancer (92.8%), belief that HPV vaccine is safe (92.0%), having support from other family members to vaccinate daughter with HPV vaccine (89.5%), and learning more about the relationship of HPV to cervical cancer (89.2%; Table 3).

Among parents who refused to vaccinate their daughter with HPV vaccine, the most frequent reasons for refusal were: being worried about safety of the vaccine (67.1%), the perception that the vaccination might not be effective (67.1%), that injection might cause pain (65.9%), and their perception that their daughter is at low risk of becoming infected with HPV infection (65.9%). Willingness to receive HPV vaccine was also lower among parents who were afraid of vaccinations in general.

On the basis of multiple regression analysis, the odds ratio of willingness to vaccinate was positively associated with the perceived benefits of HPV vaccination (adjusted odds ratio [aOR], 1.16; 95% confidence interval [CI], 1.07-1.25). The odds ratio of willingness to vaccinate was particularly greater among parents who believed that the vaccine was safe (aOR, 2.11; 95% CI, 1.01-4.45); the their daughter might become sexually active (aOR, 1.84; 95% CI,1.08-3.13); and they have support from other family members to vaccinate their daughter (aOR, 2.86; 95% CI, 1.47-5.57). Willingness to vaccinate their daughter with HPV vaccination was also greater among parents who believed that vaccination was one way that parents could ensure their child's health (aOR, 10.75; 95% CI, 3.04-38.0), and among those who believed that HPV infection could causes evere health problems (aOR, 1.64; 95% CI, 1.04-2.57). Parents with 1-10 years of education were more willing to vaccinate their daughter compared with parents who lacked any education (aOR, 1.92; 95% CI, 1.13-3.26;Table 4).In contrast, the odds ratio of willingness to vaccinate was negatively associated with the perceived barriers of HPV vaccination (aOR, 0.92; 95% CI, 0.87-0.99). The odds were particularly lower among parents who believed that their daughter was at low risk to get cervical cancer (aOR, 0.52; 95% CI, 0.29-0.95); the family might disapprove of getting their daughter vaccinated (aOR, 0.45; 95% CI, 0.22-0.76), and that the injection might cause pain (aOR, 0.53; 95% CI, 0.31-0.89). Parental willingness to vaccinate their daughter also decreased with increasing age of the parent (aOR, 0.96; 95%CI, 0.93-0.99; Table 4).

Discussion

The purpose of this study was to examine facilitators and barriers to parental acceptability of HPV vaccine for adolescent girls in rural Mysore, India. Most of the parents (79.9%) were willing to vaccinate their daughter with HPV vaccine. The main factors associated with HPV vaccine acceptance were parental education, the belief that the vaccine was safe and HPV infection could cause severe health problems, daughter might become sexually active, having support of other family members to vaccinate daughter, and believing that vaccination is one way to ensure their child's health. On the contrary, low risk perception that daughter will get cervical cancer, fear that other family members might disapprove of getting daughter vaccinated, injection might cause pain, and increasing age of the parent were all associated with not intending to accept HPV vaccination for their daughter.

There was a higher rate of HPV vaccine acceptance in this population compared with that reported among parents in the other regions of India (range, 46%-74%)[13,14,22] and other countries in south Asia (range, 26.5%-84.0%).[23-26] Even within the same district, vaccine acceptance in this rural study population was greater than among parents living in the urban region (71.1%).[14] This increased rate of HPV vaccine acceptance in the current study could be because of better awareness about cervical cancer and HPV vaccine, or because of a more positive attitude toward vaccinations in general and the immunization programs run by the government. Indeed, a study reported higher levels of knowledge about general issues related to vaccination among parents who lived in rural than urban areas of the same district, where the current study was conducted.[11] The level of awareness about HPV in Senegal was also greater among adolescents and parents who were living in rural area than those who lived in the urban ones.[27] The National Rural Health Mission that was started in 2005 by the government of India to improve maternal child health outcomes in rural India has focused on improving immunization coverage at the village level in rural India. This initiative might have also helped increase knowledge, sensitize the rural

residents about the importance of immunization in general, and helped develop positive attitudes toward vaccination among rural parents in this area.

The perception that their daughters were at low risk to get cervical cancer, pain associated with injection, and disapproval by other family members for vaccinating daughters were significant predictors of low parental acceptability of HPV vaccine for their daughters. A study among urban parents in the same district also reported association of the belief that injection might cause pain with a lower odds of HPV vaccine acceptance.[14] Parental beliefs that their daughter might be at low risk of getting cervical cancer could be because of lack of knowledge that HPV infection is a cause for cervical cancer.[7] Disapproval of other family members to get their daughter vaccinated might be because of a lack of awareness that adolescents are susceptible to HPV infection.[28] To reduce these barriers and promote HPV vaccination of girls in this area in the future, public health education programs for parents must focus on the transmission mechanisms of HPV infection, cancers caused by HPV infection (eg, cervical cancer), and the fact that cervical cancer can be prevented by HPV vaccination.[29-33] The scope of this education should be broadened to include extended family members because they have a large influence on parental decision-making to recommend HPV vaccination for girls in the community.

Another barrier to HPV vaccine acceptability in this study was the older age of the parent. This finding is consistent with a previous report from Indonesia, which showed lower HPV vaccine acceptance among older-age parents compared with the younger ones.[34] A study in Thailand also showed lower acceptability of HPV vaccine for daughters among parents older than 45 years compared with those younger than 45 years.[24] More positive attitudes among younger parents could be because of changing sexual norms, access to information compared with older age parents, who might be less interested in health information related to sexually transmitted infection. In addition, older age parents might have negative beliefs about HPV vaccine because of previous experiences with and beliefs about vaccinations in general (side effects). Further research should focus on understanding the information needs of older parents to improve HPV vaccine acceptability in rural India.

A strength of this study was the focus on a rural population, a population that has not been studied adequately. In addition, this study included a relatively large probability sample on the basis of weighted random sampling methods. Almost all of the study participants contacted participated in this study because the population was interested and so few groups or organizations are interested in getting the opinion and understanding the needs of rural residents in this region. However, the study was not without limitations. Only parents of school-going adolescent girls were included in this study. This would limit generalizability of the findings to parents who do not have school-going children within that age group. Furthermore, because of variations in social practices, culture, religion, and economic composition, all of which might affect individual beliefs about HPV, cervical cancer and HPV vaccine, the current study findings might not be generalizable to parents in other regions of India. The fact that only 8 parents were Muslim in the current study might also limit generalizability of the results to other religions because most of the sample belonged to the Hindu religion. Most of the Muslims in Mysore districts are concentrated in urban areas with a very small percentage living in rural regions. However, Muslims form a sizable portion of the overall population in India.[15] In addition, because the data were self-reported, some parents, especially the illiterate ones, might have received support from friends or extended family members while responding to some questions, which might have caused information bias. Moreover, although provision of information about cervical cancer prevention methods, HPV, and HPV vaccine enabled illiterate parents or those who lacked knowledge to answer some questions related to attitudes and beliefs about cervical cancer, HPV, and HPV vaccine, this might have also overestimated the strength of association between HPV vaccine acceptability and attitudes about HPV, cervical cancer, and HPV vaccine in this sample. Moreover, there were missing data for some questions,

which might lead to a biased estimation of the observed association between parental beliefs and attitudes about HPV vaccine and cervical cancer with HPV vaccine acceptance. However, the multiple imputation method used to predict the missing values showed results that were comparable with those obtained with analysis with complete data sets after removing the missing values. There was a very minor difference in the magnitude of the odds ratio, standard errors, and 95% CI estimates. The current study assessed parents willingness to vaccinate their daughter with HPV vaccine. Hence, we cannot be sure if parents would actually vaccinate their daughter if the vaccine were offered. According to the conceptual framework proposed by Fernandez et al, which guided this study, the nature of the environment will further modify the influence of parent's willingness to vaccinate their daughter with HPV vaccine on the actual uptake of HPV vaccine.[19] Finally, the study was conducted between September and October, 2011. There might have been changes in the beliefs and attitudes of parents regarding HPV infection, cervical cancer, and HPV vaccine in the past 7 years. This time delay in the conduct and the presentation of the study results might influence the nature of policy measures that can be designed to increase HPV vaccine acceptability among rural parents in Mysore, India.

*Conclusion*s

In conclusion, this study is one of few studies that ad-dresses public health issues among rural Indians. Willing-ness to vaccinate their daughters with HPV vaccine was high among rural parents in Mysore district. However, public health education programs to reduce the false perception of low risk of getting cervical cancer, and fear of pain with injection will be important issues on which to focus among parents in Mysore to reduce cervical cancer rates and further improve parental acceptability of HPV vaccine in the district. Health education programs should target older-aged parents as well as extended family members to ensure increased vaccination uptake in the future in rural India.

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Table 1: HPV, Cervical Cancer, and HPV Vaccine Information Presented to the Participants in Mysore, India, 2011

What is cervical cancer?

Cervical cancer is a disease which affects the entrance to the uterus (womb). It is the result of uncontrolled growth of abnormal cells which eventually form a lump or tumour

If cervical cancer is not detected and treated early, it can lead to serious health consequences including death.

What causes cervical cancer?

Scientists have linked most cases of cervical cancer to a common virus called human papillomavirus or HPV

How is HPV related to cervical cancer?

There are over 100 HPV virus types but only about 15 that cause cancer. The two most common types, 16 and 18, are responsible for most cases of cervical cancer

HPV infection that causes cervical cancer has no symptoms**.**

Women who develop cervical cancer are usually unaware of their HPV infection

While HPV may clear up on its own without treatment, some women are unable to rid themselves of the infection. Often, these women are at higher risk for cervical cancer

When an HPV infection persists, it can cause cell changes which eventually lead to cervical cancer if left untreated

HPV can also cause genital warts, small lumps or growths on the genitals. While these are unrelated to cervical cancer and are generally not dangerous, they can be prevented through vaccination

How does HPV Cause Cervical Cancer?

HPV is generally spread through sexual contact. In India, most women acquire the infection when they marry.

Sexual intercourse is not required to spread an HPV infection. The virus easily travels from person to person by skin-to-skin contact alone

HPV causes cancer through a slow process. If a woman is unable to clear the infection, the cells in her cervix gradually change. If these abnormal cells are not detected and treated, they can become a cancerous tumour

What is the HPV vaccine?

A vaccination has now been developed that will protect women against infection with HPV

The vaccination will help prevent cervical cancer

It will also protect against genital warts

Trials of the vaccination have shown it to be 99% effective in protecting against infection with the most common cancer-causing HPV viruses

The vaccination must be given to girls before they become sexually active, in order to get full protection

Table 2: Sociodemographic Characteristics of Participants and HPV Vaccine Acceptability in Mysore, India, 2011 (n=831)

		Total	Percent of willing to vaccinate	p-value
Sex	Male	193	77.7	
	Female	638	80.6	0.388
Age in years	35 or younger	443	81.5	0.125
	36-40	228	80.3	
	41-50	129	77.5	
	Older than 50	31	64.5	
Education	No formal education	527	76.1	0.006
	Grade 1 to 10^{th}	285	86.3	
	More than 10^{th} grade	19	89.5	
Occupation	Retired/unemployed	11	72.7	0.030
	Fulltime homemaker	347	82.1	
	Self-employed	58	87.9	
	Employed part-time	357	75.4	
	Employed fulltime	58	87.9	
Marital Status	Separated/widowed	71	78.9	0.821
	Married	760	80.0	
Religion	Hindus	823	80.0	0.728
	Muslim	8	75.0	
Have you ever heard about HPV?	No	204	83.3	0.159
	Yes	627	78.8	

Table 3. Attitudes and beliefs about HPV, cervical cancer, vaccination and HPV vaccine acceptability in Mysore, India, 2011 (N=831)

		Total	Percent willing to vaccinate	p-value
Susceptibility to HPV or cervical cancer				
My daughter may be at risk of getting HPV infection	Disagree	194	76.8	0.419
	Do not know	523	80.5	
	Agree	114	82.5	
It is likely that my daughter may get HPV infection in the future	Disagree	172	77.3	0.168
	Do not know	538	79.4	
	Agree	121	86.0	
It is possible that my daughter will get cervical cancer in the future	Disagree	175	76.6	0.290
	Do not know	555	81.4	
	Agree	101	77.2	
It is likely that my daughter may get cervical cancer someday	Disagree	184	77.2	0.532
	Do not know	531	81.0	
	Agree	116	79.3	
Severity of HPV or cervical cancer				
I believe that HPV infection can cause serious health problem	Disagree	74	70.3	<0.001
	Do not know	283	73.1	
	Agree	474	85.4	
I believe that HPV infection can be extremely harmful.	Disagree	84	64.3	<0.001
	Do not know	226	71.2	
	Agree	521	86.2	
I believe that cervical cancer is a serious disease	Disagree	90	68.9	<0.001
	Do not know	245	73.9	
	Agree	496	84.9	
I believe that cervical cancer can be extremely harmful.	Disagree	73	65.8	<0.001
	Do not know	523	84.7	
	Agree	235	73.6	
Perceived facilitators to HPV vaccination				
Recommendation from doctor or nurse	No	40	57.5	
	Yes	787	81.2	<0.001
Worry about daughter getting cervical cancer	No	346	77.5	
	Yes	470	81.3	0.180
Believe that HPV vaccine is safe	No	68	54.4	
	Yes	740	82.6	<0.001
Worry that daughter may become sexually active	No	379	76.0	
	Yes	403	83.4	0.01
Support from family members to vaccinate your daughter	No	107	59.8	
	Yes	716	82.9	<0.001
Knowing more about the relationship of HPV to cervical cancer	No	103	64.1	
	Yes	722	82.0	<0.001
Government approval of vaccine	No	117	67.5	
	Yes	698	81.8	<0.001
Belief that vaccine will prevent cervical cancer	No	77	57.1	
	Yes	748	82.3	<0.001
Perceived facilitators to vaccination in general				
Vaccinations are effective in preventing disease	No	123	72.4	
	Not sure	168	78.6	
	Yes	515	82.5	0.034

It is very important that my daughter receive all her vaccinations	No	15	53.3	
	Not sure	42	66.7	0.002
	Yes	767	81.4	
Vaccination is one way that parents can ensure their child health	No	23	39.1	
	Not sure	64	59.4	
	Yes	732	83.5	<0.001
I have a responsibility to have my children vaccinated for the protection of all children.	No	17	76.5	
	Not sure	27	55.6	0.004
	Yes	770	81.2	
The government does a good job providing vaccine and health services	No	33	84.8	
	Not sure	75	68.0	0.016
	Yes	708	81.5	
I would feel responsible if anything bad happened I did not my child vaccinated	No	105	76.2	
	Not sure	97	71.1	
	Yes	600	83.7	<0.005
Perceived barriers to HPV vaccination				
High cost of the vaccine	No	281	75.8	
	Yes	544	81.8	0.042
Low risk that daughter will be infected with HPV	No	230	75.2	
	Yes	590	81.4	0.050
Low risk that daughter will get cervical cancer	No	255	78.8	
	Yes	562	80.3	0.638
Family will disapproval of getting daughter vaccinated	No	383	83.0	
	Yes	430	77.4	0.047
Injection may cause pain	No	360	85.0	
	Yes	459	76.0	0.001
Not enough information available about HPV vaccine	No	253	75.1	
	Yes	563	82.2	0.018
Worried about safety of the vaccine	No	228	77.1	
	Yes	591	81.0	0.131
Vaccination may not be effective	No	257	78.6	
	Yes	569	80.3	0.569
Perceived barriers to vaccination in general				
I would feel responsible if anything bad happened I had my child vaccinated	No	226	77.9	
	Not sure	133	84.2	0.278
	Yes	442	81.9	
I am concerned about side effects of vaccinations	No	314	79.9	
	Not sure	189	80.4	0.811
	Yes	299	81.9	
I am afraid of vaccinating my children	No	521	83.7	
	Not sure	63	57.1	<0.001
	Yes	238	78.2	
It is better to get the disease and get protected naturally than vaccinated	No	158	87.3	
	Not sure	92	75.0	0.027
	Yes	563	78.9	
There are too many vaccines already included in childhood vaccine schedule	No	83	59.0	
	Not sure	180	80.6	<0.001
	Yes	556	82.9	

***Numbers for some items do not add up to 831 due to missing data

Table 4 Facilitators and barriers to accept HPV vaccination among 831 rural parents in Mysore district, India

Variables	Categories	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Sociodemographic factors			
Sex	Female	1.17 (0.78, 1.73)	1.11 (0.59, 2.10)
Age	Continuous	0.98 (0.95, 1.00)	**0.96 (0.93, 0.99)**
Education	Grade1 to 10th	**1.95 (1.32, 2.90)**	**1.92 (1.13, 3.26)**
	≥High school	**2.59 (0.59, 11.26)**	2.09 (0.36, 12.11)
Occupation	Employed	0.81 (0.57, 1.15)	1.17 (0.71, 1.92)
Marital Status	Married	1.05 (0.58, 1.92)	0.48 (0.21, 1.11)
Religion	Muslims	0.71 (0.14, 3.47)	0.68 (.09, 5.02)
Awareness about HPV (Have you ever heard about HPV?)	Yes	1.33 (0.88, 2.03)	1.22 (0.70, 2.10)
Susceptibility to HPV and cervical cancer	Continuous	1.06 (0.97, 1.16)*	0.99 (0.89, 1.10)*
HPV	Continuous	1.33 (0.95, 1.85)	1.50 (.86, 2.61)
Cervical cancer	Continuous	1.08 (0.77, 1.51)	0.90 (0.52, 1.56)
Severity of HPV and cervical cancer	Continuous	**1.31 (1.20, 1.42)***	**1.21 (1.10, 1.33)***
HPV	Continuous	**2.42 (1.80, 3.24)**	**1.64 (1.04, 2.57)**
Cervical cancer	Continuous	**2.09 (1.58, 2.77)**	1.16 (0.73, 1.83)
Perceived facilitators to HPV vaccination	Continuous	1.17 (1.10, 1.24)*	**1.16 (1.07, 1.25)***
Recommendation from doctor or nurse	Yes	**3.20 (1.67, 6.14)**	1.07 (0.41, 2.79)
Worry about daughter getting cervical cancer	Yes	1.23 (0.88, 1.74)	0.82 (0.48, 1.39)
Belief that HPV vaccine is safe	Yes	**3.96 (2.37, 6.63)**	**2.11 (1.01, 4.45)**
Worry that daughter may become sexually active	Yes	**1.27 (1.01, 1.59)**	**1.84 (1.08, 3.13)**
Support from family members to vaccinate your daughter	Yes	**3.21 (2.08, 4.95)**	**2.86 (1.47, 5.57)**
Knowing about the relationship of HPV to cervical cancer	Yes	**2.54 (1.62, 3.96)**	0.92 (0.44, 1.95)
Government approval of vaccine	Yes	**2.23 (1.44, 3.44)**	0.94 (0.49, 1.80)
Belief that vaccine will prevent cervical cancer	Yes	**3.49 (2.14, 5.69)**	1.57 (0.73, 3.36)
Perceived facilitators to vaccination in general	Continuous	**1.26 (1.13,1.40)***	1.09 (0.95, 1.25)*
Vaccinations are effective in preventing disease	Ye	**1.85 (1.17, 2.93)**	1.01 (0.51, 2.00)
It is very important that my daughter receive all her vaccinations	Yes	**4.00 (1.43, 11.20)**	1.63 (0.28, 9.35)
Vaccination is one way that parents can ensure their child health	Yes	**7.56 (3.22, 17.74)**	**10.75 (3.04, 38.0)**
I have a responsibility to have my children vaccinated for the protection of all children	Yes	**1.76 (0.62, 4.98)**	0.33 (0.05, 2.08)
The government does a good job providing vaccine and health services	Yes	0.88 (0.33, 2.39)	0.31 (0.07, 1.32)
I would feel responsible if anything bad happened I did not have my child vaccinated	Yes	**1.67 (1.02, 2.75)**	1.04 (0.50, 2.15)

Perceived barriers to HPV vaccination	Continuous	0.99 (0.95, 1.04)*	**0.92 (0.87, 0.99)***
High cost of the vaccine	Yes	1.40 (0.98, 1.98)	**1.77 (1.06, 2.96)**
Low risk that daughter will be infected with HPV	Yes	1.43 (0.99, 2.07)	1.17 (0.64, 2.14)
Low risk that daughter will get cervical cancer	Yes	1.07 (0.74, 1.53)	**0.52 (0.29, 0.95)**
Family will disapproval of getting daughter vaccinated	Yes	**0.68 (0.48, 0 .97)**	**0.45 (0.26, 0.76)**
Injection may cause pain	Yes	**0.57 (0.40, 0.82)**	**0.53 (0.31, 0.89)**
Not enough information available about HPV vaccine	Yes	**1.51 (1.05, 2.16)**	**1.86 (1.09, 3.18)**
Worried about safety of the vaccine	Yes	1.29 (0.89, 1.86)	0.87 (0.49, 1.54)
Vaccination may not be effective	Yes	0.91 (0.63, 1.31)	1.00 (0.57, 1.77)
Perceived barriers to vaccination in general	Continuous	0.97 (0.89, 1.07)*	0.99 (0.89, 1.10)*
I would feel responsible if anything bad happened I had my child vaccinated	Yes	1.27 (0.85, 1.88)	1.05 (0.58, 1.89)
I am concerned about side effects of vaccinations	Yes	1.09 (0.72, 1.66)	0.95 (0.55, 1.66)
I am afraid of vaccinating my children	Yes	0.68 (0.46, 1.01)	0.77 (0.44, 1.35)
It is better to get the disease and get protected naturally than vaccinated	Yes	**0.56 (0.33, 0.93)**	1.05 (0.54, 2.04)
There are too many vaccines already included in childhood vaccine schedule	Yes	**3.37 (2.06, 5.49)**	1.90 (0.94, 3.84**)**
Do you know someone with cervical cancer?	Yes	0.65 (0.36, 1.15)	0.61 (0.27, 1.38)
Social norms	Continuous	1.03 (0.99, 1.07)*	1.01 (0.97, 1.04)*
Do you think the following people would want you to vaccinate your daughter against HPV infection			
Your Doctors	Yes	**1.94(1.23, 3.07))**	1.55 (0.83, 2.92)
Your spouse	Yes	**2.14 (1.42, 3.24)**	**2.25 (1.22, 4.12)**
Your friends	Yes	1.19 (0.77, 1.83)	1.06 (0.53, 2.09)
Your father & mother	Yes	**1.77 (1.14, 2.74)**	0.84 (0.44, 1.64)
Other relatives	Yes	0.72 (0.48, 1.10)	**0.44 (0.20, 0.94)**
Your in-laws	Yes	1.33 (0.89, 1.98)	1.48 (0.76, 2.88)
Your neighbors	Yes	0.87 (0.54, 1.40)	0.78 (0.35, 1.74)
Source of information about HPV vaccine	Continuous	1.09 (1.00, 1.18)*	1.05 (0.95, 1.16)*
Television	Yes	**1.96 (1.32, 2.92)**	1.16 (0.57, 2.38)
Newspaper or Radio	Yes	1.26 (0.86, 1.85)	0.78 (0.41, 1.51)
Internet	Yes	1.07 (0.76, 1.52)	1.49 (0.89, 2.50)
Doctor	Yes	**2.07 (1.29, 3.30)**	1.50 (0.70, 3.19)
ANM or Anganwadi teacher or Worker	Yes	1.14 (0.74, 1.77)	0.53 (0.27, 1.03)
Friends or Neighbours	Yes	1.20 (0.83, 1.73)	0.71 (0.38, 1.31)
My daughter's school	Yes	0.80 (0.38, 1.67)	0.90 (0.35, 2.31)
Family member or relatives	Yes	1.25 (0.87, 1.80)	1.80 (0.94, 3.45)

Recommended age for HPV vaccination	Continuous	1.13 (0.96, 1.35)	1.10 (0.88, 1.38)

*Odds ratio estimates are based on a GEE that included constructs with composite scores estimated based on the sum of scores of individual items that formed the constructs .
Reference for 'yes' categories are 'no'