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RESEARCH PAPER

Knowledge, attitudes and factors associated with acceptability of human papillomavirus vaccination among undergraduate medical, dental and nursing students in South India

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ABSTRACT

Purpose: To evaluate knowledge, attitudes and factors associated with acceptability of human papillomavirus (HPV) vaccine among undergraduate medical, dental, and nursing students in South India.

Methods: Using a post-test study design, a convenience sample of 988 students (age 18–26 years) were surveyed. The primary outcome was vaccine acceptability (likely to intend to receive the vaccine). Bivariate analysis using Chi-Square test of independence and multivariate binary logistic regression analysis was used to examine factors associated with vaccine acceptability.

Results: Out of 988 students surveyed, majority had heard about cervical cancer (95%), HPV (89.3) or genital warts(77.5). Only 59.7% had heard of HPV vaccine prior to the survey; 65.2% intended to receive the vaccine and 68.3% were willing to recommend the vaccine to others. Participants aged <22 years were less likely to accept the vaccine (OR:0.85, CI:0.76–0.96) compared with participants aged older than 22 years. Medical students (OR:1.12, CI:1.03–1.23), students who reported alcohol use (OR:1.15, CI:1.03–1.29) and those with moderate knowledge scores were more likely to intend to receive the vaccine (OR:1.14, CI:1.04–1.24), compared to others. On multivariate analysis, only course (OR 1.366, CI 1.016–1.835) and attitude score (OR 4.17; CI 2.12–8.2) were statistically associated with intention to receive the HPV vaccine.

Conclusion: Two-thirds of students intended to receive the HPV vaccine. Although the overall awareness of the HPV-related disease and prevention is good, considerable knowledge gaps exists in many areas suggesting that that more education about HPV disease and benefits of vaccination should be included in the undergraduate medical school curriculum.

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Human papillomavirus (HPV) disease; HPV vaccine; knowledge; attitudes and perception; medical students; India

Introduction

Cervical cancer is the fourth leading cancer worldwide among women, with an estimated 527,624 new cases and 265,672 deaths annually.[1] In India, cervical cancer is the second most common cancer among women, accounting for approximately 122,844 new cases and 67,477 deaths annually.[2,3] HPV is a common sexually transmitted infection (STI) and causes a wide spectrum of diseases including anogenital warts and cervical cancers.[4] Persistent infection with one of the high-risk (oncogenic) HPV types is necessary cause of cervical cancer. In India, high-risk HPV types 16 and 18 account for approximately 80% of cervical cancers and 63% of high-grade cervical precancerous lesions.[3] The virus infects epithelial cells of skin and mucosa, and has also been associated with cancer of the oropharynx, vulva, vagina, anus, and penis.[4]

Despite the recommendations by the World Health Organization (WHO) and the availability of highly effective and safe HPV vaccines in more than 100 countries, HPV vaccine is not currently included as part of the national immunization program (NIS) in India; however, the vaccine is available in the private sector since 2008, and in 2016, the State Government of Delhi and Punjab launched HPV vaccine implementation.[5-10] Two types of HPV vaccines are available in India – quadrivalent vaccine (Gardasil^{TM}, Merck, USA, HPV4 targeting HPV types 6,11,16 and 18) and bivalent vaccine (Cervarix^{TM}, GSK Biologicals, Belgium, HPV2 targeting HPV types 16 and 18).[3] The 9 valent HPV vaccine (Gardasil^{TM}, Merck, USA) is not currently available in India.[11] The Indian Academy of Pediatrics Advisory Committee on Vaccination and Immunization Practices (IAP COVI) recommends offering HPV vaccine to all females aged 9–26 years who can afford the vaccine (Category 2 of IAP categorization of vaccines).[11] For girls aged 9–14 years, two intramuscular doses of either of the two HPV vaccines (HPV4 or HPV2) at 6-months interval is recommended. For girls aged 15 years and older, and for immunocompromised girls and women, three doses of the vaccine over a 6-month period is recommended.[10,11]

Barriers for the implementation of HPV vaccine program in India are the vaccine costs, health prioritization, variable epidemiologic surveillance data on HPV-related cancer burden, lack of awareness of HPV, vaccine safety, and societal and cultural barriers.[6,12,13] Community engagement to increase knowledge of HPV disease burden and vaccine safety and efficacy, health care provider training and education, continued advocacy to policy makers for including HPV vaccine as part of the national

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immunization program are some of the key strategies to address HPV vaccine implementation barriers in India.[3,14]

Medical as well as other health care professional students (e.g. dental, nursing, pharmacy), as future physicians and health care providers are the key stakeholders in improving awareness of HPV-related disease burden and advocate for HPV vaccination programs.[15-17] It is important to assess the knowledge of HPV and the acceptability of the vaccine among medical, dental, and nursing students in the health sector, especially given the controversy and debates related to the cultural aspects, disease prioritization and parental attitudes.[6,13] Medical college structure in India differs from those in North America. The Bachelor of Medicine and Bachelor of Surgery (MBBS) degree course in India consists of a 5.5 year (4.5 years of academic education plus 1 year of mandatory rotating internship) and considered as an undergraduate degree (UG) degree program. In general, the candidate should have completed 17 years of age as on December 31 of the year of admission to a school offering a bachelor medical, dental, nursing, or medical and laboratory technology (MLT) UG degree course in India.

The awareness and attitudes about HPV vaccine among undergraduate students have been reported, but data are limited regarding HPV vaccine acceptability and recommendation to others.[15–23] It is important to assess the knowledge of HPV and the acceptability of the vaccine among medical students in the health sector, especially given the controversy and debates related to the cultural aspects, disease prioritization and parental attitudes.[6,13] Utilizing data from previously published studies for survey development,[19-23] we evaluated the acceptability and correlates of HPV vaccination among medical and paramedical students in South India.

Results

Participant characteristics

A total of 1095 participants were approached; 44 were excluded (e.g. inconsistent or incomplete information, unwilling to participate). In addition, 63 participants reported prior receipt of the HPV vaccine and were also excluded from the analysis. The final sample for analysis yielded 988 students 72.3% were females; 50.8% were between the ages of 20–22 years (Table 1). Most were medical students (43.5%) followed by dental (27.9%), nursing (21.1%), and MLT students (7.5%). Majority of participants reported no previous sexual experience (94.5%), did not smoke (93.0%), and did not consume alcohol (86.7%). Eighty-one (79.6%) participants belonged to the middle socio-economic status, defined as those with annual household disposable income between 200,000 Rupees ($3080 at 2017 prices) and 1 million Rupees ($15,398 at 2017 prices) [21].

Awareness of HPV, HPV vaccine and cervical cancer

Out of 988 students surveyed, majority had heard about cervical cancer (95%), HPV (89.3%) or genital warts (77.5%). However, only 59.7% had heard of HPV vaccine prior to the survey.

Table 1. Socio-demographic characteristics of study participants (n = 988).

Characteristics	Number	Percentage
Gender		
Male	274	27.7
Female	714	72.3
Age (years)		
18–19	396	40.1
20–22	502	50.8
23–25	82	8.3
25–26	08	0.8
Degree Course		
Medical (MBBS)	430	43.5
Dental (BDS)	276	27.9
Nursing	208	21.1
MLT	74	7.5
Year of Course		
First Year	318	32.2
Second Year	243	24.6
Third Year	227	23.0
Fourth Year	129	13.1
Internship	71	7.2
Smoking[a]		
Smoker	65	6.6
Non-smoker	919	93.0
Drinking status[b]		
Drinks alcohol	127	12.9
Does not drink alcohol	857	86.7
Economic status[c]		
High & Middle-High	152	15.4
Middle	786	79.6
Middle-low and Low	30	3.0
Location[d]		
Urban	551	55.8
Rural	396	40.1
Father's profession[e]		
Doctor/healthcare provider	113	11.4
Public employed	299	30.3
Self-employed	491	49.7
Retired/unemployed	65	6.6
Mother's Profession[f]		
Doctor/healthcare provider	102	10.3
Public employed	187	18.9
Self-employed	95	9.6
Retired/unemployed	595	60.2
Marital Status[g]		
Single	899	91.0
Married	10	1.0
Dating	68	6.9
Sexual status[h]		
No sexual experience	934	94.5
Sexual experience with contraceptive	31	3.1
Sexual experience without contraceptive	17	1.7

[a,b,c,d,e,f,g,h]Missing data for 4, 4, 20, 41, 20, 9, 11 and 6 students respectively;
Abbreviations: MBBS – Bachelor of Medicine and Bachelor of Surgery; MLT – Medical Laboratory Technology

Sources of information on HPV vaccine

College and universities (42.1%) were the most common source of information followed by TV/internet (12.1%), family or friends (4.9%), and primary care physician (2.9%). However, 37.2% of students had not heard of the WHO recommendations for HPV vaccination.

Knowledge of HPV infection and cervical cancer

Most students (78.0%) knew the sexual route of HPV transmission; 25.8% believed that HPV infection can be asymptomatic (Table 2). Although, 62.6% students knew that cervical cancer is caused by persistent infection with high-risk HPV types, and that HPV can affect males (62.6%), only 37.2% were aware that HPV

Table 2. Summary of knowledge statements on HPV, HPV infection, cervical cancer and HPV vaccine (n = 988).

Q. NO	STATEMENTS	CORRECT ANSWER	TRUE (n/ %)	FALSE (n/ %)	I DO NOT KNOW (n/ %)
HPV, HPV INFECTION, CERVICAL CANCER RELATED STATEMENTS					
1	Cervical cancer is most commonly associated with persistent HPV infection	True	618(62.6)	32 (3.2)	338(34.2)
2	HPV sexually transmitted	True	771 (78.0)	43(4.4)	174 (17.6)
3	More than 50% of sexually active men and women are infected with HPV at some point in their lives[a]	True	329(33.3)	168(17)	485 (49.1)
4	HPV is transmitted to the partner only if the carrier shows symptoms	False	212 (21.5)	353 (35.7)	423 (42.8)
5	HPV can cause oropharyngeal cancer	True	368(37.2)	161(16.4)	459 (46.5)
6	There are specific HPV types that cause cervical cancer	True	583 (59)	35 (3.5)	370 (37.4)
7	Most HPV infections will be cleared by the immune system	True	425 (43.0)	116 (11.7)	447(45.2)
8	HPV can infect males	True	618 (62.6)	90(9.1)	280 (28.3)
9	Most HPV infections don't cause any symptoms	True	255 (25.8)	235 (23.8)	498 (50.4)
10	There is no current antiviral drug to cure HPV	True	228 (23.1)	267 (27.0)	493 (49.9)
HPV VACCINE RELATED STATEMENTS					
11	There is a vaccine to prevent HPV infection[b]	True	523 (52.9)	344(34.8)	117 (11.8)
12	Currently available HPV vaccines protect against 2 or more HPV types[c]	True	276 (27.9)	53 (5.4)	656 (66.4)
13	Both, males and females, should be vaccinated	True	636 (64.4)	203(20.5)	149(15.1)
14	HPV vaccines help clear the existing HPV infection	False	83 (8.4)	466 (47.2)	439 (44.4)
15	Adolescents and young adults are screened for HPV before getting vaccinated[d]	True	451 (45.6)	139 (14.1)	392 (39.7)
16	Girls/women who have already been vaccinated also require cervical cancer screening	True	603 (61)	81 (8.2)	304 (30.8)
17	HPV vaccine is currently recommended for the age group between 9 to 26 years	True	378(38.3)	257 (26.1)	353 (35.7)
18	The market cost of HPV vaccine in India is ranging from 5000 to 10,000 rupees	True	73 (7.4)	248 (25.1)	667 (67.5)
19	Two or more doses of HPV vaccine are required for protection	True	405(41.0)	64 (6.5)	519 (52.5)
20	Condoms protect against HPV	False	489 (49.5)	88 (8.9)	411 (41.6)

[a,b,c]Missing data for 6,4, 3, 6 respectively.

can cause oropharyngeal cancer. Overall, 49.5% of students stated that condoms protect against HPV infection.

Knowledge of HPV vaccine

A minority of participants (24.4%) reported that HPV vaccine may be administered to a woman with prior infection; 21.8% knew that HPV vaccine cannot treat the existing infection. However, 64.4% indicated that both males and females should be vaccinated and 61% knew that cervical cancer screening was required for individuals who are already vaccinated. In addition, 38.3% of participants were aware of the recommended age range (9–26 years) for receiving the HPV vaccine, and 7. 4% knew the vaccine cost as <10,000 Indian rupees (<$154).

Combined knowledge score for HPV infection and vaccination

The HPV infection/vaccination knowledge score was in the range 0 to 18, with a mean score of 8.55 (SD 4.055) Of the 20 knowledge statements, participants could score from 0 to 20 (each correct answer given one point and incorrect/ do not know answers given 0). Of the 988 respondents, 21 (2.1%) scored zero and 3 (0.3%) scored 18 points; none of the participants scored the maximum of 20 points. A total of 439 (44.1%) respondents received a score of 10 points and above. Our study showed no significant difference between males and females' HPV infection/vaccine knowledge scores (p = 0.694); 43.4% males (119 out of 274) and 44.8% females (320 out of 714) received a knowledge core of 10 and above.

In binary logistic regression analysis, medical students (OR: 2.31, CI: 1.75–3.05) and medical and dentistry students with clinical rotations as part of their curriculum (OR: 2.14, CI: 1.58–2.89) had more knowledge compared to students studying other courses and without clinical rotations. Students who had heard of the HPV vaccine beforehand (OR: 1.79, CI: 0.161–1.98) scored higher on the knowledge score. Parents' profession (p = 0.084 for father's and 0.869 for mother's) did not reflect high knowledge on the participants. Parents' profession had no association with participant's knowledge scores.

Attitude towards HPV vaccination

Majority (87.4%) strongly agreed/agreed that HPV infection is a serious condition, but only 12.0% believed that they could be easily infected by HPV (Table 3). Many participants (86.4%) stated that awareness education on HPV should be implemented at schools; 82.5% of participants stated that government of India must make the HPV vaccine affordable to all adolescents and young adults and 68.4% thought that it is preferable to vaccinate both males and females. Less than half (43.4%) of the participants were willing to undergo PAP smear for cervical cancer screening.

Attitude score towards HPV vaccination

The overall attitude score ranged from 34 to 120 with a mean of 62.29 (SD 9.631). On converting the attitude score into a 5-point scale, the attitude score ranged from 1.36 to 4.80 with a mean of 2.49 (SD 0.385) corresponding to an overall positive attitude to HPV vaccination. The lower the attitude score, the more is the positive attitude towards HPV vaccination. There was no significant difference (p = 0.565) in attitude scores between male and female students [27 (9.85%) out of 274 male respondents and 62 (8.68%) out of 174 female respondents had positive attitude towards HPV vaccination]. Students with a history of smoking (13 out of 65, 20%) demonstrated more positive attitude compared to non-smokers (76 out of 919, 8%; p value = 0.001). Almost half of

Table 3. Participant's attitudes towards HPV vaccination (n = 988).

Attitude Assessing Statement	Strongly agree *n* (%)	Agree *n* (%)	Neutral *n* (%)	Disagree *n* (%)	Strongly disagree *n* (%)
I think I can be easily infected by HPV[a]	23 (2.3)	96(9.7)	342 (34.6)	289 (29.3)	231 (23.4)
I think HPV infection is a serious disease[b]	331 (33.5)	533 (53.9)	99 (10.0)	12 (1.2)	5 (0.5)
Getting the HPV vaccine would be beneficial to a teenage girl or boy's future health[c]	393 (39.8)	425 (43.0)	125 (12.7)	33 (3.3)	7 (0.7)
Getting the HPV vaccine will send a message to teenagers that it is OK to have sex[d]	58 (5.9)	172 (17.4)	354 (35.8)	284 (28.7)	111 (11.2)
Education on HPV should be implemented at school[e]	457 (46.3)	396 (40.1)	106 (10.7)	11 (1.1)	5 (0.5)
Men can get involved to prevent their partner from getting cervical cancer[f]	231 (23.4)	395 (40.0)	285 (28.5)	44 (4.5)	12 (1.2)
People who have only one sexual partner have a low risk of becoming infected with HPV[g]	168 (17.0)	405(41.0)	300 (30.4)	86 (8.7)	20 (2)
Using a condom can provide 100% protection against HPV infection[h]	51 (5.2)	219 (22.2)	481 (48.7)	188 (19.0)	41 (4.1)
HPV vaccination is not necessary because a Pap test can be done to rule out cervical cancer[i]	41 (4.1)	106 (10.7)	398 (40.3)	320 (32.4)	114 (11.5)
It is preferable to vaccinate both men and women against HPV[j]	238 (24.1)	451 (45.6)	253 (25.6)	24 (2.4)	12(1.2)
I believe that Government of India must make the HPV vaccine affordable to all adolescents and young adults given the benefits it offers[k]	407 (41.2)	408 (41.3)	152 (15.4)	12 (1.2)	2 (0.2)
I have had family/friends sought my opinion regarding HPV vaccination[l]	74 (7.5)	176 (17.8)	414 (41.9)	218 (22.1)	83 (8.4)
I believe that the HPV vaccine should be recommended for all teenage girls and young women[m]	323 (32.7)	448 (45.3)	190 (19.2)	16 (1.6)	6 (0.6)
I believe that vaccination should be recommended for all teenage boys and young men[n]	264 (26.7)	412(41.7)	252 (25.5)	40(4.0)	13 (1.3)
I believe it would be difficult and embarrassing for me to ask for the HPV vaccine because it is associated with a sexually transmitted infection.[o]	71 (7.2)	190 (19.2)	365 (36.9)	232 (23.5)	124 (12.6)
If other people knew I received the HPV vaccine, I would be embarrassed.[p]	54 (5.5)	144 (14.6)	340 (34.4)	296 (30.0)	148 (15.0)
I would worry about what my partner or future partner would think if I received the HPV vaccine[q]	69 (7.0)	154 (15.6)	321 (32.5)	282 (28.5)	153 (15.5)
If other people knew I have HPV infection, I would be embarrassed.[r]	91 (9.2)	216 (21.9)	321 (32.5)	221 (22.4)	121 (12.2)
I would be willing to get a PAP smear for cervical cancer screening[s]	137(13.9)	292 (29.6)	380 (38.5)	80 (8.1)	51 (5.2)
I would like to receive or recommend HPV vaccination, whether or not they come from conservative families[t]	190 (19.2)	363 (36.7)	351 (35.5)	52 (5.3)	19 (1.9)
I believe that all physicians should recommend every teenage girl to be vaccinated and inform them about harmful effects of HPV[u]	294 (29.8)	442 (44.7)	220 (22.3)	18 (1.8)	6 (0.6)
Knowing the risks of HPV, I would like to be educated by the experts on HPV vaccination[v]	315 (31.9)	430(43.5)	211 (21.4)	19 (1.9)	5 (0.5)
If this vaccine is freely available in schools/clinics, I would be willing to take the vaccine[w]	270 (27.3)	374 (37.9)	288 (29.1)	39(3.9)	10 (1)
If this vaccine is freely available in school/clinics, I would be willing to recommend the vaccine to others[x]	300 (30.4)	375 (38.0)	257 (26.0)	34 (3.4)	10 (1)
Knowing the risks of HPV, I intend on taking HPV vaccine in the future.[y]	278 (28.1)	377 (38.2)	263 (26.6)	32 (3.2)	24 (2.4)

[a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w,x,y]Missing data for 7,8,5,9,13,24,9,8,9,10,7,23,5,7,6,6,9,18,48,13,8,8,7,12,14 respectively.

female students (344 out of 696, 49.43%) expressed their willingness to accept PAP smear for cervical cancer screening; of the 344 female students who were willing to opt for PAP smear screening test, 152 (44.19%) were medical students (pursuing MBBS degree) with clinical rotation experiences with a lower attitude score suggesting a positive attitude towards vaccination (this group represented only 15.4% of the total study participants). Parent's profession (father's profession, p value = 0.817 and mother's profession, p value = 0.265), sexual history (p value = 0.566) and residence location (p value = 0.465) did not play any role in student attitudes.

Participants Likely to Intend to Receive HPV Vaccine and Recommend the Vaccine to Others (Bivariate analysis and binary logistic regression analysis).

In our study, 65.2% of participants intended to receive the HPV vaccine in the future and 68.3% were willing to recommend the vaccine to others, if it was freely available in schools/clinics. On bivariate analysis, participants aged <22 years were less likely to intend to receive the vaccine (OR:0.85, CI:0.76–0.96) and less likely to recommend the vaccine compared with those participants aged older than 22 years (OR:0.75 CI: 0.65–0.87). (Table 4). Medical students (OR:1.12, CI:1.03–1.23) and students who reported alcohol use (OR:1.15, CI:1.03–1.29) were more likely to intend to receive the vaccine, compared to others. Those with good/adequate knowledge scores were more likely to intend to receive the vaccine (OR:1.14, CI:1.04–1.24) and more likely to recommend the vaccine (OR:1.27, CI:1.14–1.42). Participants who showed positive attitude related to HPV vaccination were more likely to recommend the vaccine to others (OR:1.58, CI:1.42–1.77). Based on results of the bivariate analysis, gender (p = 0.788), socio-economic (p = 0.157), clinical rotations (p = 0.577), sexual experience (p = 0.140),

Table 4. Acceptability of HPV vaccine among undergraduate students and recommendations of HPV vaccine to others (bivariate analysis).

	ACCEPTABILITY OF HPV VACCINE AMONG MEDICAL STUDENTS				RECOMMENDATIONS OF HPV VACCINE TO OTHERS			
	Subject in analysis	N (%)	p value	OR (95% CI)	Subject in analysis	N (%)	p value	OR (95% CI)
Gender								
Male	271	184 (67.9)	0.788	1.01 (0.92–1.117)	274	159 (58.03)	0.42	1.05 (0.93–1.19)
Female	703	471 (66.99)			714	394 (55.18)		
Age								
17–22 years	885	586 (66.2)	0.030*	0.854 (0.76–0.96)	898	488 (67.9)	0.001*	0.75 (0.65–0.87)
Above 22 years	89	69 (77.5)			90	65 (72.22)		
Course								
MBBS	422	303 (71.8)	0.008*	1.126 (1.03–1.23)	430	278 (64.65)	<0.001*	1.31 (1.18–1.46)
Non-MBBS	352	200 (56.81)			558	275 (49.28)		
Year								
Clinical	665	451 (67.8)	0.577	1.03 (0.93–1.13)	670	390 (58.2)	0.04*	1.14 (1.002–1.29)
Non-clinical	309	204 (66.01)			318	163 (51.26)		
Socioeconomic status								
High and middle-high	152	110 (72.36)	0.157	1.09 (0.98–1.22)	152	98 (64.47)	0.019*	1.19 (1.04, 1.36)
Middle/middle-low and low	803	534 (66.5)			816	442 (54.17)		
Father's profession								
Healthcare	111	77 (69.37)	0.553	1.042 (0.913, 1.19)	113	67 (59.29)	0.398	1.076 (0.91, 1.27)
Non-healthcare	843	561 (66.55)			855	471 (55.09)		
Mother's profession								
Healthcare	100	69 (69)	0.661	1.033 (0.898, 1.19)	102	53 (51.96)	0.413	0.924 (0.76, 1.124)
Non-healthcare	865	578 (66.82)			877	493 (56.21)		
Smoking								
Smoker	65	48 (73.84)	0.238	1.106 (0.95, 1.29)	65	44 (67.69)	0.047	1.229 (1.03, 1.47)
Non-smoker	905	604 (66.74)			919	506 (55.06)		
Alcohol								
Consumes alcohol	126	96 (76.19)	0.020*	1.159 (1.039, 1.29)	127	89 (70.08)	0.001*	1.31 (1.15,1.49)
Non-alcoholic	844	555 (65.76)			857	460 (53.68)		
Sexual experience								
Sexual experience with or without condom	48	37 (77.08)	0.140	1.153 (0.98, 1.35)	48	28 (58.33)	0.75	1.04 (0.815, 1.33)
No sexual experience	920	615 (66.85)			934	523 (55.99)		
Calculated knowledge score								
Good/adequate knowledge (10–20)	434	313 (72.12)	0.004*	1.14 (1.04, 1.24)	439	279 (63.55)	<0.001*	1.27 (1.14, 1.42)
Poor knowledge (0–9)	540	342 (63.33)			549	274 (49.91)		
Calculated attitude score								
Positive attitude	89	79 (88.76)	<0.001*	1.36 (1.24, 1.49)	89	75 (84.27)	<0.001*	1.58 (1.42, 1.77)
Negative attitude	885	576 (65.08)			899	478 (53.17)		
Information source								
No information	362	237 (65.47)	0.363	0.96 (0.874, 1.05)	368	192 (52.17)	0.064	0.896 (0.796, 1.009)
Others (media, college, etc,)	612	418 (68.3)			620	361 (58.23)		

Abbreviations: MBBS, Bachelor of Medicine and Bachelor of Surgery; CI, confidence intervals; OR odds ratios.

smoking (p = 0.238), father's profession (p = 0.553), and mother's profession (p = 0.661) were not found to be significant factors for participants likely to intend to receive the HPV vaccine. Based on results of the bivariate analysis, gender (p = 0.42), sexual experience (p = 0.75), smoking (p = 0.047), father's profession (p = 0.398), and mother's profession (p = 0.413) were not found to be significant factors for recommending the vaccine to others. Variables that were significant for acceptability of the vaccine included age (p value = 0.03), course (p value 0.008), alcohol (p value 0.020), knowledge score (p value 0.004) and attitude score (p value < 0.001). These variables were then considered for multivariate analysis to see which of these factors cause significant effect on the dependent variable (intention to receive the vaccine). Since the dependent variable is categorical and takes only two values, either yes or no, we performed multivariate binary logistic regression analysis. Results of binary logistic regression analysis for intention to receive the vaccine and recommendations of the vaccine to others are shown in Table 5. In adjusted analysis, only type of degree course (OR 1.366; CI 1.016, 1.835) and attitude score (OR 4.17; CI 2.12, 8.2) were statistically associated with student's intention to receive the HPV vaccine. Course (OR 1.694; CI 1.286, 2.232), alcohol use (OR 1.790; CI 1.173, 2.734), knowledge score (OR 1.499; CI 1.142, 1.969) and attitude score (OR 4.975; CI 2.747, 9.009) were found to be significant factors associated with student's recommendation of the vaccine to others.

Discussion

In this study, approximately two-thirds of the students intended on receiving the HPV vaccine and recommending the vaccine to others, which is similar to the findings from the other surveys done in India and China.[15,21,24] Low vaccine acceptability among medical students has also been reported in Chennai, South India and Chongqing, China.[16,25]

Educating the medical and paramedical students about HPV-related disease and the importance of vaccination is a key strategy given the crucial role of HCP recommendation to improve the uptake of adolescent HPV vaccines.[26,27] In the current study, the key predictors of intention to receive the HPV vaccine were students enrolled in medical school (compared to nursing or dental students) and positive attitude.[26] Factors associated with recommendation of the vaccine to others were students older than 22 years, medical students, alcohol use, moderate knowledge HPV infection/vaccine knowledge and positive attitude.

Table 5. Acceptability of HPV vaccine among undergraduate students and recommendations of HPV vaccine to others (binary logistic regression analysis).

Variables	P value	Odds Ratios	Confidence Intervals
Acceptability of HPV Vaccine (Intention to receive the vaccine)			
Course	0.039	1.366	1.016, 1.835
Attitude score	<0.001	4.17	2.12, 8.2
Recommendations of HPV Vaccine to Others			
Course	<0.001	1.694	1.286, 2.232
Alcohol use	0.007	1.790	1.173, 2.734
Knowledge score	0.004	1.499	1.142, 1.969
Attitude score	<0.001	4.975	2.747, 9.009

In the present study, students had moderate knowledge of HPV infection and vaccine. The majority of the participants knew that HPV is a STI and can cause cervical cancer. However, many participants were unaware that HPV infection is often asymptomatic, may cause oropharyngeal cancer, and the absence of specific anti-viral therapy. Only 50% of students were aware of the HPV vaccine. In a study conducted among medical students enrolled in a government medical college in the State of Andhra Pradesh, 54% of participants were aware of the HPV vaccine for cervical cancer prevention.[28] In contrast, majority of students surveyed at other medical schools in South Indian States of Karnataka (75.6%) and Tamil Nadu (86.4%) were aware of the availability of HPV vaccine for cervical cancer prevention.[15,16] Our study showed no significant difference between males and females' HPV infection and vaccine knowledge scores. Previous reports from India have found that male students had poor awareness of cervical cancer, HPV disease and vaccine.[15,29]

The differences in knowledge about HPV infection and availability of HPV vaccine among students in our study compared to other reported studies may be multifactorial such as lack of education about HPV infection and availability of a safe and effective vaccine to prevent cervical cancer, lack of exposure to HPV-related disease burden in certain affluent private medical colleges and university (compared to governmental medical colleges which predominantly serve low-income populations at high risk for cervical cancer), inadequate exposure to print and audio-visual media in some settings, socioeconomic factors, societal and religious factors, and stigma.[15-17,30,31]

In the present study, senior students exposed to clinical rotations as part of their curriculum had higher knowledge on HPV and positive attitude for PAP smear testing compared to first year students which may be attributed to the medical education system in India where students are exposed to clinical aspects of medicine only after the first year. In one report from India, college students enrolled in a biology major course had higher knowledge and awareness regarding cervical cancer compared to students enrolled in non-biology courses.[29]

In the present study, medical students had more knowledge compared to students studying other courses. In a study from Malaysia, medical students had the highest level of knowledge about HPV infection and vaccine compared to dental and pharmacy students.[24] In contrast, another study reported that nursing students had more knowledge on HPV vaccine compared to medical and dental students.[16] In addition to physicians, other health care providers including dentists, nurses and pharmacists play an important role in patient education regarding the benefits of HPV vaccination and offering a strong recommendation.[32]

In the present study, medical students and students with a more positive attitude towards vaccination was associated with intention to receive the HPV vaccine. Studies conducted in the U.S. have found that parents or young women are more likely to accept the HPV vaccine when they receive written educational information about the risks and benefits; however, other reports suggest that parental attitudes and life experiences play a major role in influencing HPV vaccine acceptability.[33-35] In one survey, most parents of adolescent girls in Mysore, India

were willing to accept the HPV vaccine for their daughters, regardless of poor awareness of HPV and its association with cervical cancer.[36] In another study from Kolkata, 80% of parents agreed to vaccinating their daughters against HPV after they were provided a vaccine information sheet.[13] A U.S. study reported that 64% of parents agreed to accept the vaccine for their daughters and recommend it to others.[19]

In our study, only 6% of the students had received the HPV vaccine prior to the survey despite increased high participant reported awareness of HPV and HPV vaccine. In a study from North India, similar low rate (7%) of HPV vaccine acceptance was reported among college students from higher socioeconomic status indicating that lack of awareness, personal beliefs, societal, religious, and cultural barriers may account for poor uptake of HPV vaccine.[6,29,37,38] Other reasons cited for poor acceptability of HPV vaccine in India are the high cost, concerns about vaccine safety, relatively low public health spending, lack of uniform health choices, and lack of national policy on cervical cancer screening.[6,12,13] Concerns about adverse effects of HPV vaccine and inadequate information were the most common barriers to vaccine acceptance among medical students in China.[21]

College/university was the main source of information about HPV among our respondents. Studies have reported news, magazines, mass media, and HCP are primary sources of HPV vaccine information.[24,37] In our study, one-third of respondents preferred health clinics set up in school, colleges and universities as preferred sites for receipt of HPV vaccine, consistent with other reports from Greece and China.[38,39] In a cross-sectional study from Gaborone, Botswana, 70% of parents reported that they would be willing to have their daughters vaccinated at schools if the vaccine was available.[40] Schools and television were regarded as the ideal methods of disseminating HPV vaccine information and cervical cancer prevention in Ghana.[41] School-based HPV vaccination have been successfully implemented in in the United Kingdom and Australia.[42,43]

The present study has many limitations including use of a post-only study design, convenience sampling, and inclusion of a single site. The pilot testing of the questionnaire was conducted on 10 participants which may limit the results of the internal consistency reliability test. Participant self-reported data might also have resulted in selection and information bias. The number of female participants were more in number since the nursing batch had female students more than the males. This study did not investigate religious and other unique cultural barriers including concerns for high-risk sexual behaviour. This study did not use validated measures available in the literature to measure HPV vaccine knowledge and attitudes, which limits our ability to compare data with other studies and settings. In the present study, we combined the HPV infection and HPV vaccination knowledge items into once scale, although measuring HPV infection/vaccination knowledge as separate constructs would have strengthened validity. The negative statements used in the combined attitude questions were not reverse coded which may also limit the psychometric validity and interpretability of the attitude scale used in our study.

This study underscores the need to develop a well-designed educational program on HPV vaccine and cervical cancer control and prevention for medical and paramedical students in India. Future prospective studies could evaluate the impact of innovative multi-component medical school curriculum (e.g. case-based curricular methods coupled with interactive small group discussions, simulation training, communication strategies to address vaccine hesitancy) to improve knowledge and promote HPV vaccine recommendations.[44] Given the high burden of cervical cancer and other HPV-associated diseases in India, medical and paramedical students can play a pivotal role in implementing a successful HPV immunization program as future health care providers. Future studies should also evaluate implementation of population-based cervical cancer screening and perform comparative cost-effectiveness analysis of HPV vaccination strategy versus cervical cancer screening in India.[3,7] The introduction of HPV vaccine as part of the NIS in India must be considered by policy makers to significantly reduce the cervical cancer burden.[3]

Conclusion

Two-thirds of students in South India intended to receive the HPV vaccine. Although the overall awareness of the HPV-related disease and prevention is good, there is considerable knowledge gaps in many areas. We suggest that more education about HPV disease and benefits of HPV vaccination should be included in the undergraduate medical school curriculum to address the knowledge barriers among medical and paramedical students.

Methods

Study design, site and participants

Using a post-test study design, we conducted a survey among undergraduate students from November 2016 to February 2017 at a tertiary care teaching hospital in Mangalore, a coastal city in the Southern State of Karnataka, India. Participants included in the study were medical, dental, nursing, and MLT students of both sexes, aged 18– 26 years. Students aged <18 years and >26 years, not enrolled in the above referenced medical and paramedical courses, not willing to participate, surveys with missing data (>5% for any variable) were excluded from the study. Using a convenient sampling method, study participants were surveyed in a private setting at the beginning or at the end of a class. Written informed consent was obtained from all participants. This study was approved by the Institutional Review Board at K.S. Hegde Medical Academy, Deralakatte, India.

Measure

A 61-item, self-administered, semi-structured anonymous questionnaire was designed consisting of 4 sections: The first section determined participant socio-demographic information (Table 1). The second section assessed awareness of HPV infection, cervical cancer, and HPV vaccine. Information on the awareness was determined by using four

items with Yes-No responses (have you heard of 1) HPV; 2) cervical cancer; 3) genital warts; and 4) HPV vaccine. The third section determined knowledge of HPV infection (10 questions) and HPV vaccine (10 questions) using one measure with True/False/I don't know responses (Table 2).

Following completion of the third (knowledge) section of the survey, participants received a brief 1-page information pamphlet about HPV and vaccine after review of which they were asked to complete the remainder of the survey. The fourth section assessed attitudes towards HPV vaccination using 25 statements on a 5-point Likert scale (Table 3). The attitude questions included positive and negative statements about HPV vaccination. Reverse coding was not needed for any of the negative statements. Participants could choose more than one option only for the question about risk factors for cervical cancer, HPV-related diseases, and information sources.

The survey was designed based on prior studies.[19-23] After developing the survey items, we conducted a content review by 3 reviewers. Reviewers were selected based on their clinical and research experience in HPV and cervical cancer, expertise in pediatric/adolescent vaccine sciences, infectious diseases, public health and microbiology. Reviewers examined the accuracy of the items in each content domain and also discussed potential concerns that may arise during the administration of the questionnaire. The questionnaire was then pilot tested among 10 random participants to determine the clarity and comprehension of the survey items. The Cronbach's alpha for Section C (HPV knowledge and HPV vaccine related knowledge), and Section D (Attitude toward HPV vaccination) of the questionnaire was 0.850 and 0.814 respectively.

Outcome measures

All study participants (range, 18–26 years) were eligible for HPV vaccination. In our study, 6% (63/1051) of the students had already received at least one dose of the HPV vaccine series and therefore excluded from the analysis. The final analytic sample consisted of 988 participants who had not received the vaccine.

The main outcome measure was to find the willingness of the respondent to accept the vaccine (likely to intend to receive the vaccine), assessed by the question: "If the HPV vaccine is freely available in schools and clinics in India, would you receive it?" (possible responses: strongly agree, agree, neutral, disagree, strongly disagree). The secondary outcome measure was to find out the willingness of the participant to recommend the HPV vaccine to others, assessed by the question: "If the HPV vaccine was freely available in schools and clinics in India, would you recommend the vaccine to others?" (possible responses: strongly agree, agree, neutral, disagree, strongly disagree).

Knowledge score

The knowledge section included 20 statements (true or false) regarding HPV infection (10 questions) and HPV vaccine (10 questions). Each accurate response to the 20 knowledge questions HPV infection or vaccine received one point, while zero point was given to an incorrect or 'I do not know' or a missing response. The knowledge score was dichotomized to facilitate statistical analyses with higher knowledge considered as 10 or more points on the knowledge scale. Higher knowledge score suggested that the participants were more knowledgeable about HPV infection and vaccination.

Attitude score

The attitude section included 25 statements regarding attitude towards HPV vaccination. A 5-point Likert scale was used to compute the attitude score based on the participant responses to the 25 attitude statements: Strongly Agree (1 point), Agree (2 points), Neutral (3 points), Disagree (4 points), and Strongly Disagree (5 points). Thus, the total attitude score corresponding to each respondent could range from 25 to 125. The attitude score was converted into a scale of 1–5. Positive attitude towards HPV vaccination correlated to an attitude score near 1.

Statistical analysis

All statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS), (version 20.0; SPSS, Chicago, Illinois, USA). Sociodemographic characteristics are presented as frequencies and percentages. The data was summarized using descriptive statistics and first analysed using bivariate analysis. A p value less than 0.05 were considered to be statistically significant. Bivariate analysis using Chi-Square test of independence and multivariate binary logistic regression analysis was used to examine factors associated with vaccine acceptability and recommendation of the vaccine to others.

Differences in HPV infection/vaccine knowledge scores were examined by gender and other demographic characteristics using the chi-squared test of independence. The same analysis was performed on the variables of age, course (whether MBBS or other course), year of study (whether clinical or non-clinical), economic status, father's profession, mother's profession and the sexual status. The variables which were found to be highly significant (p value <0.001) were age, course, year of study and the economic status. These significant variables were further considered for binary logistic regression analysis to evaluate which of these factors caused significant difference in the knowledge scores. On binary logistic regression analysis, only course, year of training and economic status caused significant effect on the knowledge score.

Bivariate analysis was done to check for the dependent variable of HPV vaccine acceptability (likely to intend to receive the vaccine) and recommendation of the vaccine to others on gender, age, course, year, socioeconomic status, parents' profession, smoking and alcohol status, and sexual experience. The inference was drawn using the Chi-Square test of independence of attributes. These tests found that age, course, alcohol use, knowledge and attitude scores had shown significant influence on the acceptability of the vaccine. For recommendation of the vaccine to others, variables of age, degree course, year of training, socioeconomic status, alcohol use, knowledge and attitude scores had shown similar significant influence.

Variables that were found to be significant on bivariate analysis (p value <0.05) were then considered for binary logistic regression analysis to evaluate which of these variables cause significant effect on the dependent variable (Intention to receive the HPV vaccine and Recommendation of the vaccine to others). The association measure was calculated using adjusted odds ratios (OR) and 95% confidence intervals.

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Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed

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