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Original Research Article

Understanding Knowledge Gaps in HPV Infection and Vaccination among Medical Students and Its Implications on Current and Future Trends of HPV Prevention Strategy in India

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Abstract:

Background: HPV infection attributed cancers are more common among women in low- and middle-income countries, while men are more commonly affected in high-income countries. There is a gap in knowledge about HPV infection, HPV vaccine and preventive strategies among the health care providers which will determine the future trends of HPV infection in India. Hence, this study was conducted with the aim of assessing the level of knowledge regarding HPV infection and the role HPV vaccine as a preventive strategy among the medical students.

Materials & Methods: Between January 2018 and March 2018, data were collected using a pre-structured questionnaire, approved by the ethics committee that was distributed through an online web portal. Responses were stored in a cloud-based format on Qualtrics, and analyzed in SPSS. All participants completed informed consent prior completion of the survey.

Results: of the 498 participants who completed the survey, 114 (22.9%) were in pre-clinical, 151 (30.3%) in preclinical and 233(46.8%) were in clinical stage of their medical training. The level of knowledge among medical students increased with the number of years spent in medical school across all domains ($p < 0.0001$). However, in key areas crucial to understanding the transmission of HPV and its impact on disease prognosis, students demonstrated poor knowledge. Of the female students, only 7.5% (17) had been vaccinated against HPV.

Conclusion: The knowledge gap among future healthcare providers significantly hinders the effective implementation of preventive strategies. It is essential to take comprehensive measures, addressing everything from policy-making to raising awareness among high-risk populations, and equipping healthcare providers with the necessary training and knowledge to achieve the WHO cervical cancer elimination goal by 2030.

Keywords: HPV vaccine, knowledge, medical students, cervical cancer, head and neck cancer.

Introduction

Cancer will be the leading cause of premature mortality by 2030, among which ¾th burden will be from lower- and middle-income countries (LMIC) affecting the productivity according to the Globocan 2022 report [1]. Infectious agents contribute to nearly 15% of global cancers, and 26% of these cancers are seen in developing countries [2].

The Asian Region, contributes to about 37.9% of cancers, which were attributed to Human Papillomavirus (HPV), helicobacter pylori and Hepatitis B infections. HPV infection attributed cancers were more common among women in LMIC countries, while men were more commonly affected in high-income countries (HIC). Globally, the

infection rates varied from 6.9 /100,000 person-years in HIC to 16.1/ 100,000 persons-years in the LMIC [3]. However, in India Age-standardised incidence rates (ASIR) is 9.0 /100,000 person years, where in nearly 75-90% of cervical cancer, 34% of head and neck cancer is caused by HPV infection [3-10].

Though tobacco is an important etiological factor for head and ,neck cancers (HNC) in Asia, its association with HPV infection further reduces survival and treatment response along with an increase in risk for progression of severity and mortality by 1 to 1.5% [5]. With very low cancer screening rates, India accounts for 25% of cancer deaths of which 50% die within first year of detection as a result of delayed diagnosis [3,9,11,12]. The prevalence of HPV infection is significantly high among specific groups. It ranges from approximately 65.4% to 94.6% in populations such as women with benign cervical conditions, individuals with ano-genital warts, commercial sex workers, urban poor communities, HIV-positive patients, rural populations, and those with low socioeconomic status. Among asymptomatic women, the prevalence is notably lower, estimated at 12% to 19.6%. [12-15]

Single dose of quadrivalent prophylactic HPV vaccine provides at least 10 years of protection and has shown 70% efficacy in reducing the burden of cervical and other HPV-related cancers in men and women respectively. [16] Notably, anti-HPV antibody titers were 2-3 times higher in younger individuals following vaccination, emphasizing the importance of early administration. [17] The prophylactic HPV vaccine, as a public health measure, can be cost-effective especially in low- and middle-income countries (LMICs) where quality screening programs are often inadequate. [18] Various studies across HICs and LMICs have also highlighted significant knowledge gaps among healthcare workers regarding HPV infection, vaccination, and preventive strategies. Bridging these gaps is essential for the successful implementation of vaccination programs and achieving long-term goals of reducing HPV-related cancers and WHO cervical cancer elimination goal by 2030. [6,19,20]

Vaccine hesitancy, low participation in cervical cancer screening programs, and the increasing burden of HPV associated non cervical cancers makes it imperative to assess the knowledge of the health care providers during their formative years in medical school to understand the role of medical education and curriculum in imparting adequate knowledge targeting the HPV prevention strategy.

Aim: Hence, this study was conducted with the aim of assessing the level of knowledge regarding HPV infection and the role HPV vaccine as a preventive strategies among the medical students.

Methods

The cross sectional study was conducted among students from a medical college in Mysore, following ethical approval from the Research Ethics Committee of Mysore Medical College and Research Institute (MMCRI) and the Institutional Review Ethics Board (IREB) of the Public Health Research Institute (PHRI) of Mysore. Informed consent was obtained from all participants after explaining the study's purpose and ensuring confidentiality and anonymity.

The data was collected using a self-administered questionnaire to assess knowledge, related to HPV infection, cervical cancer, Head and Neck Cancers (HNCs) and HPV vaccination. The questionnaire was adopted from Maharajan et al (2015) was validated for internal consistency by conducting a pilot study with 20 participants.21 Based on the pilot testing, minor modifications to the questionnaire were made. For construction and content validity, the questionnaire was reviewed by four study investigators and two medical students before data collection. A web link to the questionnaire was shared with students via email and WhatsApp. The questionnaire consisted of four sections: general information demographic data, knowledge, attitudes, beliefs about HPV, HPV vaccination and cervical cancer and HNCs and willingness to recommend the HPV vaccine. The survey remained open for two months, between January and March 2018, during which students were given access to the link in the presence of the investigator. The collected data was stored in a cloud-based format on Qualtrics and later exported to Microsoft Excel for further analysis using SPSS 20. The data was analyzed using SPSS 21.0.

Data Analysis: Socio-demographic factors and categorical data was summarized using frequency and percentages. Pearson chi-square test was used to determine the difference in knowledge between the male and female students and by duration in medical education. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 608 medical students from a public university were invited to the study, 536 (88.2%) participated, with 498 (82%) participants ultimately included in the final analysis. Among them, 45.4% were female. The participants were distributed across different years of study with 114 (22.9%) in their first year of medical training, 151 (30%) in their second year, 123 (24.7%) in their third year, and 110 (22%) were in fourth year. The mean age of the participants was 20.7 ± 2.05 years, majority were Hindus by religion 498(88%), and only three were married. Among the female students, 17 (7.5%) reported being vaccinated against HPV.

Table 1 & Figure 1: Medical students showed good knowledge in domains: 80.7% knew that HPV infection causes cervical cancer, 72.1% understood that HPV infection is preventable, 73.5% recognized that condom use reduces transmission risk, 78.9% were aware that persistent HPV infection leads to cervical cancer, 72.1% knew that HPV infects both men and women, 76.3% identified that HPV causes genital warts, and 69.5% knew that a Pap smear is used as a screening test for cervical cancer.

Students had a moderate level of knowledge in areas such as understanding that HPV is not a rare infection (22.3%) and does not always have visible symptoms (44.6%), knowing that it cannot be cured with antibiotics (55.6%), recognizing it as a common STD (50.2%), and understanding that vaccines can prevent 70% of cervical cancers (57.0%). However, there was poor knowledge regarding whether HPV infection resolves spontaneously (24.1%) and that 90% of infections resolve spontaneously within two years (25.9%). Additionally, only 31.3% knew that HPV can cause head & neck cancers, 44.6% understood that vaccines can reduce the risk of oral and anal cancers, and 33.5% were aware of the serotypes associated with anal cancer and anogenital warts. Notably, a significant proportion (xx%) of students responded with "I don't know" to these questions.

Table 2: Male students have better understanding than females that condoms can prevent HPV infection (62.1% vs 49.1%) (p=0.003), HPV types 6 and 11 cause 90% of ano-genital warts (43.4% vs. 41.6%), (p=0.039) and HPV causing head and neck cancers (33.8% vs. 28.3%), with a statistically significant difference (p=0.035) respectively. However females had better understanding about vaccines and their protective efficacy that HPV vaccines prevent ~70% of cervical cancers (60.2% vs. 54.4%, p=0.014p = 0.014p=0.014). HPV vaccines reduce risks of anal and oro-pharyngeal cancers,

Gender difference was not seen among those with good: knowledge on HPV being preventable (~72%) and the role of Pap smears in cervical cancer screening (~69.5%). There were significant gaps in knowledge, regarding role of various sero-types in ano-genital cancers and genital warts.

Misconceptions persist, nearly 30% of respondents do not know that HPV is a sexually transmitted infection, and 44.4% are unsure about the treatment of HPV. A larger proportion of females responded with "Do not know" for many questions, such as about the spontaneous resolution of HPV infections (45.6% of females vs. 34.6% of males).

Table 3: HPV-related knowledge improves progressively from the first to the fourth academic year, with senior students demonstrating better awareness that the infection is common (91.8%), preventable (91.8%), and a sexually transmitted infection (79.1%), its association with cervical cancer, its ability to infect both genders, and the protective role of condoms (86.4%).

Knowledge about HPV-related cancers, genital warts, and the importance of screening tools like Pap smears also increases, with 93.6% of fourth-year students recognizing Pap smears as essential for cervical cancer detection.

Table 1: Distribution of the study participants according to their level of knowledge:

	Question	Yes	No	Do not know
	Good Knowledge			
1	HPV infection causes cervical cancer,	402(80.7)	17(3.4)	79(15.8)
2	HPV infection with some serotypes is preventable,	359 (72.1)	39 (7.8)	100 (20.1)
3	Condom use reduces the risk of HPV transmission,	366 (73.5)	36 (7.2)	96 (19.30
4	persistent HPV infection leads to cervical cancer	393 (78.9)	17(3.4)	88 (17.7)
5	HPV infects both men and women	359 (72.1)	50 (10.0)	89 (17.9)
6	HPV causes genital warts	380(76.3)	30 96.0)	88 (17.7)
7	Pap smear is used as a screening test for cervical cancer.	346 (69.5)	29 (15.3)	123 (24.7)
8	HPV is a rare infection	67 (13.5)	320(64.3)	111(22.3)
	Fair /moderate Knowledge			
9	HPV always has visible symptoms,	139(27.9)	222 (44.6)	137 (27.5)
10	HPV cannot be cured with antibiotics,	88(17.7)	277(55.6)	133(26.7)
11	HPV as a sexually transmitted disease (STD),	344 (69.1)	76 (15.3)	78 (15.7)
12	Vaccines can prevent 70% of cervical cancers.	284 (57.0)	36 (7.2)	178 (35.7)
	Poor Knowledge			
13	HPV infections can resolve spontaneously,	120 (24.1)	181 (36.3)	197 (39.6)
15	HPV infections resolve within two years,	129 (25.9)	104(20.9)	265(53.5)
16	Condom use can prevent HPV infection	280 (56.2)	99 (19.9)	119 (23.9)
17	HPV can cause head and neck cancers	156 (31.3)	133 (26.7)	209 (42.0)
18	vaccine can reduce the risk of oropharyngeal and anal cancers	222 (44.6)	67 (13.5)	209 (42.0)
19	HPV types 16 and 18 causes nearly 90 % of anal cancer.	167 (33.5)	76 (15.3)	255 (51.2)

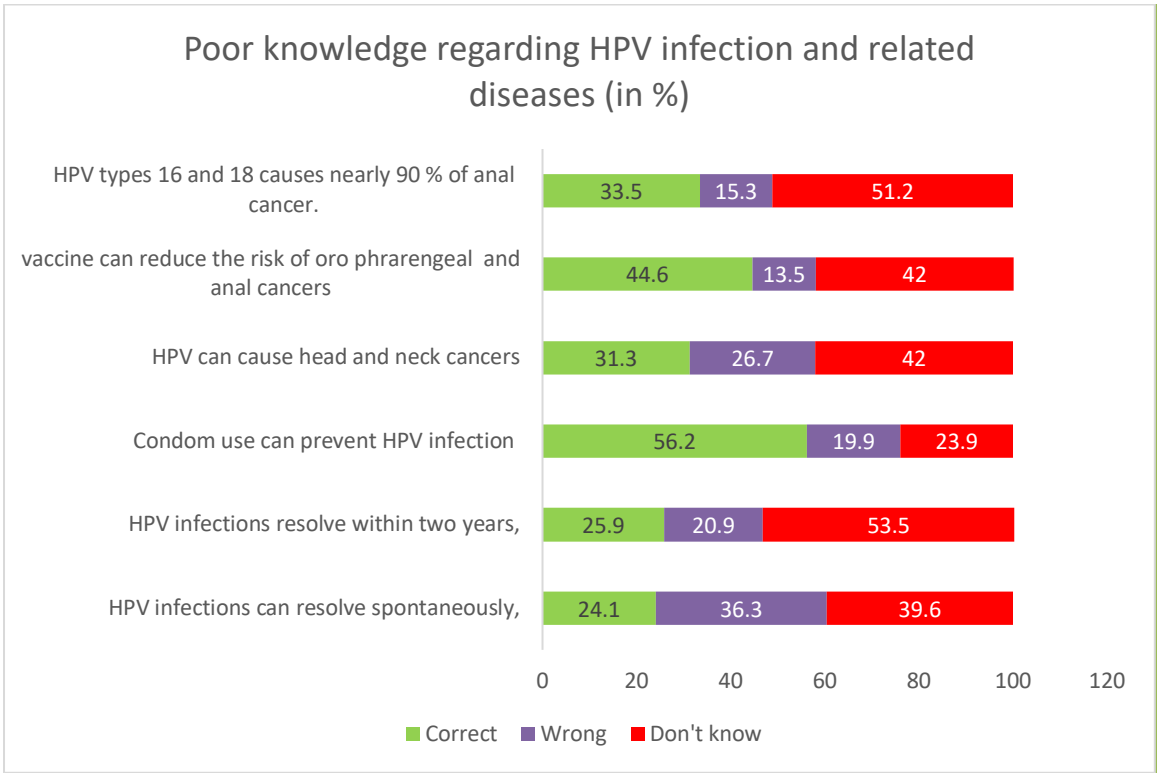

Figure 1: Distribution of participants according to poor knowledge regarding HPV infection and related diseases

Table 2: Comparing the knowledge on HPV infection, disease and prevention among the male and female study participants.

	Questions	Male (n= 272)	Female (n=226)	Total N=498	P
	HPV infection and symptoms				
1.	HPV can cause cervical cancer. Yes No Do not know	 222(81.6) 11 (4.05) 39 (14.4)	 180(79.6) 6 (2.7) 40 (17.7)	 402(80.7) 17(3.4) 79 ((15.8)	**0.46**
2.	HPV is very rare. Yes No Do not know	 41 (15.1) 177(65.1) 54 (19.9)	 26 (11.5) 143(63.3) 57(25.2)	 67(13.5) 320(64.3) 111(22.3)	**0.24**
3.	HPV may infect both men and women. Yes No Do not know	 201(73.9) 28(10.3) 43(15.8)	 158(69.9) 22(9.7) 46(20.4)	 359(72.1) 50(10.0) 89(17.9)	**0.429**
4.	Most HPV infections resolve spontaneously.* Yes No Do not know	 73(26.8) 105(38.6) 94(34.6)	 47(20.8) 76(33.6) 103(45.6)	 120(24.1) 181(36.3) 197(39.6)	**0.038**
5.	HPV can be cured with antibiotics.* Yes No Do not know	 58 (21.3) 150(55.1) 64(23.5)	 30(13.3) 127(56.2) 69(30.5)	 88(17.7) 277(55.6) 133(26.7)	**0.034**
6.	HPV is not a sexually transmitted infection. Yes No Do not know	 44(16.2) 193(71.0) 35(12.9)	 32(14.2) 151(66.8) 43(19.0)	 76(15.3) 344(69.1) 78(15.7)	**0.16**
7.	HPV infection is common. Yes	 135 (49.6)	 115 (50.9)	 250(50.2)	**0.63**

	No Do not know	66(24.3) 71(26.1)	47(20.8) 64(28.3)	113(22.7) 135(27.1)	
8.	About 90% of HPV infections clear within two years.* Yes No Do not know	 85 (31.2) 55(20.2) 132(48.5)	 44(19.5) 49(21.7) 133(58.8)	 129(25.9) 104(20.9) 265(53.2)	 **0.01**
9.	Most people with genital HPV infections have symptoms. Yes No Do not know	 140(51.5) 67(24.6) 65(23.9)	 93(41.2) 61(27.0) 72(31.9)	 233(46.8) 128(25.7) 137(27.5)	 **0.052**
	HPV related cancers and warts				
10.	HPV can cause genital warts. Yes No Do not know	 211(77.6) 18(6.6) 43(15.8)	 169(74.8) 12(5.3) 45(19.9)	 380(76.3) 30(6.0) 88(17.7)	 **0.445**
11.	HPV can cause head and neck cancers.* Yes No Do not know	 92(33.8) 8029.4) 100(36.8)	 64(28.3) 53(23.5) 109(48.2)	 156(31.3) 133(26.7) 209(42.0)	 **0.035**
12.	HPV types 16 and 18 causes nearly 90 % of anal cancer. Yes No Do not know	 95(34.9) 42(15.4) 135(49.6)	 72(31.9) 34(15.0) 120(53.1)	 167(33.5) 76(15.3) 255(51.2)	 **0.734**
13.	HPV types 6 and 11 causes approximately 90% of ano - genital warts.* Yes No Do not know	 118(43.4) 35(12.9) 119(43.8)	 94(41.6) 15(6.6) 117(51.8)	 212(42.6) 50(10.0) 236(47.4)	 **0.039**
14.	Persistence of HPV infection leads to cervical cancer. Yes No Do not know	 212(77.9) 14(5.1) 40(16.9)	 181(80.1) 03(1.3) 42(18.6)	 393(78.9) 17(3.4) 88(17.7)	 **0.062**
	Prevention of HPV infection and related diseases				
15.	Infections with some HPV types are preventable. Yes No Do not know	 194 (71.3) 27(9.9) 51(18.8)	 165(73.0) 12(5.3) 49(21.7))	 359(72.1) 39(7.8) 100(20.1)	 **0.14**
16.	Using condoms reduces the risk of getting HPV. Yes No Do not know	 209 (76.8) 20(7.4) 43(15.8)	 157 (69.5) 16(7.1) 53(23.5)	 366(73.5) 36(7.2) 96(19.3)	 **0.098**
17.	Condom use can prevent HPV infection.* Yes No Do not know	 169(62.1) 53(19.5) 50(18.4)	 111(49.1) 46(20.4) 69(30.5)	 280(56.2) 99(19.9) 119(23.9)	 **0.003**
18.	Current HPV vaccines can prevent around 70% of cervical cancer. * Yes No Do not know	 148(54.4) 28(10.3) 96(53.3)	 136(60.2) 08(3.5) 82(36.3)	 284(57.0) 36(7.2) 178(35.7)	 **0.014**
19.	HPV vaccine can reduce the risk of anal and Oro- pharyngeal cancer.* Yes No Do not know	 133(48.9) 41(15.1) 98(36.0)	 89(39.4) 26(11.5) 111(49.1)	 222(44.6) 67(13.5) 209(42.0)	 **0.013**
20	A Pap-smear can be used to screen for cancer. Yes No Do not know	 186(68.4) 22(8.1) 64(23.5)	 160(70.8) 07(3.1) 59(26.1)	 346(69.5) 29(5.8) 123(24.7)	 **0.054**

Table 3: Comparing the knowledge on HPV infection, disease and prevention among the students across the years in medical college.

Sl no.	Questions	Ist year	IInd year	IIIrd year	IVth year	Total N=498	P
	HPV infection and symptoms						
1.	HPV can cause cervical cancer.						
	Yes	78(68.4)	113(74.8)	113(91.9)	**98(89.1)**	**402(80.7)**	
	No	4(3.5)	6(4.0)	3(2.4)	**4(3.6)**	**17(3,4)**	**0.000**
	Do not know	32(28.1)	32(21.2)	7(5.7)	**8(7.3)**	**79(15.8)**	
2.	HPV is very rare.						
	Yes	19(16.7)	33(21.9)	10(8.1)	**5(4.5)**	**67(13.5)**	
	No	48(42.1)	84(55.6)	94(76.4)	**94(85.5)**	**320(64.3)**	**0.000**
	Do not know	47(41.2)	34(22.4)	19(15.4)	**11(10.0)**	**111(22.3)**	
3.	HPV may infect both men and women.						
	Yes	73(64.0)	95(62.9)	103(83.7)	**88(80.0)**	**359(72.1)**	
	No	9(7.9)	22(14.6)	11(8.9)	**8(7.3)**	**50(10.0)**	**0.000**
	Do not know	32(28.1)	34(22.5)	9(7.3)	**14(12.7)**	**89(17.9)**	
4.	Most HPV infections resolve spontaneously						
	Yes	4(3.5)	32(21.2)	51(41.5)	**33(30.3)**	**120(24.1)**	
	No	39(34.2)	53(35.1)	46(37.4)	**43(39.1)**	**181(36.3)**	**0.000**
	Do not know	71(62.3)	66(43.70	26(21.1)	**34(30.9)**	**197(39.6)**	
5.	HPV can be cured with antibiot-ics.*						
	Yes	14(12.3)	27(17.9)	34(27.6)	**13(11.8)**	**88(17.7)**	
	No	47(41.2)	72(47.7)	75(61.0)	**83(75.5)**	**277(55.6)**	**0.000**
	Do not know	53(46.5)	52(34.4)	14(11.4)	**14(12.7)**	**133(26.7)**	
6.	HPV is not a sexually transmitted infection.						
	Yes	17(14.9)	28(18.5)	16(13.0)	**15(13.6)**	**76(15.3)**	
	No	66(57.9)	92(60.9)	99(80.5)	**87(79.1)**	**344(69.1)**	**0.000**
	Do not know	31(27.2)	31(20.5)	8(6.5)	**8(7.3)**	**78(15.7)**	
7.	HPV infection is common.						
	Yes	36(31.6)	58(38.4)	75(61.0)	**81(73.6)**	**250(50.2)**	
	No	28(24.6)	48(31.8)	22(17.9)	**15(13.6)**	**113(22.7)**	**0.000**
	Do not know	50(43.9)	45(29.8)	26(21.1)	**14(12.7)**	**135(27.1)**	
8.	About 90% of HPV infections clear within two years.*						
	Yes	9(7.9)	32(21.2)	44(35.8)	**44(40.0)**	**129(25.9)**	
	No	26(22.8)	30(19.9)	26(21.1)	**22(20.0)**	**104(20.9)**	**0.000**
	Do not know	79(69.3)	89(58.9)	53(43.1)	**44(40.0)**	**265(53.2)**	
9.	Most people with genital HPV in-fections have symptoms.						
	Yes	47(41.2)	74(49.0)	65(52.8)	**47(42.7)**	**233(46.8)**	
	No	18(15.8)	26(17.2)	39(31.7)	**45(40.9)**	**128(25.7)**	**0.000**
	Do not know	49(43.0)	51(33.8)	19(15.4)	**18(16.4)**	**137(27.5)**	
	HPV related cancers and warts						
10.	HPV can cause genital warts.						
	Yes	68(59.6)	109(72.2)	103(83.7)	**100(90.9)**	**380(76.3)**	
	No	9(7.9)	13(8.6)	5(4.1)	**3(2.7)**	**30(6.0)**	**0.000**
	Do not know	37(32.5)	29(19.2)	15(12.2)	**7(6.4)**	**88(17.7)**	
11.	HPV can cause head and neck cancers.*						
	Yes	42(36.8)	54(35.8)	29(23.6)	**31(28.2)**	**156(31.3)**	
	No	15(13.2)	33(21.9)	49(39.8)	**36(32.7)**	**133(26.7)**	**0.000**
	Do not know	57(50.0)	64(42.4)	45(36.6)	**43(39.1)**	**209(42.0)**	
12.	HPV types 16 and 18 causes nearly 90 % of anal cancer.						
	Yes	15(13.2)	39(25.8)	63(51.2)	**50(45.5)**	**167(33.5)**	

	No	6(5.3)	18(1.9)	33(26.8)	**19(17.3)**	**76(15.3)**	**0.000**
	Do not know	93(81.6)	94(62.3)	27(22.0)	**41(37.3)**	**255(51.2)**	
13.	HPV types 6 and 11 causes approximately 90% of ano - genital warts.*						
	Yes	19(16.7)	44(29.1)	82(66.7)	**67(60.9)**	**212(42.6)**	
	No	3(2.6)	17(11.3)	15(12.2)	**15(13.6)**	**50(10.0)**	**0.000**
	Do not know	92(80.7)	90(59.6)	26(21.1)	**28(25.5)**	**236(47.4)**	
14.	Persistence of HPV infection leads to cervical cancer.						
	Yes	76(66.7)	106(70.2)	110(89.4)	**101(91.8)**	**393(78.9)**	
	No	1(0.9)	8(5.3)	5(4.1)	**3(2.7)**	**17(3.4)**	**0.000**
	Do not know	37(32.5)	37(24.5)	8(6.5)	**6(5.5)**	**88(17.7)**	
	Prevention of HPV infection and related diseases						
15.	Infections with some HPV types are preventable.						
	Yes	55(48.2)	101(66.9)	102(82.9)	**101(91.8)**	**359(72.1)**	
	No	14(12.3)	14(9.3)	8(6.5)	**3(2.7)**	**39(7.8)**	**0.000**
	Do not know	45(39.5)	36(23.8)	13(10.6)	**6(5.5)**	**100(20.1)**	
16.	Using condoms reduces the risk of getting HPV.						
	Yes	70(61.4)	97(64.2)	104(84.6)	**95(86.4)**	**366(73.5)**	
	No	8(7.0)	16(10.6)	7(5.7)	**5(4.5)**	**36(7.2)**	**0.000**
	Do not know	36(31.6)	38(25.2)	12(9.8)	**10(9.1)**	**96(19.3)**	
17.	Condom use can prevent HPV infection.*						
	Yes	47(41.2)	79(52.3)	75(61.0)	**79(71.8)**	**280(56.2)**	
	No	20(17.5)	34(22.5)	28(22.8)	**17(15.5)**	**99(19.9)**	**0.000**
	Do not know	47(41.2)	38(25.2)	20(16.3)	**14(12.7)**	**119(23.9**	
18.	Current HPV vaccines can prevent around 70% of cervical cancer. *						
	Yes	46(40.0)	78(51.7)	74(60.2)	**86(78.2)**	**284(57.0)**	
	No	6(5.3)	17(11.3)	11(8.9)	**2(1.8)**	**36(7.2)**	**0.000**
	Do not know	62(54.4)	56(37.1)	38(30.9)	**22(20.0)**	**178(35.7)**	
19.	HPV vaccine can reduce the risk of anal and Oro- pharyngeal cancer.*						
	Yes	30(26.3)	64(42.4)	70(56.9)	**58(52.7)**	**222(44.6)**	
	No	7(6.1)	26(17.2)	15(12.2)	**19(17.3)**	**67(13.5)**	**0.000**
	Do not know	77(67.5)	61(40.0)	38(30.9)	**33(30.0)**	**209(42.0)**	
20	A Pap-smear can be used to screen for cancer.						
	Yes	43(37.7)	89(58.9)	111(90.2)	**103(93.6)**	**356(69.5)**	
	No	3(2.6)	19(12.6)	5(4.1)	**2(1.8)**	**29(5.8)**	**0.000**
	Do not know	68(59.6)	43(28.5)	7(5.7)	**5(4.5)**	**123(24.7)**	

Discussion

The global strategy for Cervical Cancer Elimination Initiative by WHO emphasizes on scaling-up of preventive and curative interventions, including HPV screening and vaccination among the high incidence transitioning countries like India [1].

HPV-related knowledge improved significantly with academic progression as the final-year students were better aware of HPV as a common and preventable sexually transmitted infection (91.8%) and the role of Pap smears in cervical cancer detection (93.6%). [22,23] This suggests that knowledge was attributed to structured education in the curriculum also noted in studies by Pandey et al. [24] The general awareness about HPV infection and prevention was good among the students however gaps in knowledge was observed in understanding symptoms, HPV associated non cervical cancer diseases and vaccination. Only 31.3% of students recognized HPV's role in head and neck cancers, despite growing evidence of HPV serotypes 16 and 18 being associated with these malignancies, rising incidence of HPV-associated head and neck cancers, estimated at 7% to 78.7% in India, particularly in males. [7] Currently vaccination programs in developed countries have

significant reduced oral HPV infections (0.11% in vaccinated men vs. 1.61% in unvaccinated men, p=0.008), emphasizing the potential impact of comprehensive vaccination strategies. Thus highlighting the need for extending the HPV related awareness beyond non cervical cancers. [5,24,25] Only 7.5% of female students in this study had received the vaccine, which was similar and comparable to other studies in India (6%-18.1%) but significantly lower than the 45.2% vaccination rate among U.S. medical students. [6,22,23] Only 57% of the students recognized that vaccines can prevent 70% of cervical cancers and only 44.6% recognized their role in prevention of oral and anal cancers. The lower vaccination rates were as result of limited awareness of vaccine availability (27.2%-31.1%), efficacy (23.6%-37.4%), and its role in preventing cancers in both genders (25.2%-37.6%). [2,20,24]

The successful uptake of HPV vaccination largely depends on healthcare providers recommendations. Awareness of the HPV vaccine among healthcare workers in India was 81%, but only 47% recommended it, mostly in urban areas. However, among gynecologists, 76% supported the use of the vaccine [2,20]. In contrast, studies in the U.S. showed that the decision to vaccinate largely depended on healthcare provider recommendations (48.7%), parental desire (48.9%) and being vaccinated influenced the health care provider to recommend the vaccine [19,24,26]. WHO has recommended single-dose regimens as effective compared to multi-dose regimens in preventing HPV infections and precancerous lesions, suggesting a promising strategy for cervical cancer prevention it become imperative to address the vaccination status of the health care providers as well for better acceptance by the community. [7,17]

A qualitative study and Bangalore study concluded that female students had more in-depth knowledge compared to male students, on the contrary our study found no gender differences on the critical aspects having an effect on the disease diagnosis, prognosis and outcomes level of knowledge. [22,23] although in order to improve future HPV vaccine acceptance and recommendations their knowledge has to enhance in areas related to vaccine effectiveness, availability and role in male and female cancer prevention. Nearly 70% of students recognized HPV as a sexually transmitted infection (STI) and acknowledged that both men and women can get infected with HPV, 62% causes genital warts and 51.35% believed HPV can cause other genital malignancies, however only 27% believed most HPV infections are asymptomatic, 23.6% students thought there is no treatment for HPV infection according to Malvika JC et.al. Similar to our study the gaps in knowledge are mainly related to symptoms –25.7% believed had no symptoms and only 24.1% knew that 90% of HPV infection resolve spontaneously within 2 years and 55.6% that antibiotics cannot be used for treatment. [27] Single dose HPV vaccination has been proved to be an effective strategy in prevention of HPV related cancers, hence understanding the trends in HPV-related cancers compressively considering the low rates of cervical cancer screening, the diverse patterns of HPV-associated diseases, the increasing prevalence of HPV-associated head and neck cancers , challenges such as limited awareness of HPV vaccines among healthcare providers ("knowledge gap" - specialists to primary care workers), high-risk behaviours among adolescents, parental hesitancy towards vaccination, and the high cost of vaccines is essential for developing effective and efficient preventive strategy. [2,4,7,11,13,28]

Conclusion

While this study highlights good general awareness of HPV among medical students, significant gaps persist in understanding vaccination, its broader implications, and non-cervical HPV-related cancers. Addressing these gaps through targeted education, awareness programs, and innovative vaccination strategies is critical for reducing the burden of HPV-related diseases, particularly in LMICs. The cost-effectiveness and proven efficacy of the vaccine in preventing HPV-related cancers should also be a focal point. The knowledge gap among future healthcare providers significantly hinders the effective implementation of preventive strategies. It is essential to take comprehensive measures, addressing everything from policy-making to raising awareness among high-risk populations, and equipping healthcare providers with the necessary training and knowledge to achieve the WHO cervical cancer elimination goal by 2030.

Recommendation

The HPV vaccination should be introduced in National Immunization Schedule to both boys and girls (adolescent aged 9-16 years) and focusing on prevention of infection attributed cancers with a comprehensive approach which should include vaccination, screening and BCC. Integrating detailed HPV-related topics, including vaccination and non-cervical cancers, into medical education to improve awareness and advocacy thus empowering the healthcare providers with adequate knowledge and confidence to recommend vaccines.

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