

# An investigation into the human papilloma virus (HPV) vaccination among undergraduate medical students (A prospective cross-sectional KAP survey)

## Abstract

**Introduction:** The most common sexually transmitted infection worldwide is the human papillomavirus (HPV) infection. It is believed that over 80% of sexually active women have contracted the virus at some point in their lives. About 11 million women in Saudi Arabia who are aged 15 to 44 years are at risk of having HPV-related cervical cancer.

**Aim:** To assess the awareness and knowledge of undergraduate medical students (males and females) about the human papilloma virus (HPV) vaccination and to pinpoint the major factors influencing their attitudes towards it.

**Subjects and methods:** A prospective, cross-sectional online survey included 411 undergraduate medical students (males and females) across different grades during three months, from January 1<sup>st</sup> to March 31<sup>st</sup>, 2024, at the Batterjee Medical College, Jeddah City, Saudi Arabia. We statistically analyzed the collected data using Microsoft Office<sup>®</sup>, Excel<sup>®</sup> 2016, and IBM's Statistical Package for Social Studies (SPSS<sup>®</sup>) version 26.0. IBM is located in Chicago, Illinois, USA.

**Results:** The majority of participating students were of young age, 20–25 years old (233, 56.69%), female (393, 95.62%), and of Saudi nationality (260, 63.26%). The most common recruited students were from the preparatory year (124, 30.17%), while the fewest were from the M6 grade (6, 1.46%). We implemented “Kamel's scoring system for students' awareness”, which yielded the following scores: not acceptable (124, 30.17%), fairly acceptable (101, 24.57%), moderately acceptable (95, 23.11%), acceptable (71, 17.27%), and highly acceptable (20, 4.87%). Next, we implemented “Kamel's scoring system for students' knowledge”, which yielded the following scores: very low (130, 31.63%), low (110, 26.76%), moderate (90, 21.90%), high (50, 12.17%), and very high (31, 7.54%). We implemented “Kamel's scoring system for students' attitude” to assess the students' attitude towards HPV vaccine utilization. We interpreted the calculated scores as inadequate or poor (136, 33.09%), reasonable or fair (100, 24.33%), sufficient or good (80, 19.46%), remarkable or very good (70, 17.03%), and outstanding or excellent (25, 6.08%). results were of statistical significance (*the P-value* is <0.00001).

**Conclusion:** The estimated degree of awareness and knowledge about the HPV vaccination among undergraduate medical students at the Batterjee Medical College (BMC) was poor. This results in low motivation and utilization of the available vaccine.

**Keywords:** awareness and knowledge of HPV vaccination, attitude towards HPV vaccination, prevention of cervical cancer, and medical students in Saudi Arabia

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## Background

In the USA and Europe, cervical cancer ranks as the third most common female genital tract malignancy (after ovarian and endometrial carcinomas). Therefore, for Saudi women during their reproductive years, cervical cancer ranks as the second most prevalent cancer (after endometrial carcinoma). Saudi women have an estimated cervical cancer incidence of 1.9 per 100,000 at the age-standardized rate.<sup>1</sup>

Many factors, such as lack of education or knowledge about HPV infection, absence or negligence of routine screening programmes, and the difficulty encountered in accessing healthcare facilities, have been linked to cervical cancer in women living in various parts of the world.<sup>2</sup>

Human papillomavirus (HPV), with high-risk serotypes 16 and 18, is the primary cause of cervical cancer and accounts for about

70% of cancer cases. Whereas, HPV of low-risk serotypes 6 and 11 is regarded as a cause of ano-genital warts (*Condyloma Accuminata*) that mostly do not progress into cancer. There is poor information about HPV's genotypes and its prevalence in Saudi Arabia.<sup>1,2</sup>

Teenagers in Saudi Arabia (males and females) may benefit from the HPV vaccination despite the lack of information regarding the virus frequency, as there may be a rise in HPV infection among young people who are sexually active nationwide.<sup>2</sup> The estimated number of new cervical cancer cases and deaths in the year 2024 is 358 and 179, respectively.<sup>3</sup>

High-risk women for cancer cervix include infection with human papillomavirus (serotypes 16 and 18), early sexual activity, multiple sexual partners, early age at first vaginal delivery, and grand-multiparity. Also, women with immunosuppressive illnesses such as diabetes mellitus or HIV infection, co-infection with other sexually transmitted infections (such as herpes simplex), heavy cigarette

smoking and excess alcohol intake, long-term use (> 5 years) of combined oral contraceptive pills, oestrogen-only HRT, low socio-economic status, a lack of screening (a Pap-smear of HPV-DNA testing), as well as women with morbid obesity.<sup>1-3</sup>

Three types of HPV vaccine have been developed to prevent not only cervical cancer but also other HPV-related vulvar, vaginal, anal, and oropharyngeal diseases. A bivalent (Cervarix®) vaccine that protects against HPV 16 and 18, a quadrivalent (Gardasil®) vaccine that is effective against HPV serotypes 6, 11, 16, and 18, and a nine-valent (Gardasil-9®) vaccine that protects against HPV serotypes 16, 18, 31, 33, 45, 52, and 58. The recommended age for vaccination in both sexes is from 9 to 45 years old in a 2- or 3-dose schedule (at 0, 2 months, and 6 months). People who are pregnant or have a yeast hypersensitivity should not take it. The first dose of HPV vaccine listed in the compulsory Saudi national immunisation schedule is at the age of 11- years -old.

It is unknown how many Saudi women have had HPV vaccinations. However, a number of surveys have indicated a low uptake. Only 2% of Saudi females received the HPV vaccine in 2020. Whereas, it was just 4% of the participants in a different local study in Eastern Province who had had the vaccination.<sup>5</sup> Furthermore, a Riyadh-based survey in Saudi Arabia revealed that 89.5% of Saudi parents have not received HPV vaccination.<sup>6</sup> It is interesting to note that medical students (males and females) also reported poor HPV vaccine uptake.<sup>7-9</sup>

The HPV vaccine may not be accepted by the Saudi population as a means of preventing cervical cancer for a variety of reasons, including cultural beliefs and values, religious and moral reasons,<sup>9</sup> public media content, vaccine hesitancy (due to low belief in its safety and efficacy or for its possible side effects), and personal education disparities.<sup>8</sup> Globally, vaccine hesitancy has been found to be the primary cause of low vaccination uptake and coverage rates.

Although cancer of the cervix is preventable, most women in developing countries, including Saudi Arabia, are clinically presented at advanced stages that require extensive surgical and chemotherapy/radiotherapy treatment with a reduced survival rate. The World Health Organisation (WHO) estimates that the HPV vaccine will be able to save more than 4 million women's lives in low- and middle-income countries over the next decade.<sup>9</sup> Thus, understanding cervical cancer and the role of HPV infection is the most predictive factor for positive HPV vaccination behaviour.

The HPV vaccination rate in Saudi Arabia is lagging behind other countries. Most educational interventions were primarily directed at the female population and parents rather than healthcare providers, despite evidence that provider recommendation is a key determinant of vaccine uptake.<sup>10</sup> The HPV vaccine is available in Saudi Arabia (approved by the Saudi Food and Drug Administration in 2010) and is expected to protect against two-thirds of cervical cancer cases.<sup>11</sup>

## Aims of the study (objectives)

- To measure the degree of awareness and knowledge about HPV vaccination among undergraduate medical students at the Batterjee Medical College (BMC), Jeddah City, Saudi Arabia.
- To trace the impact of students' awareness and knowledge on their attitudes towards HPV vaccine utilization and recommendation.
- To reduce the gap between medical knowledge and utilization rate of the HPV vaccination among medical students.

## Proposed study questions

- What is the degree of awareness and knowledge among undergraduate medical students at the BMC about the HPV vaccine?
- What is the impact of students' awareness and knowledge on their potential attitude towards the perception and utilization of the HPV vaccine? Is there a significant correlation between students' background awareness and knowledge and their potential attitude towards HPV vaccine utilization and recommendation? The null hypothesis (H0) assumes no correlation, while the real hypothesis (H1) assumes the existence of a strong correlation between the two variables.

## Patients and methods

This is a prospective, online, cross-sectional KAP study that carried out (by a confidential invitation link distributed to BMC medical students with varying academic studying years). In an effort to reach as many students as possible, the questionnaire was distributed "anonymously" on several social media sites that are popular in Saudi Arabia, including Facebook®, Messenger®, WhatsApp®, Twitter®, Instagram®, Telegram®, Snapchat®, and Tick-Tok®. The duration of the questionnaire phase was three months, from January 1st to March 31st, 2024, with a six-month study period.

## Selecting and excluding criteria

The selection criteria included all undergraduate students of the preparatory year as well as medical students (males and females) from different medical grades (from M1 to M6) who are assigned to the General Medicine Practice program and still affiliated with the Batterjee Medical College (BMC), Jeddah City, Saudi Arabia. The recruited students, as they are living in different districts and villages related geographically to the city of Jeddah, would symbolize the whole city.

The exclusion criteria involved all undergraduate and postgraduate medical students (males and females) who are studying at, and affiliated with other medical colleges, other than the BMC, either in the city of Jeddah or in any other city in Saudi Arabia or worldwide.

## Sample size calculation

The minimal sample size required for a valid study is 384 students, which was calculated in two ways: online at [www.calculator.net](http://www.calculator.net), and then confirmed by using the following mathematical equation, considering the level of confidence is 95% with an expected prevalence of 50% and precision of 0.05 (margin of error):

$$n = \frac{z^2 \times p(1-p)}{\epsilon^2} \quad (1)$$

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = 384.16 \quad (2)$$

Where

n: is the sample size.

z: is the z-score of 95% confidence level (1.96).

p: is the expected population proportion (50%).

ε: is the margin of error (5%)

Since our population was known as 1551 total students (797 students of the preparatory year and 754 students of the different 6 grades of medical school for the academic year 2023-2024), we used the following correction formula:

$$fn = \frac{P}{1 + P / n} \quad (1)$$

$$fn = \frac{1551}{1 + 1551 / 384.16} = 309 \quad (2)$$

Where:

n: minimal sample size.

fn: corrected sample size.

P: known population (1551 students).

We initially planned to recruit 400 participants to increase the statistical validity and reliability of the study. We received a total of 436 answer sheets (the initial 20 students' responses were used for the questionnaire validation process, and then 416 students' responses). After the process of filtration, the final number of participants was 411, with five responses excluded due to incomplete sheets. The high number of participating students increases the significant power of the study and lowers the margin of error to 4.15%.

### Study tools

For every medical student who fulfilled the study's inclusion criteria and agreed to participate freely in the current trial (signed an informed consent online), the entire data listed in the questionnaire was collected.

The information was gathered through an online electronic survey, and the co-authors used a Google Form (Google LLC, Mountain View, California, United States) to record the participating students' responses in an anonymous manner. A structurally coherent set of four sets of essential questions related to HPV- vaccination were developed.

([https://docs.google.com/forms/d/e/1FAIpQLSev12\\_JV6wh\\_SrULXs62lgJs6aV97VlrZt29VhP3Asl5RH\\_HQ/viewform](https://docs.google.com/forms/d/e/1FAIpQLSev12_JV6wh_SrULXs62lgJs6aV97VlrZt29VhP3Asl5RH_HQ/viewform)).

There were four sections on the questionnaire. The first section (composed of 16 questions) covered the socio-demographic details of the recruited students, such as age, sex, nationality, and educational level. Awareness about the HPV vaccine was covered in the second section (30 questions). The third section (10 questions) was about the students' knowledge of the HPV vaccine. The last fourth section (composed of nine questions) covered the students' attitudes towards HPV vaccination.

**Table 1** Sociodemographic characteristics of participated students

SN	Variables		Participating students		Chi-Square X <sup>2</sup>	Significance P-value*
			Number (Total n=411)	Percentage (%)		
Q1	Age (in years)	15 - < 20	153	37.23	673.1569	<0.00001*
		20 - < 25	233	56.69		
		25 - < 30	18	4.38		
		30 - < 35	5	1.22		
		≥ 35	2	0.487		
Q2	Gender (Sex)	Male	18	4.38	684.3066	<0.00001*
		Female	393	95.62		

The questionnaire validation process has been completed using a representative sample of twenty students from the targeted study's population (a pilot study), which has demonstrated satisfactory reliability (Pearson's correlation coefficient = 0.86) and validity (Cronbach's  $\alpha$  coefficient = 0.84). Of course, the result of the pilot study was excluded from the final analysis.

The collected data was statistically analysed using Microsoft Office, Excel® 2016, and IBM's Statistical Package for Social Studies (SPSS®) version 26.0., Chicago, Illinois, USA. The Pearson Chi-square test and Fisher's exact test are used for categorical variables, while the Student's t-test is used for continuous variables. The significance cut-off value was 0.05, and it was used as the *p*-value. The survey's results are presented in graphs and by using numbers, percentages, mean values, and standard deviations.

For previous studies, the literature was searched mainly for the keywords at the Bristol University Library online (MetaLib®), in addition to the pertinent online medical journals and magazines. Additionally, we looked for articles that were indexed in CINAHL Plus, MEDLINE, PubMed, EMBASE, the Cochrane Methodology Register, and MEDLINE. Since proximity searches were not possible in PubMed, Ovid used to search MEDLINE.

### Ethical considerations

Approval was obtained at the start of the study from the institutional research board (IRB) of the Batterjee Medical College, Jeddah, Saudi Arabia. All procedures were consistent with the ethical and scientific research committee standards and with the Helsinki Declaration of 1964 and its later modifications.

Informed consent has been obtained from all students who agreed to participate "freely" in our study. Data was collected anonymously, and the confidentiality of participants' data was guaranteed. The collected data was kept safely as a soft copy without sharing any, except if it was requested by the BMC research unit for verification.

### Results

The total number of undergraduate medical students recruited for statistical analysis in the current study was 411 male and female students (out of a total 1551 students, with a percentage of 26.50%). The sociodemographic characteristics of the participating students are shown in (Table 1). The main age group of the involved students (Figure 1) was between 20 and 25- years -old (233, 56.69%). Female students prevailed over male students (393 females and 18 males), with a dominant Saudi nationality of Arabic ethnicity (260, 63.26%, and 344, 83.70%, respectively).

Table I Continued..

SN	Variables		Participating students		Chi-Square X <sup>2</sup>	Significance P-value*
			Number (Total n=411)	Percentage (%)		
Q3	Nationality	Saudi	260	63.26	57.8151	<0.00001*
		Non-Saudi	151	36.74		
Q4	Ethnicity	Arabic	344	83.7	1318.808	<0.00001*
		Asian	41	9.98		
		African	22	5.35		
		British	2	0.487		
		American	2	0.487		
Q5	Religion	Muslim	404	98.3	1170.854	<0.00001*
		Christian	2	0.487		
		Others	5	1.22		
Q6	Studying Year	Preparatory year	124	30.17	47.0012	<0.00001*
		M1	95	23.11		
		M2	71	17.27		
		M3	58	14.11		
		M4	43	10.46		
		M5	14	3.41		
Q7	Parents' Education Level	M6	6	1.46	376.8674	<0.00001*
		Primary (G1-6)	29	7.06		
		Intermediate (G7-9)	15	3.65		
		High school (G10-12)	61	14.84		
		University	212	51.58		
		Postgraduate	94	22.87		
Q8	Home Residence	City (Urban)	396	96.35	706.3796	<0.00001*
		Village (Rural)	15	3.65		
Q9	Marital Status	Single	381	92.7	1343.387	<0.00001*
		Married	24	5.84		
		Divorced	3	0.73		
		Widowed	3	0.73		
Q10	Duration of Marriage (in years)	< 5	230	55.96	762.6085	<0.00001*
		5 - < 10	179	43.55		
		10 - < 15	2	0.487		
		15 - < 20	0	0		
		≥ 20	0	0		
Q11	Parity (for females)	None	360	87.59	1145.106	<0.00001*
		2-Jan	15	3.65		
		4-Mar	19	4.62		
		≥ 5	17	4.14		
Q12	Working status	Student	380	92.46	969.92	<0.00001*
		Graduate	13	3.16		
		Employed	18	4.38		
Q13	Annual Family Income (in USD)	< 4,000	140	34.06	129.392	<0.00001*
		4,000 - < 5,000	80	19.46		
		5,000 - < 6,000	41	9.98		
		6,000 - < 7,000	34	8.27		
		≥ 7,000	116	28.22		
Q14	Special habits	Smoking	53	12.9	741.307	<0.00001*
		Alcohol Drinking	10	2.43		
		None	348	84.67		
Q15	Chronic illness	Hypertension	16	3.93	864.581	<0.00001*
		Diabetes Mellitus	12	2.92		
		Others	59	14.36		
Q16	Health Insurance	None	324	78.83	54.9854	<0.00001*
		Governmental	83	20.19		
		Private	182	44.28		
		None	146	35.52		

\*Statistical significance (p < 0.05)

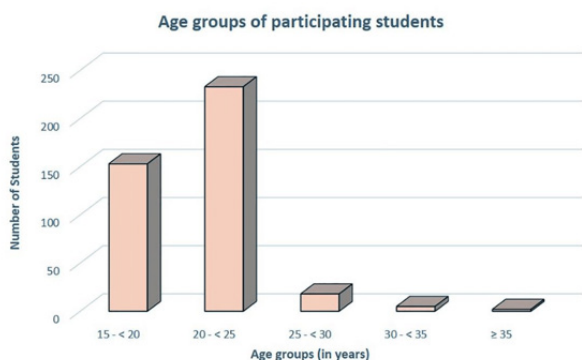


Figure 1 Age groups of participating students.

The invited students were from the preparatory year and the five medical grades (M1 to M5), in addition to M6 students (medical interns or House-officers). The main participating students were from the preparatory year (Figure 2) and the lesser were from the M6 year. As the parents' education level plays an important role in tutoring their children (Figure 3), we found that the majority have a university degree (212, 51.58%).

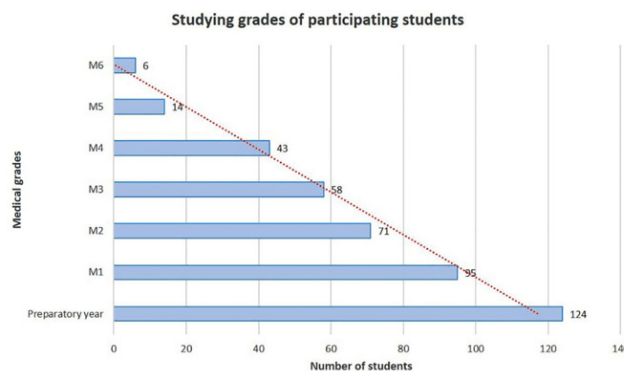


Figure 2 Studying grades of participating students.

Most of the participating students were single (381, 92.70%), living in Jeddah City, Saudi Arabia (396, 96.35%), with low-average family income (261, 63.50%), devoid of any medical illness (324, 78.83%), and without habits of medical importance (348, 84.67%). All the above-mentioned data are of statistical significance (the  $P$ -value is  $<0.00001$ ).

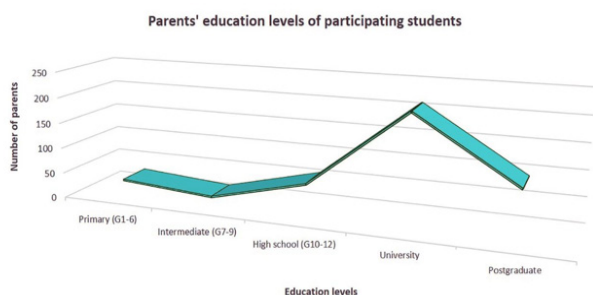


Figure 3 Parents' education levels of participating students.

For assessment of students' awareness about the HPV vaccine, we postulated 30 pre-structured questions (Table 2). The students have to answer these by either "True", "False", or "I don't know". Each "true" answer is calculated as "1," and the other two answers are considered "0." "**Kamel's scoring system for students' awareness**" was implemented (Table 3), and the calculated scores were interpreted as: not acceptable (0–6), fairly acceptable (7–12), moderately acceptable (13–18), acceptable (19–24), and highly acceptable (25–30). The majority of participating students had an unacceptable level of awareness (124, 30.17%) with statistical significance ( $P$ -value  $<0.00001$ ).

Table 2 Awareness about HPV vaccine

SN	Variables	Students' answers		
		True	False	I don't know
<b>Awareness about HPV Vaccine</b>				
Q1	HPV vaccine available in Saudi Arabia.	229	18	164
Q2	HPV vaccine included in Saudi National Vaccination Schedule.	172	43	196
Q3	HPV vaccine present in 3 different forms.	142	30	239
Q4	The name of HPV vaccines: Cervarix, Gardasil, Gardasil-9.	142	22	247
Q5	Both males and females are requested to be vaccinated.	208	44	159
Q6	The age of HPV vaccination is from 9 to 45-year-old.	168	33	210
Q7	Cervarix® vaccine is against HPV serotypes 16 and 18.	133	26	252
Q8	Gardasil® vaccine is against HPV serotypes 6, 11, 16 and 18.	118	29	264
Q9	Gardasil-9® vaccine is against HPV serotypes 6, 11, 16, 18, 31, 33, 45, 52, 58	112	27	272
Q10	HPV vaccine can prevent Human Papilloma Virus infection.	192	26	193
Q11	HPV vaccine can protect against 70% of cancer cervix.	192	24	195
Q12	HPV vaccine can protect against ano-genital warts.	189	24	198
Q13	HPV vaccine can lower the chance of having abnormal Pap-smear.	173	28	210
Q14	HPV vaccine sometimes cause (pain, swelling, redness at site of injection).	182	23	206
Q15	HPV vaccine can induce Human Papilloma Virus infection.	134	62	215
Q16	Vaccinated female should continue routine screening for cancer cervix.	191	22	198
Q17	Infected female with HPV should be vaccinated.	160	34	217
Q18	HPV vaccine is given in two doses (0, 6-12 months) for ages 9-14 years old.	133	31	247
Q19	HPV vaccine is given in 3 doses (0, 2, 6 months) for ages 15-45 years old.	129	27	255

Table 2 Continued..

SN	Variables	Students' answers		
		True	False	I don't know
<b>Awareness about HPV Vaccine</b>				
Q20	The site of injection for HPV vaccine is in the deltoid region of the upper arm or in the higher antero-lateral area of the thigh (IM).	160	28	223
Q21	All females have to be screened for HPV infection before vaccination.	160	32	219
Q22	All males have to be screened for HPV infection before vaccination.	147	31	233
Q23	HPV vaccine helps to clear out HPV infection.	142	43	226
Q24	HPV vaccination protect against all HPV infections.	149	41	221
Q25	HPV vaccinated girls do not need screening by Pap-smear test.	110	67	234
Q26	HPV vaccine offers protection against all Sexual-transmitted infections (STIs).	118	68	225
Q27	HPV vaccine is not safe during pregnancy.	132	34	245
Q28	HPV vaccine encourages teenage girls to have sex.	90	111	210
Q29	There is no need to use barrier contraception after HPV vaccination.	98	92	221
Q30	HPV vaccine is most effective when given before practice sex.	124	27	260

Table 3 Kamel's scoring system for students' awareness

Total Score	Score interpretation	Frequency (N = 411)	Percentage (%)	Chi-Square X <sup>2</sup>	Significance P-value*
0 - 6	Not acceptable	124	30.17	95.1764	<0.00001*
7 - 12	Fairly acceptable	101	24.57		
13 - 18	Moderately acceptable	95	23.11		
19 - 24	Acceptable	71	17.27		
25 - 30	Highly acceptable	20	4.87		
Total		411	100%		

\*Statistical significance (p < 0.05)

For assessment of students' knowledge about the HPV vaccine, we postulated 8 pre-structured questions (Table 4). The students have to answer these by checking the correct answer, “√,” according to their background knowledge. Each correct answer is calculated as “1,” and the other wrong answers are considered “0.” The “Kamel's

scoring system for students' knowledge” was implemented (Table 5), and the calculated scores were interpreted as very low (0-2), low (3-4), moderate (5-6), high (7-8), and very high (9-10). The majority of participating students had a very low level of knowledge (130, 31.63%) with statistical significance (P-value <0.00001).

Table 4 Knowledge about HPV vaccine

SN	Variables	Participating students		
		Checked (√)	Percentage	
Q1	What is your source of information about HPV vaccine?	Doctor/Nurse	85	20.68
		Medical study	141	34.31
		Family member.	30	7.3
		Friends.	51	12.41
		Social media.	104	25.3
Q2	Did you participate in HPV vaccination awareness campaign?	Yes	68	16.55
		No	269	65.45
		Not applicable	74	18
Q3	Did you attend any educational activity about HPV vaccine?	Yes	82	19.95
		No	261	63.5
		Not applicable	68	16.55
Q4	Who do you prefer to lead HPV vaccination campaign?	University staff.	79	19.22
		MOH doctors.	115	27.98
		Medical students.	84	20.44
		Para-medical personnel	9	2.19
		I do not know.	124	30.17
Q5	What is the mode of transmission of HPV?	Sexual intercourse.	284	69.1
		Air droplet.	55	13.38
		Contaminated injection.	72	17.52

**Table 4** Continued..

SN	Variables	Participating students		
		Checked (√)	Percentage	
Q6	Which of the following illness can be prevented by HPV vaccine?	Cervical cancer.	216	52.55
		Breast cancer.	66	16.06
		Endometrial cancer.	54	13.14
		Ovarian cancer.	75	18.25
Q7	Why you do not support vaccination against HPV?	New not tested vaccine.	120	29.2
		HPV vaccine is not safe.	17	4.14
		HPV vaccine is expensive.	43	10.46
		HPV vaccine does not protect against all HPVs.	38	9.25
		Uncertain effectiveness.	28	6.81
		My religion is against it.	9	2.19
		It is not necessary.	39	9.49
		Vaccination encourages teenagers to have early sex.	16	3.89
		Feeling shame when discussing it with others.	15	3.65
		Bad experience after vaccination.	23	5.6
Q8	Why you do support vaccination against HPV?	Medicine can cure infection.	63	15.33
		HPV vaccine protect against ano-genital warts.	115	27.98
		HPV vaccine protect against most of cervical cancers.	70	17.03
		HPV vaccine is free.	51	12.41
		Governmental approval.	37	9
		Easy accessible.	30	7.3
		Almost free of side effects.	19	4.62
		It is a mandatory vaccine.	21	5.11
		HPV infection is common.	25	6.08
		HPV infection may present without symptoms.	43	10.46

**Table 5** Kamel's scoring system for students' knowledge

Total score	Score interpretation	Frequency (N = 411)	Percentage (%)	Chi-Square X <sup>2</sup>	Significance P-value*
0 - 2	Very low	130	31.63	103.0535	<0.00001*
3 - 4	Low	110	26.76		
5 - 6	Moderate	90	21.9		
7 - 8	High	50	12.17		
9 - 10	Very high	31	7.54		
Total		411	100%		

\*Statistical significance (p < 0.05)

For assessment of students' attitudes towards HPV vaccine utilization, we postulated 9 pre-structured questions (Table 6). The students have to answer these by either "Yes", "No", or "I am not sure". Each "yes" answer is calculated as "1," and the other two answers are considered "0." Then, "*Kamel's scoring system for students' attitude*" was implemented (Table 7), and the calculated

scores were interpreted as inadequate or poor (0-2), reasonable or fair (3-4), sufficient or good (5-6), remarkable or very good (7-8), and outstanding or excellent (≥ 9). The majority of participating students had an inadequate or poor attitude (136, 33.09%) with statistical significance (P-value <0.00001).

**Table 6** Attitudes towards HPV vaccine

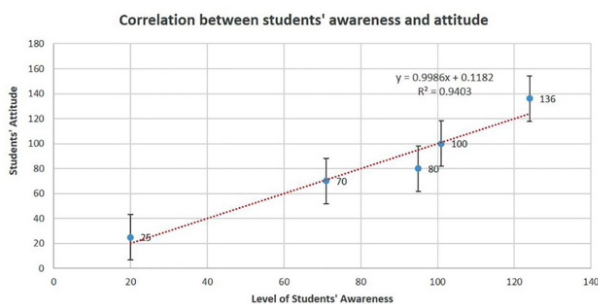
SN	Variables	Students' answers		
		Yes	No	I am not sure
Q1	In case of no health insurance, are you ready to pay for HPV vaccine?	174	74	163
Q2	Have you vaccinated with HPV vaccine?	90	174	147
Q3	Are you willing to be vaccinated by HPV vaccine?	201	59	151
Q4	Do you recommend HPV vaccination to others?	212	41	158
Q5	Do you recommend HPV vaccination to your family members?	203	41	167
Q6	Are you afraid of receiving HPV vaccine?	124	130	157
Q7	Do you think HPV vaccine awareness program would help to decide whether to take the vaccine or not?	236	43	132
Q8	Do you plan to discuss the HPV vaccine with your physician?	191	60	160
Q9	Do you plan to discuss the HPV vaccine with your partner?	200	40	171

**Table 7** Kamel's scoring system for students' attitude

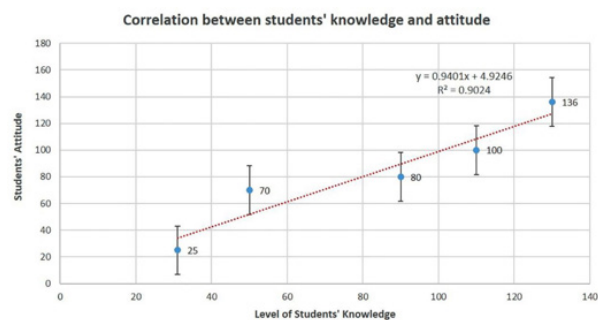
Total score	Score interpretation	Frequency (N = 411)	Percentage (%)	Chi-Square X <sup>2</sup>	Significance P-value*
0 - 2	Inadequate (Poor)	136	33.09	100.9246	<0.00001*
3 - 4	Reasonable (Fair)	100	24.33		
5 - 6	Sufficient (Good)	80	19.46		
7 - 8	Remarkable (Very good)	70	17.03		
≥ 9	Outstanding (Excellent)	25	6.08		
Total		411	100%		

\*Statistical significance (p < 0.05)

To know which of our study's hypotheses is correct (H0 or H1), we used the scatter plot, where the x-axis represents the constant variables (awareness and knowledge scores) and the y-axis represents the dependable variable (attitude towards HPV vaccine). After calculation of the correlation coefficient (r) for both elements, we found that there is a strong positive linear correlation between students' awareness score and their attitude towards the HPV vaccine (r = 0.9403) which means that with a higher score of students' awareness, there is a confident active attitude concerning HPV vaccine utilization and recommendation to others (Figure 4). Similarly, there is a strong positive linear correlation between students' knowledge score and their attitude to HPV vaccine (r = 0.9024), which means that with a higher level of students' knowledge, there is an assured energetic attitude concerning HPV vaccine utilization and recommendation to others (Figure 5). Accordingly, we can agree with the real hypothesis (H1).



**Figure 4** Correlation between students' awareness and attitude.



**Figure 5** Correlation between students' knowledge and attitude.

Thus, among the individuals' cognitive variables linked to HPV vaccination uptake are awareness and knowledge about the vaccine, a favourable attitude for more intake, and advice (confidence in the vaccine's safety and effectiveness).

## Discussion

Over the last 15 years, many studies have assessed awareness and knowledge about HPV vaccination in a variety of different Saudi populations (parents and guardians,<sup>11-16</sup> vulnerable female patients,<sup>17-29</sup> healthcare professionals,<sup>30-33</sup> and university students<sup>7, 34-47</sup>) and in diverse settings, making a comparative study difficult. Except for physicians and undergraduate medical students (have good awareness and deprived vaccine utilization), all studies pointed to a substantial lack of awareness and knowledge with poor attitudes towards the HPV vaccine resulting in a low vaccination rate and increasing HPV infection cases.

In 2014, Al-Darwish A et al.,<sup>34</sup> investigated the awareness and knowledge of 188 university students (111 males and 77 females) at King Faisal University in Al-Ahsa City, Saudi Arabia. The awareness reported was 33% and the knowledge was 52.5% among the 5<sup>th</sup>-year medical students. In the same academic year, Al-Shaikh et al.,<sup>35</sup> examined 1249 female students of health colleges at Princess Nora bint Abdul-Rahman University, Riyadh City, Saudi Arabia. Their awareness was 4.3%, with 95.7% having poor knowledge. The recorded utilisation rate of the HPV vaccine was only 13.5%. This variance in results between the upper two studies might be attributed to the high medical background information among the students of the last-year medical college.

In 2020, Al-Shrari AS,<sup>36</sup> studied 402 students of health colleges (35.82% males and 64.18% females) at Northern Border University, Saudi Arabia. The awareness level was 8%, and the knowledge was 18.66%. In the same academic year, Altamimi T,<sup>37</sup> investigated 966 female students from health colleges at the University of Hail, Saudi Arabia. The awareness was 31%, while the knowledge was 10.49%.

In 2021, Farsi NJ et al.,<sup>7</sup> investigated 517 students from the 3<sup>rd</sup> and 4<sup>th</sup> year medical schools at 4 different medical colleges in Jeddah City, Saudi Arabia (King Abdul-Aziz University, King Saud bin Abdul-Aziz University for Health Sciences, Ibn Sina National College for Medical Studies, and the Batterjee Medical College). Although awareness was 42%, knowledge was poor, with a 48.9% positive attitude (interested in receiving the HPV vaccine). In the same academic year, Bokhary N et al.,<sup>38</sup> conducted a cross-sectional study at King Abdul-Aziz University, Jeddah City, Saudi Arabia. From the medical college, 462 students (49.13% males and 50.87% females) were included with 70.1% awareness, 38.7% poor knowledge, 37.2% fair knowledge, and 24% excellent knowledge.

In 2022, Ali MD et al.,<sup>39</sup> studied 125 students from the pharmacy college (12.8% males and 87.2% females) at Mohammad Al-Mana College for Medical Sciences (MACHS) in Dammam City, Saudi



Arabia. The awareness was 35%, and the attitude was 32.8%. Azer SA et al.,<sup>40</sup> investigated 172 students (52.3% from medical schools and 22.1% from non-medical colleges) at King Saud University, Riyadh City, Saudi Arabia. The reported utilisation was 60.5% for medical students and 26.7% for non-medical students. In the same academic year, Al-Shammari F. and Khan KU,<sup>41</sup> presented a study of 386 students (63% males and 37% females) at the University of Hail, Saudi Arabia. The knowledge was poor, with a low attitude.

In the year 2023, Easwaran V et al.,<sup>42</sup> studied 140 female pharmacists at King Khalid University, Abha City, Saudi Arabia. Their awareness was 8.5%, with poor knowledge and a 6.4% attitude. Aldawood E. et al.,<sup>43</sup> have investigated 403 students from health colleges (57.1% males and 62.7% females). The score of knowledge was poor (8.8±3.6). Abdelaliam SMF et al.,<sup>44</sup> did a study at the College of Nursing, Princess Nourah bint Abdulrahman University, Riyadh City, Saudi Arabia. The awareness level was 26.5%, the knowledge score was 2.77±1.78, and the attitude was low (10.7%). Lastly, in the same academic year, Aldawood E et al.,<sup>45</sup> conducted a cross-sectional study at King Saud University, Riyadh City, Saudi Arabia. The knowledge was 66.7%, with a low attitude (5.2%).

In the current year, 2024, Al-Fhaid F et al.,<sup>46</sup> investigated 159 students from health colleges at Majmaah University, Saudi Arabia. The knowledge was 15.7%, while the attitude was 7.5%. While Aftab T et al.,<sup>47</sup> studied 200 students (52% males and 48% females) from the College of Medicine at Northern Border University, Arar City, Saudi Arabia. The awareness score was 28% and the knowledge score was 4.20 ± 0.79% with a low attitude.

Comparably, in our study (with taking the potential differences in the scoring systems used), the calculated scores for students' awareness were as following; not acceptable (124, 30.17%), fairly acceptable (101, 24.57%), moderately acceptable (95, 23.11%), acceptable (71, 17.27%), and highly acceptable (20, 4.87%). The calculated scores for students' knowledge were as following; very low (130, 31.63%), low (110, 26.76%), moderate (90, 21.90%), high (50, 12.17%), and very high (31, 7.54%). Accordingly, the calculated scores for scores for students' attitude were inadequate or poor (136, 33.09%), reasonable or fair (100, 24.33%), sufficient or good (80, 19.46%), remarkable or very good (70, 17.03%), and outstanding or excellent (25, 6.08%). All results were of statistical significance (*P-value* is <0.00001).

The status is not different in other countries of the Middle East, such as the United Arab Emirates (UAE),<sup>48</sup> Kuwait,<sup>49</sup> Qatar,<sup>50</sup> Jordan,<sup>51,52</sup> and Lebanon.<sup>53,54</sup> Similarly in Asia countries, such as Turkey,<sup>55</sup> Iran,<sup>56</sup> Pakistan,<sup>57</sup> Cyprus,<sup>58</sup> Malaysia,<sup>59</sup> Indonesia,<sup>60</sup> Thailand,<sup>61</sup> Japan,<sup>62</sup> Hong Kong,<sup>63</sup> Korea,<sup>64</sup> India,<sup>65</sup> and China.<sup>66</sup> Equally in Africa countries, such as Ethiopia,<sup>67</sup> Nigeria,<sup>68</sup> Uganda,<sup>69</sup> Kenya,<sup>70</sup> Somalia,<sup>71</sup> and Senegal.<sup>72</sup> Even in countries termed "developed countries", such as the USA,<sup>73</sup> European countries (like the UK,<sup>74</sup> France,<sup>75</sup> Germany,<sup>76</sup> Italy,<sup>77</sup> Sweden,<sup>78</sup> Poland,<sup>79</sup> Spain,<sup>80</sup> and Greece<sup>81</sup>), as well as Australia.<sup>81</sup> Despite lack of knowledge, the majority of medical students would accept a 'catch-up' HPV vaccination. Female participants were significantly more willing to accept HPV vaccinations than to males.

### Limitations of previous studies

Up-to-date, there are few provincial studies that have evaluated medical students' awareness and knowledge about the HPV vaccination.<sup>1-9, 34-47</sup> Furthermore, no research has examined the variables underlying the low acceptance rate of the HPV vaccine among medical students, especially in Jeddah City, Saudi Arabia.

Thus, in order to prepare the upcoming medical doctors, to serve at different healthcare facilities, the gap between their knowledge and practice (vaccine utilization) should be secured.

### Strength of the current study

The current study addresses one of the preventive measures that significantly reduces health problems related to HPV infection among both males and females. Students at medical colleges frequently have the ability to make a difference in their communities, although a sizable fraction of them might not be sexually active yet in conservative Saudi society. Therefore, it is essential to involve local universities in vaccination campaigns in order to guarantee that students are aware of the vaccine's value and its availability.

We recommend using, firstly introduced, **Kamel's scoring systems** for students' awareness, students' knowledge, and assessment of students' attitude (5-likert scales) in future studies with high reliability and validity; accordingly, we can compare studies with uniformly used scales.

### Future studies

Future research should focus on testing methods for effective awareness and knowledge - raising directed all target groups about the human papilloma virus infection, cervical premalignant lesions and invasive cancer, early screening methods, and the role of HPV vaccination.

### Conclusion and recommendation

The awareness and knowledge of the undergraduate medical students (males and females) who participated in the study regarding HPV vaccination were discouraging. Therefore, we emphasize the need to run well-designed healthcare education programs and campaigns (by the BMC institution with the participation of the Ministry of Health) to promote the awareness and knowledge of students early in their schools, even before starting college study. We recommend using the world immunization week (April 24-30) every year for education and vaccination events. In addition, encourage medical schools to include more information about HPV infection and vaccines in their study curricula. The use of various media platforms to educate students' parents about risk factors for HPV infection, the benefits of early vaccination, and its accessibility is vital to achieving a successful prevention strategy. Our recommendation should be applicable to all countries, all over the world, that are sharing the same problem.

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### Conflicts of interest

Authors declare that there is no conflict of interest.

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