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Knowledge, attitude and perception of Italian dental students toward HPV-related oropharyngeal cancer and vaccination: a cross-sectional study

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Abstract

Background Human papillomavirus (HPV) infection is a leading cause of oropharyngeal squamous cell cancer (OPSCC). This study aimed to carry out a Knowledge, Attitude and Perception survey on HPV infection, HPV+ OPSCC, and HPV vaccination among Italian dental students.

Methods Through an online self-administered questionnaire consisting of 82 questions, data on dental students' sociodemographic characteristics, knowledge, attitudes and perceptions concerning HPV+ OPSCC, infection and vaccination were acquired. A statistical analysis, based on their year of attendance (*early career*, from 1st to 3rd year vs. *late career*, from 4th to 6th year) was also conducted.

Results A total of 412 dental students completed the questionnaire. Knowledge of HPV+ OPSCC was reported by 61% of early-career students and 73% of late-career students, with high awareness of the HPV-OPSCC correlation in both groups (85% vs. 89%, respectively). The percentage of correct responses regarding HPV infection knowledge was 61% for early-career and 73% for late-career students, while vaccine knowledge was 70% and 78%, respectively. Over 90% of students acknowledged the dentist's role in educating patients about HPV and OPSCC, and attitudes toward discussing HPV and vaccination were positive. However, only about half would recommend the vaccine to either gender. Statistically significant differences were found between early- and late-career groups across all knowledge sections ($p < 0.001$), while no significant differences emerged for perception ($p = 0.076$) or attitude ($p = 0.147$).

Conclusions The study reveals encouraging results but highlights significant gaps in dental students' knowledge, perceptions, and attitudes toward HPV+ OPSCC, infection, and vaccination. Addressing these gaps through targeted education and training in dental curricula could improve HPV prevention awareness and patient education, ultimately enhancing public health outcomes.

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Keywords Human papillomavirus viruses, Oropharyngeal neoplasms, Knowledge, Attitude, Knowledge attitude and perception dental students

Introduction

Human papillomavirus (HPV) infection is the most common sexually transmitted infection (STI) worldwide, affecting approximately 75–80% of sexually active people in their lifetime [1–4]. While most infections are asymptomatic and resolve on their own within 1–2 years, long-lasting or multiple reinfections, especially with high-risk strains, are associated with cervical, anogenital and oropharyngeal squamous cell carcinoma cancers (OPSCC) [5, 6]. While HPV infection is the principal cause of cervical cancer, it has also become a significant and rearing cause of head and neck cancers in both sex [7–10], with a rapid increase among males [11].

It is estimated that 70% of OPSCC are HPV+ [12]. The incidence and mortality of OPSCC are 757,000 new cases per year (M/F ratio of 2.5) and 367,000 deaths per year, respectively [13]. The oropharynx is a complex region that represents an area of overlap between dentistry, maxillofacial surgery, and ENT specialist, although the latter is generally considered the primary specialist for this anatomical site. However, previous studies have shown that 40–43% of patients with symptoms related to oral or oropharyngeal cancer first seek care from dentists [14, 15]. Therefore, dentists should be able to recognize oropharyngeal lesions, especially those located primarily in the anterior portion of the oropharynx (anterior tonsillar pillar, palatine tonsils, soft palate, and uvula) [16]. However, it is important to acknowledge the limitations of an oral examination compared to more advanced instrumental techniques. A comprehensive examination of the oropharynx is best performed by an ENT specialist using a videolaryngoscope [17]. Consequently, early recognition by dentists is essential for prompt referral to otolaryngologist, for further evaluation and specialist management.

Currently, one of the main approaches for preventing HPV infection and related cancers is vaccination [18, 19]. Three different licensed vaccine types (bivalent, quadrivalent, and nonavalent) are currently approved by the European Medicines Agency and the US Food and Drug Administration: Cervarix, Gardasil/Silgard and Gardasil 9. Cervarix is only active against HPV 16 and 18, Gardasil has additional activity against HPV 6 and 11, whereas Gardasil 9 is also active against serotype 31, 33, 37, 52, and 58 [20, 21].

Since clinical trials on the vaccine suggest that its efficacy is greater in HPV-naïve individuals, the ideal time for vaccination is before any sexual activity begins [22]. Indeed, all three vaccinations are approved for use in

boys and girls from 9 years of age and are administered in 2–3 doses [23].

According to data from the Behavioral Risk Factor Surveillance System, a considerable majority of individuals who have not received HPV vaccination have visited oral health care providers within the previous year, underscoring their potential importance in facilitating discussions about HPV, raising awareness, and promoting agreement on vaccination [24].

Therefore, dentists could play a leading role in the primary prevention of HPV+ OPSCC by instructing patients and their parents about the risks of infection and spreading information on vaccination availability [25–28], as recommended by the American Dental Association and the American Academy of Pediatric Dentistry [29].

This requires dental providers to be prepared to answer patients' questions about HPV infection and vaccines and to educate them about the connection between HPV and OPSCC [30, 31]. However, discussions related to these issues were infrequent in the oral health care setting, which may be due to a lack of knowledge and communication skills among oral health care professionals [24, 32]. To address these gaps, dental students, as future health care providers, must be trained to increase public understanding of HPV-related diseases, and establishing their level of awareness is the first step in evaluating whether it is necessary to strengthen educational training programs. KAP (knowledge, attitude, and perception) surveys are well suited for this purpose because of their simplicity in design, ability to generate quantifiable data, ease of interpretation and concise way in which the results can be presented. Furthermore, KAP surveys facilitate cross-cultural comparisons [33].

Since, to the best of our knowledge, no similar studies exist in the literature, the aim of this paper is to assess knowledge, attitude, and perceptions on HPV infection, HPV+ OPSCC, and HPV vaccination among Italian dental students.

Materials and methods

Study description

The present study has been conducted by the Oral Medicine Unit, Department of Neuroscience, Reproductive and Oral Sciences of the “Federico II” University, Naples (Italy), in collaboration with the “Scuola Medica Salernitana”, Department of Medicine, Surgery and Dentistry, Salerno (Italy), from February 2023 to May 2023. The study is compliant with the ethical principles of the World Medical Association Declaration of Helsinki and the methods carried out in this study were approved by

the Ethics Committee of the “Federico II” University of Naples, Italy (No. 437/20). The inclusion criteria for the study are as follows: (a) be a student enrolled at the Dental Italian University, from the 1st to the 6th year of attendance; (b) to be native speakers to complete the questionnaire form in full.

The students received a link via e-mail to participate in the self-administered online questionnaire via Google Forms, which included mandatory responses. Participation was voluntary, and informed consent was obtained online from all the participants.

The present survey employed a previously published validated questionnaire, originally designed to assess knowledge, attitudes, and perceptions (KAP) related to HPV+ OPSCC, infection, and vaccination among pediatric dentists [34]. The items were adapted only where necessary to ensure relevance and appropriateness for dental students. Specifically, the following modifications were made: (a) In the “Attitude” section, for items 1, 2, 3, 6, 7, and 8, the term “paediatric dentist” was replaced with “dental students”; (b) In the “Perception” section, for items 15 and 17, the phrase “As soon as I become a dentist” was added at the beginning of the question, and the verb was adjusted to the future tense.

Although the survey was based on a previously published research study conducted by our group and other researchers, the KAP questionnaire underwent a thorough review to reconfirm its content validity. Survey items originally developed in English were translated into Italian, the official national language, to facilitate administration to local participants. The translation process was executed by an ad hoc group using a rigorous forward and backward translation methodology, as recommended by Sousa & Rojjanasrirat [35]. This process was meticulously carried out by two bilingual researchers (F.C., T.C.) to ensure both linguistic and cultural accuracy. Initially, two independent bilingual translators, who are fluent in both English and Italian, completed the forward translation. These translations were then synthesized into a single Italian version by comparing and resolving any discrepancies.

Subsequently, the synthesized Italian version underwent a backward translation into English by other two different bilingual translators who were unaware of the original survey items (G.M., N.C.). The back-translated version was compared with the original English version to identify and correct any semantic discrepancies, ensuring that the translated items retained their original meaning.

The resulting Italian version of the survey was reviewed by a multidisciplinary committee, including the translators and additional experts in the field, to further refine and validate the translation. This committee ensured that the translated survey maintained conceptual, semantic,

and content equivalence with the original. Pilot-testing, according to Sousa & Rojjanasrirat’ guideline, was not done because the committee, composed entirely of Italian mother language, believed that all parts of the questionnaire were perfectly clear. This thorough process ensures that the translated survey is both reliable and valid for use in the target population of Italian dental students.

In this study, internal consistency was assessed using Cronbach’s alpha coefficient, with a value above 0.7 indicating good consistency [36]. The overall Cronbach’s alpha for the questionnaire was 0.83, demonstrating strong internal consistency.

To evaluate test–retest reliability, the questionnaire was administered twice to a group of 20 dental students, three weeks apart, using the intraclass correlation coefficient (ICC) [37] with 95% confidence intervals, based on a mean-rating, absolute-agreement, two-way mixed-effects model. The ICC value was 0.907, indicating an excellent level of reliability. The time required to complete the questionnaire was 15 min.

The results of the test-retest reliability analysis, as well as the Italian and English versions of the questionnaire, are provided in the Supplementary Materials (Supplementary Materials 1 Table S1-S2, and Supplementary Materials 2).

Description of the questionnaire

The questionnaire included four sections. The first part included 4 questions related to students’ demographic data: sex, age range, graduation year attendance, and university geographical region. The second part consisted of 48 statements and aimed to investigate the students’ knowledge of HPV+cancer (statements 1–18), infection (statements 19–33), and vaccines (statements 34–48). For this part, “true”/“false” dichotomous responses were used, and knowledge statements (Table 1) were scored as correct (+1) or incorrect (0), with the percentage of respondents answering correctly reported in the final analysis. The third and fourth parts consisted of 20 and 10 statements related, respectively, to the perceptions and attitudes of students about HPV+OPSCC, infection and vaccination (Tables 2 and 3). A five-point Likert scale for each statement was used with five answer options: 5. Strongly agree; 4. Agree; 3. Neither agree nor disagree; 2. Disagree; 1. Strongly disagree.

Statistical analysis

For each item, the absolute and relative frequencies of the responses were calculated. Additionally, sociodemographic factors were analyzed to stratify all responses by age range, year of study, and geographical region. To assess the participants’ level of knowledge, the number and average number of correct answers were calculated; subsequently, a comparison was conducted using

Table 1 Questionnaire assessing dental students' knowledge on HPV+ OPSCC, HPV infection and HPV vaccine statements used required one of the following responses: "true"/ "false"

Knowledge on HPV+ OPSCC	
1	HPV can lead to cervical cancer
2	HPV can lead to OP-cancer
3	HPV can lead to anal cancer
4	HPV can lead to testicular cancer
5	HPV can lead to vaginal cancer
6	HPV can lead to penile cancer
7	All HPV subtypes can cause OP-cancer
8	A growing number of patients diagnosed with OP-cancer lack risk factors as tobacco and alcohol use
9	The average age of patients diagnosed with OP-cancer is decreasing
10	OP-cancer is frequently preceded by clinically identifiable premalignant lesions
11	OP-cancer caused by HPV is frequently preceded by identifiable premalignant lesions
12	OP-cancer caused by HPV carries a less favourable prognosis
13	Girls have an increased risk of developing HPV-related OP-cancer
14	HPV-related oral malignant lesions are often diagnosed in an advanced stage of progression
15	Papilloma and verruca vulgaris are HPV-related premalignant lesions
16	The tongue is the principal head and neck cancer site associated with HPV
17	Individuals with frequent oral sex encounters, a greater number of different sexual partners and earlier sexual experiences seem to be at a higher risk for OP-cancer development
18	HPV can produce the abnormal cervical cells found in Pap test
Knowledge on HPV infection	
19	HPV infections can be transmitted by any skin-to-skin contact
20	HPV infection is a relatively uncommon sexually transmitted infection
21	Approximately 30% of sexually active individuals are infected by HPV during their lifetime
22	There are more than 100 types of HPV
23	HPV can lead to AIDS
24	Antibiotics are effective for HPV infection
25	Most patients with HPV experience symptoms of the infection
26	HPV infection occurs in both sexes
27	10% of HPV infections can become persistent
28	HPV infection risk increases with the number of sex partner and starting to have sex at an early age
29	Majority of HPV infections can be cleared on their own within 1 to 2 years
30	Vertical transmission of HPV infection is not possible from mother to the embryo, fetus or baby during pregnancy or childbirth
31	HPV may be transmitted among the family members by kissing and digital contact
32	Children can't acquire the infection from close family members and caregivers with hand warts during cleaning of the anogenital area and diaper changing
33	Oral papilloma can develop as a result of oral sex or autoinoculation
Knowledge on HPV vaccine	
34	The HPV vaccine defends women against cervical cancer
35	Bivalent, quadrivalent and nonavalent vaccines are available in our country
36	HPV vaccines are suggested ideally between 9 and 26 years of age
37	Women who have been vaccinated should not continue screening for HPV infection
38	HPV vaccines are more effective in women prior to exposure to the virus
39	It is important that male adolescents receive anti-HPV vaccination
40	Anti-HPV vaccination is recommended in the first year of life
41	In the national immunization program, the HPV vaccine is only available for females
42	Anti-HPV vaccination is recommended before the beginning of sexual activity
43	Anti-HPV vaccination is recommended in sexually active people
44	The HPV vaccine is equally effective no matter what age it is given
45	HPV vaccine is able to prevent HPV infection and possibly prevent children from developing cancers associated with the infection
46	Sexually active patients should not be offered the HPV vaccine
47	Before vaccination, individuals should be screened for HPV infection
48	Anti-HPV vaccination is active only against subtypes 16 and 18

Table 2 Questionnaire assessing dental students' perceptions on HPV+ OPSCC, infection, and vaccine. Level of agreement to each statement was assessed by a five-point likert scale: (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; (5) strongly agree

Perception	
1	I think the dentist has an important role in preventing HPV infection
2	I think the dentist should inform the patients about the link between HPV and OP-cancer
3	I think the dentist should promote vaccination
4	I need more information about the infection
5	I need more information about the vaccine
6	I need more information about HPV and cancer
7	I think safety and effectiveness of the vaccine are yet demonstrated
8	I think the dentist is not afraid to offend patients and their parents discussing oral sex practices
9	think patients' parents are interested in HPV prevention
10	I think patients' parents would accept vaccination to prevent a sexually transmitted infection
11	I think patients' parents would accept vaccination to avoid a potentially carcinogenic infection
12	I think patients' parents would decline vaccination for fear of adverse events
13	I think patients' parents would decline vaccination for lack of adequate knowledge on sexually transmitted infection
14	I think patients' parents would decline vaccination for fear of increasing sons' sexual activity
15	I think dental students should acquire more knowledge on HPV-related diseases during the attendance of the degree course in dentistry
16	I think I am acquiring extensive knowledge on HPV-related diseases during the attendance of the degree course in dentistry
17	In discussion vaccination with patients and their parents, it would be helpful for the dentist to have standard talking points
18	I think I have to acquire skills on how communicate with parents on HPV infection and oral cancer
19	I consider inclusion of vaccine in the national vaccine schedule as necessary
20	Vaccine does not encourage starting to have sex at an early stage

Pearson's chi-square test to evaluate the variations in correct answer ratios across different demographic characteristics. For non dichotomous categorical variables, an added post hoc analysis was performed when the chi-square test was used. An additional comparison was performed by grouping questions based on the same main topics (1–18 for HPV+OPSCC, 19–33 for infection, and 34–48 for vaccination). Regarding attitude and practice, the frequency distribution was evaluated, and a related comparison of the scores assigned to each question was performed with the Kruskal–Wallis and Mann–Whitney tests for non dichotomous variables and Pearson's chi-square test for dichotomous variables. The negative statements used in the attitude and perception questions were

Table 3 Questionnaire assessing dental students' attitude on HPV+ OPSCC, infection, and vaccine. Level of agreement to each statement was assessed by a five-point likert scale: (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; (5) strongly agree

Attitude	
1	As soon as I become a dentist, I will feel comfortable talking about HPV+ cancer with patients/parents
2	As soon as I become a dentist, I will feel comfortable talking about vaccination with patients/parents
3	As soon as I become a dentist, I will feel comfortable talking about HPV infection with patients/parents
4	I would obtain the vaccine for me
5	I agree with the current effort to provide vaccination to preadolescents
6	As soon as I become a dentist, for religious reasons, I will not be against recommending vaccination to my patients
7	As soon as I become a dentist, I will not be more inclined to recommend vaccination to girls rather than boys
8	As soon as I become a dentist, I will routinely carry out oral cancer screening on my patients
9	I am inclined to periodically update my knowledge on HPV-related diseases reading scientific papers
10	I am inclined to attend lectures/seminars/conferences on HPV-related diseases

reverse coded to allow the statistical analysis of all the responses.

Additionally, students were divided into two groups based on their year of attendance: *early career* (from 1th to 3rd year) and *late career* (from 4th to 6th year). An initial analysis was conducted using the Student's t-test to assess the differences in the total score of responses for the six categories: overall knowledge, OPSCC-HPV knowledge, HPV infection knowledge, HPV vaccine knowledge, perception, and attitude. Following this, a two-way ANOVA was performed to evaluate potential interactions between the study career (early vs. late) and other variables, including sex and geographic region.

Statistical significance was determined by considering a p value of less than 0.05 for all conducted tests. For multiple comparisons, Bonferroni correction was used to adjust the p values accordingly.

The sample size for the study was determined before the administration of the questionnaires, based on a 5% margin of error and a 95% confidence level. Given that the estimated number of dental students in Italy is approximately 6782, a required sample size of 364 was calculated using Cochran's correction formula [38]. Since the questionnaire was administered in the first semester of 2023, and considering that the Dentistry degree in Italy is a limited-enrollment course with a duration of 6 years, the total number of dental students was calculated based on the available spots in Italian university from the academic years 2017/2018 to 2022/2023, as reported by

Table 4 Sociodemographic analysis of respondents ($N=412$) and percentage of correct responses on knowledge on overall, HPV+ OPSCC, infection, and vaccine, according to sex, age range, graduation year attendance and university geographical region.

Characteristics		Number of students	HPV+ OPSCC	HPV Infection	HPV vaccine	Overall
Sex	Male	202/412 (49%)	2446/3816 (64%)	2005/3030 (66%)	2199/3030 (72%)	6650/8876 (75%)
	Female	210/412 (51%)	2526/3780 (67%)	2132/3150 (68%)	2396/3150 (76%)	7054/10,080 (70%)
Age range (Years)	≤ 19	40/412 (10%)	409/720 (57%)	353/600 (59%)	395/600 (66%)	1157/1920 (60%)
	20–21	108/412 (26%)	1213/1944 (62%)	993/1620 (61%)	1160/1620 (72%)	3366/5184 (65%)
	22–23	137/412 (33%)	1697/2466 (69%)	1420/2055 (69%)	1558/2055 (76%)	4675/6576 (71%)
	≥ 24	127/412 (31%)	1653/2286 (72%)	1371/1905 (72%)	1482/1905 (78%)	4506/6096 (74%)
Attendance	1°	64/412 (15%)	682/1152 (59%)	579/960 (60%)	658/960 (68%)	1919/3072 (63%)
	2°	84/412 (20%)	934/1512 (62%)	756/1260 (60%)	876/1260 (69%)	2566/4032 (64%)
	3°	62/412 (15%)	709/1116 (64%)	602/930 (65%)	685/930 (74%)	1996/2976 (67%)
	4°	84/412 (20%)	1079/1512 (71%)	889/1260 (71%)	973/1260 (77%)	2941/4032 (73%)
	5°	70/412 (17%)	889/1260 (70%)	764/1050 (73%)	815/1050 (78%)	2468/3360 (74%)
	6°	48/412 (12%)	679/864 (79%)	547/720 (76%)	588/720 (82%)	1814/2304 (79%)
	Early career	210/412 (51%)	2325/3780 (61%)	1937/3150 (61%)	2219/3150 (70%)	6481/10,080 (64%)
Late career	202/412 (49%)	2647/3636 (73%)	2200/3030 (73%)	2376/3030 (78%)	7223/9696 (74%)	
Geographical region	North	140/412 (34.0%)	1666/250 (66%)	1390/2100 (66%)	1542/2100 (73.4%)	4598/4450 (68.6%)
	Centre	135/412 (32.8%)	1661/2430 (68%)	1350/2025 (67%)	1504/2025 (74.3%)	4515/6480 (69.8%)
	South	137/412 (33.2%)	1645/2466 (67%)	1397/2055 (68%)	1549/2055 (75.4%)	4591/6576 (70.0%)
All participants			4972/7416 (67.0%)	4137/6180 (67%)	4595/6180 (74.3%)	13,704/19,776 (69.3%)

the Ministry of University and Research and the Ministry of Education and Merit [39, 40].

Results

Sociodemographic data

A total sample of 412 dental students completed the questionnaire. The sample analyzed was almost equally divided into males and females, and the majority of participants were aged between 22–23 years and were attending their 2nd or 4th year of university. Table 4 summarizes the sociodemographic characteristics by sex, age group, year of study, and university geographical region, as well as the percentage of correct answers in the **knowledge** section, stratified by these sociodemographic factors. Moreover, results are presented by categorizing students into two groups based on their year of study: an “early career” group, comprising students in their first,

second, and third years, and a “late career” group, consisting of students in their fourth, fifth, and sixth years. Table 5 shows the p-value derived by comparative analysis of responses on knowledge, attitudes and perceptions between different sociodemographic groups. Table 6 summarizes the **knowledge** section scores of the early and late career groups, divided into subgroups by sex and geographical region, along with the respective p-values for the comparisons.

Knowledge

HPV+ OPSCC (statements 1–18)

The total percentage of correct responses for HPV+OPSCC cancer knowledge was 67% (early career: 61% vs. late career: 73%), as shown in Table 4. Over 50% of participants in both groups (early and late) replied incorrectly to only 2 out of the 18 questions

Table 5 Comparative analysis of responses on knowledge (overall, HPV+ OPSCC, infection and vaccine), perception and attitudes stratified by sex, years of attendance, and geographical region

Variables		Knowledge – Overall	Knowledge – HPV+ OPSCC	Knowledge – Infection	Knowledge – Vaccine	Perception	Attitude
Sex							
Male	Female	$p=0.161$	$p=0.733$	$p=0.217$	$p=0.006^*$	$p=0.001^*$	$p=0.000^*$
Years of Attendance							
Early career	Late career	$p=0.000^*$	$p=0.000^*$	$p=0.000^*$	$p=0.000^*$	$p=0.076$	$p=0.147$
Geographical region							
North	Centre	$p=0.550$	$p=0.482$	$p=1.000$	$p=1.000$	$p=1.000$	$p=1.000$
	South	$p=0.492$	$p=1.000$	$p=0.694$	$p=0.629$	$p=1.000$	$p=1.000$
Centre	South	$p=0.996$	$p=0.916$	$p=1.000$	$p=1.000$	$p=1.000$	$p=1.000$

*Significance $p \leq 0.05$

Table 6 Comparison of early and late career responses on knowledge on overall, HPV+ OPSCC, infection, and vaccine, according to sex and geographical region

Variables (n. of students)		Knowledge – HPV+ OPSCC	p-value	Knowledge – Infection	p-value	Knowledge – Vaccine	p-value	Overall	p-value
Sex									
Early ca-reer (210)	Male (112)	1226/2016 (61%)	p=0.013	1012/1680 (60%)	p=0.046*	1135/1680 (67%)	p=0.004*	3373/5376 (63%)	p=0.001*
	Female (98)	1097/1764 (62%)		925/1470 (63%)		1084/1470 (74%)		3106/4704 (66%)	
Late ca-reer (202)	Male (90)	1220/1620 (75%)		990/1350 (73%)		1064/1350 (79%)		3274/4320 (76%)	
	Female (112)	1427/2016 (71%)		1200/1680 (71%)		1303/1680 (78%)		3930/5376 (73%)	
Geographical region									
Early ca-reer (210)	North (75)	789/1350 (58%)	p<0.001*	667/1125 (59%)	p=0.002*	765/1125 (68%)	p=0.002*	2221/3600 (62%)	p<0.001*
	Centre (70)	785/1260 (62%)		637/1050 (61%)		727/1050 (69%)		2149/3360 (64%)	
	South (65)	749/1170 (64%)		633/975 (65%)		727/975 (75%)		2109/3120 (68%)	
Late ca-reer (202)	North (65)	877/1170 (75%)		723/975 (74%)		777/975 (80%)		2377/3120 (76%)	
	Centre (65)	876/1170 (75%)		713/975 (73%)		777/975 (80%)		2366/3120 (76%)	
	South (72)	894/1296 (69%)		764/1080 (71%)		822/1080 (76%)		2480/3456 (72%)	

*Significance $p \leq 0.05$

concerning knowledge of HPV+OPSCC. These participants stated incorrectly that papilloma and verruca vulgaris were HPV+pre-malignant lesions (early career: 74% vs. late career: 63%, answered incorrectly) and that HPV+OPSCC was commonly preceded by recognizable pre-malignant lesions (early career: 67% vs. late career: 59%, answered incorrectly). Over 90% of students in both groups knew that HPV can lead to cervical cancer (early career: 92% vs. late career: 94%). Considering correlation between HPV and OPSCC, both groups scored high (early career: 85% vs. late career: 89%). These results did not differ when considering sex distribution ($p=0.733$) or university macro-geographic area ($p=0.349$), but significant differences were observed in the early and late groups ($p<0.001$) (Table 5). A two-way ANOVA was conducted to examine the effects of sex and geographic region, on number of correct answers by career stage, showing statistically significant interaction effects for both sex ($p=0.013$) and geographic region ($p<0.001$) (Table 6).

HPV infection (statements 19–33)

The total percentage of correct answers for knowledge was 67% (early career: 61% vs. late career: 73%), as shown in Table 4. Out of 15 questions, only 3 were incorrectly answered by more than 60% of the participants in both groups (early and late). These participants were unaware that infection transmission can be possible by

any skin-to-skin contact (early career: 82% vs. late career: 83%, answered incorrectly); HPV may be transmitted among family members by kissing and digital contact (early career: 79% vs. late career: 73%, answered incorrectly). Instead, more than 90% of the students knew that this infection occurred in both sexes (early career: 90% vs. late career: 92%). A considerable difference was observed between the early and late career groups in response to the question regarding whether the majority of patients with HPV show symptoms of the infection, with respectively 55% and 85% answering correctly.

These results did not differ when considering sex distribution ($p=0.217$) or university macro-geographic area ($p=0.465$), but significant differences were observed in the early and late groups ($p<0.001$) (Table 5). A two-way ANOVA was conducted to examine the effects of sex and geographic region, on number of correct answers by career stage, showing statistically significant interaction effects for both sex ($p=0.046$) and geographic region ($p<0.002$) (Table 6).

HPV vaccine (statements 34–48)

The total percentage of correct answers for knowledge about the HPV vaccine was 74% (early career: 70% vs. late career: 78%), as shown in Table 4. Out of 15 questions, only 3 were incorrectly answered by more than 50% of the participants. These participants wrongly held that vaccination was recommended for sexually

active individuals (early career: 59% vs. late career: 51%, answered incorrectly); individuals were screened for infection before vaccination (early career: 82% vs. late career: 83%, answered incorrectly); and the vaccine efficacy remained the same regardless of age (early career: 63% vs. late career: 62%, answered incorrectly).

Approximately 90% of participants answered correctly concerning the recommendation of the vaccine before the start of sexual activity (early career: 85% vs. late career: 89%) and the importance of continuing screening for infection despite vaccination (early career: 85% vs. late career: 91%).

Statistically significant differences were found in relation to sex distribution ($p=0.006$) and years of attendance ($p<0.001$), while no significant differences were observed for geographic region ($p=0.453$) (Table 5). Subsequently, a two-way ANOVA was conducted to examine the effects of sex and geographic region on number of correct answers by career stage, showing statistically significant interaction effects for both sex ($p=0.004$) and geographic region ($p=0.002$) (Table 6).

Perception

Almost all dental students thought that dentists should educate their patients about the link between HPV and OPSCC (early career: 87% vs. late career: 95%); more than 80% of participants (early career: 84% vs. late career: 92%) considered the role of the dentist important in the prevention of infection and in the promotion of vaccination (early career: 84% vs. late career: 92%).

An equal number of dental students believe they should acquire more knowledge on HPV-related diseases during the attendance of the degree course in dentistry (early career: 84% vs. late career: 92%); however, a much lower percentage feel they have gained comprehensive knowledge of these diseases during their studies (early career: 20% vs. late career: 56%).

Among the parental barriers to vaccine acceptability, 67% of the responders (early career: 63% vs. late career: 71%) agreed or strongly agreed that patients' parents would decline vaccination due to a lack of adequate knowledge of sexually transmitted infection; however, only 45% and 34% for both early and late career groups agreed or strongly agreed that vaccine refusal can be due to fear of adverse effects and fear of encouraging sexual activity in their children, respectively.

Statistically significant differences were found in relation to sex distribution ($p=0.001$), while no significant differences were observed for geographic region ($p=0.639$) and years of attendance ($p<0.076$) (Table 5). Subsequently, a two-way ANOVA was conducted to examine the effects of sex and geographic region on number of answers by career stage, showing no statistically

significant interaction effects for both sex ($p=0.233$) and geographic region ($p=0.233$).

Attitude

More than 85% of the participants agreed or strongly agreed with the periodically updated knowledge on HPV-related diseases by attending lectures/seminars/conferences (early career: 84% vs. late career: 89%) and reading scientific papers (early career: 85% vs. late career: 90%); approximately 80% would feel comfortable talking about HPV+cancer (early career: 81% vs. late career: 79%), infection (early career: 79% vs. late career: 83%) and vaccines (early career: 84% vs. late career: 84%) with patients and their parents. About 50% of the respondents were not inclined to recommend the vaccine to either sex (early career: 42% vs. late career: 56%).

Statistically significant differences were found in relation to sex distribution ($p<0.001$), while no significant differences were observed for geographic region ($p=0.952$) and years of attendance ($p=0.147$) (Table 5). Subsequently, a two-way ANOVA was conducted to examine the effects of sex and geographic region on number of answers by career stage, showing no statistically significant interaction effects for both sex ($p=0.283$) and geographic region ($p=0.698$).

All the frequency distributions of the answers are reported in Supplementary file (Table S1).

Discussion

Since the incidence of HPV+OPSCC is increasing, dentists, in collaboration with other healthcare professionals, could play a key role in HPV prevention by recommending HPV vaccination to patients and discussing HPV infection and links to OPSCC [26, 41]. Dental students, as future healthcare professionals, must have an adequate level of knowledge, along with a positive attitude toward vaccination and effective communication skills, to address this need.

Knowledge

Among the 3 knowledge sections analyzed, the highest percentage of correct answers concerned knowledge of the vaccine (early career: 70% vs. late career: 78%), followed by the HPV+OPSCC and infection items, with equal values (early career: 61% vs. late career: 73%).

These findings indicate a strong interest among students in vaccination and highlights the interconnected relationship between awareness of HPV infection and understanding of HPV+OPSCC.

Statistically significant differences between early and late career groups were found ($p<0.001$), in favor of students attending the final years of the degree course. This finding is consistent with the existing scientific literature [42–45], yet knowledge on these topics remains

suboptimal, considering the critical responsibilities dental students will assume in their professional careers. Improving these awarenesses is essential to improve the role of dental health professionals in HPV prevention and help them discuss these topics with patients [30].

Almost all students in both groups were aware of the possibility that HPV caused OPSCC and cervical cancer (>90%), but only approximately 50–60% knew that HPV caused anogenital cancer. This was probably due to the higher prevalence of HPV+cervical and OPSCC [8] since this information is already well consolidated in the first three year students. Therefore, awareness about the possibility of infection determining cancer in other anatomical sites should be implemented [46], strengthening knowledge in dental curricula. Statistically significant interaction effects for both sex ($p=0.013$) and geographic region ($p<0.001$) on number of correct answers by career stage of all three knowledge sections (HPV+OPSCC, infection and vaccine).

The sex-based difference in engagement with sexual health topics, where female students often show higher levels of engagement, is supported by several studies [47, 48]. Studies indicate that female healthcare students, including those in medical and dental fields, tend to be more involved in sexual health-related discussions, likely due to a combination of societal roles and an increased comfort with topics related to sexual health.

Instead, the regional discrepancy highlights the importance of standardizing education on critical health topics like HPV+OPSCC across all institutions, regardless of geographic location. Ensuring that dental programs consistently cover HPV-related content across the undergraduate curriculum is essential to achieving consistent levels of knowledge among dental graduates, regardless of where they study. Programs should actively engage both male and female students, promoting equal competency in HPV knowledge. These findings highlight the need for curricula that address the learning needs of all students equally.

Additionally, in the evaluation of the knowledge acquired by dental students regarding HPV, it is essential to recognize the timing and approach in which this topic is addressed in the curriculum. Typically, the subject of HPV is covered in a fragmented form across various courses, particularly during the second half of the study plan. Specifically, the infectious disease course equipped students with knowledge about HPV biology, the replication cycle, routes of infection, and HPV-associated diseases. In the dermatology course, students are taught to recognize benign lesions caused by the virus, both on the skin and mucous membranes. Subsequently, in the oral pathology and head and neck pathology courses, the role of HPV in the development of OPSCC is explored, and the importance of vaccination as a preventive measure

is discussed. However, it is important to note that the coverage of HPV across these courses is not always systematic, which may result in knowledge gaps among students. One potential improvement could be the introduction of interdisciplinary modules specifically dedicated to HPV.

Notably, it is important to consider that students acquire additional knowledge about HPV from external sources outside of formal academic settings, including public awareness campaigns, social media platforms, and other informal channels. This additional information can supplement their undergraduate education, but its accuracy and depth can vary, further underscoring the need for a more structured and consistent approach to HPV education across the curriculum.

Perception and attitude

Overall, students showed a good perception of their future role in preventing HPV infection, with no statistically significant differences between the early and late career groups ($p=0.076$).

In fact, 82.5% and 91.1% of participants agreed and strongly agreed, respectively, about the role of dentists in preventing infection and in educating patients on the link between HPV and OPSCC. Additionally, 87.9% of respondents generally promoted vaccination in line with the published literature [42], which indicated that students were ready to debate it with their patients.

However, while over 80% of participants felt it was important for dentists to play a role in HPV prevention and vaccination, a much smaller percentage felt that they had gained adequate knowledge of HPV during their studies. The significant discrepancy between perceived importance and perceived readiness suggests that while dental students recognize their potential role in public health initiatives related to HPV, they may feel under-equipped to carry out this role effectively [49]. Therefore, most of the students of both early and late career groups required more information on HPV-related diseases during the attendance of the degree course, in agreement with Spanish, Dutch, Jordan and American students [42, 50–52].

Over 60% of students thoughts that patients' parents were interested in prevention and would accept vaccination to prevent STIs and to avoid potentially carcinogenic infections, and when vaccination declined, they thought this was due to a lack of adequate knowledge of STIs. Parents' knowledge and opinions about vaccines are among the main factors that influence the decision to vaccinate [53]. Consequently, health professionals must develop and reinforce communication strategies for addressing parental concerns about vaccines to help them in their decision-making [54–56]. Our results, coupled with those reported by Naavaal et al. in the American population

[30], suggest that both future dentists and the general population are inclined to accept and integrate HPV prevention discussion into dental clinical practice. About the attitude, according to Wright's results, more than 2 out of the 3 students felt comfortable talking about HPV-related cancers, infection and vaccination with patients and parents [51]. In this study, only approximately 50% of both early and late career groups was inclined to recommend the vaccine to either sex. This showed that students still need to raise awareness of the role of the vaccine in men, which is important for increasing immunization coverage and reducing HPV+ diseases [57]. For HPV+ cancer, most students agreed that they would routinely carry out oral cancer screening on their patients (early career: 81% vs. late career: 88%), in accordance with a Spanish survey [50]. This result was promising if we considered that a positive attitude in discussions about patient and early diagnosis strategies by dental professionals, who have a good knowledge background, could have a direct helpful impact on OPSCC patient survival [58]. More than 85% of the students were inclined to periodically update their knowledge on HPV-related diseases by attending education programs and reading scientific papers, according to Lingam et al. [59]. Therefore, educational training programs are necessary to achieve a better understanding of infection and its association with OPSCC [52]. Statistically significant differences in perception and attitude were found between sex distribution, with female students exhibiting more positive outcomes, which aligns with their higher level of engagement in discussions around sexual health [47].

Limitations

This study had limitations that should be considered. First, there is a potential risk of bias in the survey responses, as participants may have been inclined to respond according to the researcher's expectations, particularly in the [Attitude](#) section. Second, the non-mandatory nature of participation might have led to self-selection bias, with only the most knowledgeable students about HPV opting to participate. However, online surveys offer advantages over paper-based surveys, such as ensuring complete responses from participants, thus minimizing the risk of incomplete or inaccurate data that may arise from skipped questions.

Conclusions

The results of the current study are encouraging, although some significant gaps in dental students' knowledge, perception and attitudes towards HPV+OPSCC, infection and vaccination exist. While students recognize the importance of their role in prevention and patient education, they often feel inadequately prepared. Addressing these gaps through targeted education and training could

enhance their awareness for comprehensive HPV prevention and patient education in future clinical practice. Strengthening these aspects within dental curricula will contribute to improving public health outcomes.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12903-024-04998-w>.

Supplementary Material 1

Supplementary Material 2

Author contributions

G.M., N.C., and S.L. conceptualized the study. Data curation was performed by A.B., M.A., and F.C. Formal analysis was conducted by D.A., A.B., and M.M. Si.L., M.M., and F.C. acquired funding. Investigation was carried out by G.M., Si.L., and D.A. Methodology was developed by V.C.A.C. and T.C. Project administration was handled by T.C. and F.C. Resources were provided by M.M., M.A., and D.A. Software development was managed by V.C.A.C., Si.L., and A.B. Supervision was conducted by S.L. and M.D.M. Validation was done by M.D.M. and S.L. Visualization was created by S.L. and M.D.M. G.M., T.C., and N.C. wrote the original draft. S.L. and M.D.M. reviewed and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author upon request.

Declarations

Ethics approval and consent to participate

Ethics Committee of the "Federico II" University of Naples, Italy (No. 437/20). All participants provided informed consent prior to their inclusion in the study.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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