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Adolescent receptiveness to dentist involvement in COVID-19 and HPV vaccination

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Abstract

Objectives: Human papillomavirus (HPV) and COVID-19 can be prevented and mitigated by vaccines. Few studies have focused on dentists' role in vaccine decision making, and even fewer have explored adolescent perspectives; a target population for both vaccinations. This study aimed to address this gap with a focus on whether opinions vary between diseases.
Methods: We administered a validated cross-sectional survey to adolescent patients (11–19 years) in an orthodontic clinic in Vancouver, British Columbia from July-August 2023. The survey included questions pertaining to patient background, vaccine history and knowledge, and dentists' roles in vaccination education, discussion, and administration. Responses were compiled and analyzed to determine differences between vaccines and across demographic groups.
Results: Adolescents surveyed (n=93) overall agreed with dentist involvement in COVID-19 and HPV vaccines, with variability according to disease and dentist role. Comfort with dentist-administered vaccines was higher for COVID-19 (60 %) than HPV (37 %, $p<0.05$). There was a significant knowledge difference, with 85 % aware that the COVID-19 vaccine can prevent severe illness, but only 22 % aware that the HPV vaccine can prevent oropharyngeal cancer ($p<0.05$). Patients showed overall willingness to discuss COVID-19/HPV vaccines with dentists (58 % and 49 %) and less agreement that dentists were qualified to educate about COVID-19/HPV vaccines (43 % and 37 %).
Conclusions: Findings indicate mixed adolescent perception of including dentists in vaccinations, with higher comfort around COVID-19 over HPV vaccines. Openness to discussion may present an opportunity for dentists to expand scope of practice into additional education, particularly around HPV and its connection with oropharyngeal cancer.

Keywords: vaccines; HPV; COVID-19; decision making; dental scope of practice

Introduction

Vaccines are widely distributed and safe mechanisms of disease prevention and control. Human papillomavirus (HPV) infection and COVID-19 can both be prevented and mitigated by vaccines [1, 2]. HPV infection is the most common sexually transmitted infection globally and can cause certain cancers, including reproductive tract and head and neck cancers (HNC) [3]. Of particular dental significance, over 70 % of oropharyngeal squamous cell carcinoma cases are caused by HPV infection, which is increasing in incidence despite stable incidence of HPV-negative HNC [3, 4]. A highly effective vaccine against HPV was first approved in the US in 2006 and is recommended for all adolescents ages 11–12. This vaccine prevents both new infections and up to 90 % of HPV-associated cancers [1]. Early vaccination is linked to higher rates of complete vaccination and optimal protection given high risk of HPV infection in adolescents and young adults [5]. Thus, targeting of vaccine and prevention campaigns support a concentration on the adolescent age group [6]. The impact of HPV on the head and neck and the benefits of vaccination provide an opportunity for dentists to address this disease and its prevention with patients. The COVID-19 pandemic played a profound role in increasing global vaccine development efforts and awareness of vaccine benefits [7]. The COVID-19 pandemic necessarily led to expansion in eligibility to provide vaccines in order to improve distribution, including newly allowing dental professionals and other expanded health care personnel to provide vaccines [8, 9]. Dental providers were included in vaccine workforces for COVID-19 in most United States and some Canadian provinces, including British Columbia, and dentists remain eligible vaccinators in various United States [10, 11].

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Despite the importance of HPV vaccinations for adolescents, vaccination rates have long been suboptimal, with notable decreases during the COVID-19 pandemic [12]. This has been connected to several causes including lack of education, not receiving a recommendation, safety concerns, and efficacy concerns [13]. While efforts to increase vaccination rates, such as reminder systems and vaccination programs implemented in schools, have been explored, few studies have investigated dentists' role in improving vaccination rates [14]. Even fewer studies have directly explored adolescent perspectives, the target population for HPV vaccination, despite research indicating that female adolescents especially may play an important role in making decisions surrounding HPV vaccination [15].

Previous studies have demonstrated conflicting results on adult patients' receptiveness to increasing dental provider involvement in vaccines. A pilot study by our group found that a majority of young adult patients (18–45 years old) agreed with increasing dentist involvement, with more comfort for the COVID-19 vaccine as opposed to the HPV vaccine [16]. Another study also demonstrated high willingness of parents to discuss (86 %) and allow administration (79 %) of HPV vaccines by dental professionals for their children [17]. On the other hand, low receptiveness (23 %) was revealed by a study examining the perceptions of parents of adolescents on dentists' role in HPV vaccine delivery. In this study, parents were more comfortable with dentists performing other vaccine-related tasks, such as education and promotion [18]. These incongruent results illustrate the need for further research on patient attitudes around dentist involvement in vaccinations. These results also demonstrate the lack of adolescent perspective currently available in vaccine literature. Currently, few dentists are educating on or administering vaccines, which may be due to lack of awareness of which vaccines they are permitted to deliver and/or a deficit in training [19]. Furthermore, parent approval, public approval, and perceived social pressure against counseling were documented as barriers to HPV counseling for adolescents in the dental office [20]. However, many dental professionals are willing to obtain training in HPV communication [21]. In one study of dentists, for example, 97 % of respondents were determined to be in the precontemplation and contemplation stages of readiness to discuss HPV vaccines with female patients [22]. Considering that more people visit the dentist than other health care centers, establishing the dental clinic as an alternative site for vaccination presents potential but requires more research on patient perspectives [23].

This study aims to expand available evidence by testing the hypothesis that adolescent patients will favor expanding the roles of dental professionals relating to both HPV and COVID-19 vaccination. Using a validated survey instrument, we assessed adolescent acceptance of various dentist roles in vaccination against HPV and COVID-19, as well as differences across demographic groups and between vaccine types, to determine factors impacting patient perspectives. This study is the first to focus directly on adolescent attitudes. In so doing, the results can inform how dentists can help promote vaccination rates and education in this patient group.

Methods

A validated cross-sectional survey was adapted for and distributed to an adolescent population to determine perceptions of dentist involvement in COVID-19 and HPV vaccination. The survey was developed from existing literature, validated for content and psychometrics, and distributed to young adult patients (data on validation available on request) [24]. The instrument (Supplement 1) included 18 optional questions regarding participant demographics and attitudes around COVID-19 and HPV vaccines. Demographics including sex at birth, gender identity, age, race/ethnicity, educational level, and household income. Vaccine questions inquired about patient vaccine status and intentions according to current dosage recommendations, knowledge, and dentist roles in COVID-19 and HPV vaccinations. Participants were able to answer "yes", "no", or "unsure" to each vaccine question and were provided a free-text field concerning each vaccine to add additional detailed feedback or opinions.

The survey was distributed to a convenience sample of 93 adolescent patients between ages 11–19 years attending appointments at the Burnaby Monarch Orthodontic Centre in Burnaby, British Columbia, Canada. This sample was estimated as adequate to assess 20 % differences in patient response to each vaccine according to previous data on patient acceptance of HPV vaccines [17] (estimated sample=79, 80 % power, alpha=0.05, beta=0.20 anticipating that patients taking the survey would complete questions about both HPV and COVID-19 vaccines). Survey distribution and response collection took place in-person from June to August 2023. The study was approved by the local Institutional Review Board as exempt (protocol #853747) and was conducted in accordance of the World Medical Association Declaration of Helsinki.

Patients were approached in the clinic while waiting for appointments. Pre-survey, the study team used a standardized script to verbally ask patients about their eligibility and whether they were willing to participate in the study. Eligibility criteria included patients between the ages of 11–19 years old, ability to speak and read English without a translator, and possession of medical decision-making

capacity, understanding that all participants were beneath the age of majority that would allow for final legal decision-making capacity. No preselection was performed using medical or dental records, and no medical or dental history was obtained from participants. Patients were informed about their complete autonomy in study participation, the anonymity in survey responses, and how their treatment at the facility would not be affected based on their decision to partake in the survey. Additionally, patients were told of the risks and benefits of participating and offered background information regarding HPV and COVID-19 (Supplement 2). Patients were asked if they had any other questions or concerns before beginning the survey.

The survey was distributed on a secure iPad and data was stored using the Research Electronic Data Capture (REDCap) secure system. There was no time limit for participants to complete the survey, and patients were able to leave the research study at any time. Patients answered the survey questions without external assistance, however, the study team was available if questions or concerns were brought up by the participant.

Following the completion of the survey, participants' first name, last name, and email were optionally collected if they chose to enter a raffle for one of three $50 gift cards. Personal identifiable information used for the purpose of the raffle was separated from the survey responses and not included in any analysis. For patients who provided contact information, an infographic regarding HPV and COVID-19 vaccination and the study team's contact information was distributed via email (Supplement 3).

Data was analyzed through R and Microsoft Excel. Descriptive statistics were completed for demographic information (Microsoft Excel, Redmond, WA). The categorical variable "race" was recategorized into "Asian", "White", and "Other" due to the imbalanced sample size of each racial group.

Differences in response to COVID-19 and HPV vaccine questions were evaluated using the Wilcoxon signed rank test given the direct comparison of separate questions using a non-parametric sample (R project for computing). Associations between and demographic factors (sex assigned at birth, education level, income level, race) were evaluated using Chi-squared tests while associations by age were evaluated using correlation coefficient given the continuous nature of this variable. Significance for all the statistical tests was set at $p<0.05$.

Results

Among the 93 adolescents who completed the survey, 60.2 % (n=56) had female sex assigned at birth. The current gender identity distribution included 39.8 % identifying as male (n=37), 54.8 % as female (n=51), 1.1 % as transgender (n=1), 2.2 % as non-binary (n=2), and 1.1 % as gender variant or nonconforming (n=1). The mean age of the population was 16.31 (standard deviation 1.64, range 13–19). A majority of participants identified as Asian (n=62, 66.7 %), followed by White (n=14, 15.1 %) and other races (n=17, 18.3 %) including Black, Middle Eastern, North African, and Indian. Household incomes represented all available categories including 32.4 % of participants who did not know or disclose their household income. Further detail on demographic breakdown of survey respondents is available as Table 1.

Most participants were fully vaccinated against COVID-19 (n=67, 72.8 %). However, less than half of the

Table 1: Demographic characteristic distribution of survey participants.

Variable	Statistic (n, %)
Sex assigned at birth	
Female	56 (60.2 %)
Male	37 (39.8 %)
Current gender identity	
Male	37 (39.8 %)
Female	51 (54.8 %)
Transgender	1 (1.1 %)
Non-binary	2 (2.2 %)
Gender variant/Nonconforming	1 (1.1 %)
Blank (not answered)	1 (1.1 %)
Other	0 (0.0 %)
Age	
Mean, SD	16.31 (1.64)
Race[a]	
White	14 (15.1 %)
Asian	62 (66.7 %)
Other	17 (18.3 %)
Education[b]	
≤High school	52 (55.9 %)
High school diploma or equivalent	37 (39.8 %)
Some college	1 (1.1 %)
Bachelor's degree	1 (1.1 %)
Master's degree	1 (1.1 %)
Doctorate/Professional degree	0 (0.0 %)
Blank (not answered)	1 (1.1 %)
Household income	
<20 k	3 (3.2 %)
20 k–35 k	6 (6.5 %)
35 k–50 k	4 (4.3 %)
50 k–75 k	18 (19.4 %)
75 k–100 k	15 (16.1 %)
>100 k	15 (16.1 %)
Blank (not answered)	32 (34.4 %)

[a]Percentages sum to over 100 % as participants were asked to select all categories that apply. [b]NB: Responses are reported as entered by participants and may reflect advanced educational attainment or other variations in the captured adolescent population.

adolescent respondents reported being fully vaccinated against HPV (47.2 %, n=43). Smaller proportions reported being partially vaccinated with a plan to complete the vaccination series (n=11; 11.9 % for COVID-19, n=7; 7.7 % for HPV), being partially vaccinated with no further plans to continue the series (9.7 % (n=9) for COVID-19). An additional 2.1 % (n=2) or were neither vaccinated nor wished to get any vaccines against COVID-19 in the future. Regarding HPV vaccinations, 3.2 % (n=3) had not started the series but were planning to get vaccinated in the future and the same proportion had received no doses and reported to not have any intentions to get vaccinated in the future. Notably, 31.5 % of participants (n=29) were unsure about their HPV vaccination status and intentions.

Many of the surveyed adolescents (84.9 %, n=79) were knowledgeable about the ability of COVID-19 vaccine to prevent severe COVID-19 illness, while only 21.7 % (n=20) knew that the HPV vaccine can prevent some types of HNC (Figure 1a). In both disease contexts, out of the roles included, participants expressed highest levels of agreement with comfort discussing COVID-19 and HPV vaccines with dentists (58 % (n=54) and 49 % (n=45) respectively agreeing) and the lowest levels of agreement regarding dentists' qualifications to educate patients about COVID-19 (43 %, n=40 "yes" responses) and HPV vaccines (33.7 %, n=31 "yes" responses). A majority of the surveyed participants (60.2 %, n=56) were comfortable with dentists administering COVID-19 vaccine, while only 37.4 % (n=34) were comfortable with HPV vaccine administration by dentists. However, a notable percentage of participants responded "unsure" rather than agreement or disagreement to dentist involvement in discussion (32 % (n=30) for COVID-19, 36 % (n=33) for HPV), education qualifications (43 % (n=40) for COVID-19, 55 % (n=51) for HPV), and administration (27 % (n=25) for COVID-19, 44 % (n=50) for HPV).

According to Wilcoxon signed rank tests, participants were more likely to be vaccinated against COVID-19 and more knowledgeable about the advantages of COVID-19 vaccines compared to HPV (Table 2). More adolescents also reported comfort allowing dentists to administer COVID-19 vaccines than HPV vaccines.

When evaluating relationships between demographic factors and survey responses, race was not associated with COVID-19 questions but was associated with HPV vaccination status ($p=0.027$, Table 3). Income was associated with comfort discussing the COVID-19 vaccine ($p=0.020$) but had no association with responses regarding HPV. Education and gender assigned at birth were not found to be associated with responses to any survey questions. Lastly, age was found to be weakly associated with each question for both COVID-19 and HPV using correlation coefficient (all $-0.03<r<0.3$).

Discussion

In this first study to assess adolescent attitudes toward dentist involvement in vaccine distribution, respondents showed mixed comfort, with few against involvement. Our findings indicated sustained differences in responses between the COVID-19 and HPV vaccine, with fewer distinctions according to demographic group.

Participants demonstrated a knowledge gap between understanding COVID-19 and HPV vaccines. Many adolescents were aware that the COVID-19 vaccine can prevent severe illness, while significantly fewer knew that the HPV vaccine can prevent HNC. This may be due to the detailed information provided during the COVID-19 pandemic from media, government, and educators [25]. The introduction of vaccination mandates led to 81.1 % of the Canadian population receiving at least one vaccine dose as of June 2024 and likely learning about its effects [26].

The lack of HPV vaccine education in our study sample can be attributed to various reasons. Historically, educational efforts to increase HPV vaccination have been aimed at parents and healthcare providers, rather than adolescents [27]. Consistent with other studies, while participants may know about HPV as a sexually transmitted infection, few were aware of its connection to HNC [28]. Research has shown that adolescents feel too shy to consult health care professionals or parents for HPV vaccine information [29]. This may be because of the stigma surrounding sexually transmitted infections [30]. Additionally, there is no national strategy or monitoring for sex education in Canada and a deficiency of funding, resulting in an education that may be lacking [31]. Regardless of cause, our findings show that more education on HPV is needed, particularly on its relationship to HNC. In fact, studies have shown that adolescents are motivated to learn more about HPV vaccines [27]. This may include improving HPV and sex education in schools, counteracting stigma, media endorsements favoring vaccination, and increasing education via health care professionals [32]. Future studies should investigate ways to decrease this knowledge gap.

Comfort with dentist-administered vaccines in our sample was significantly higher for COVID-19 than HPV vaccines. This may be related to both the knowledge gap and societal reasons for disparate awareness. The lack of adequate HPV knowledge has also led to misinformation,

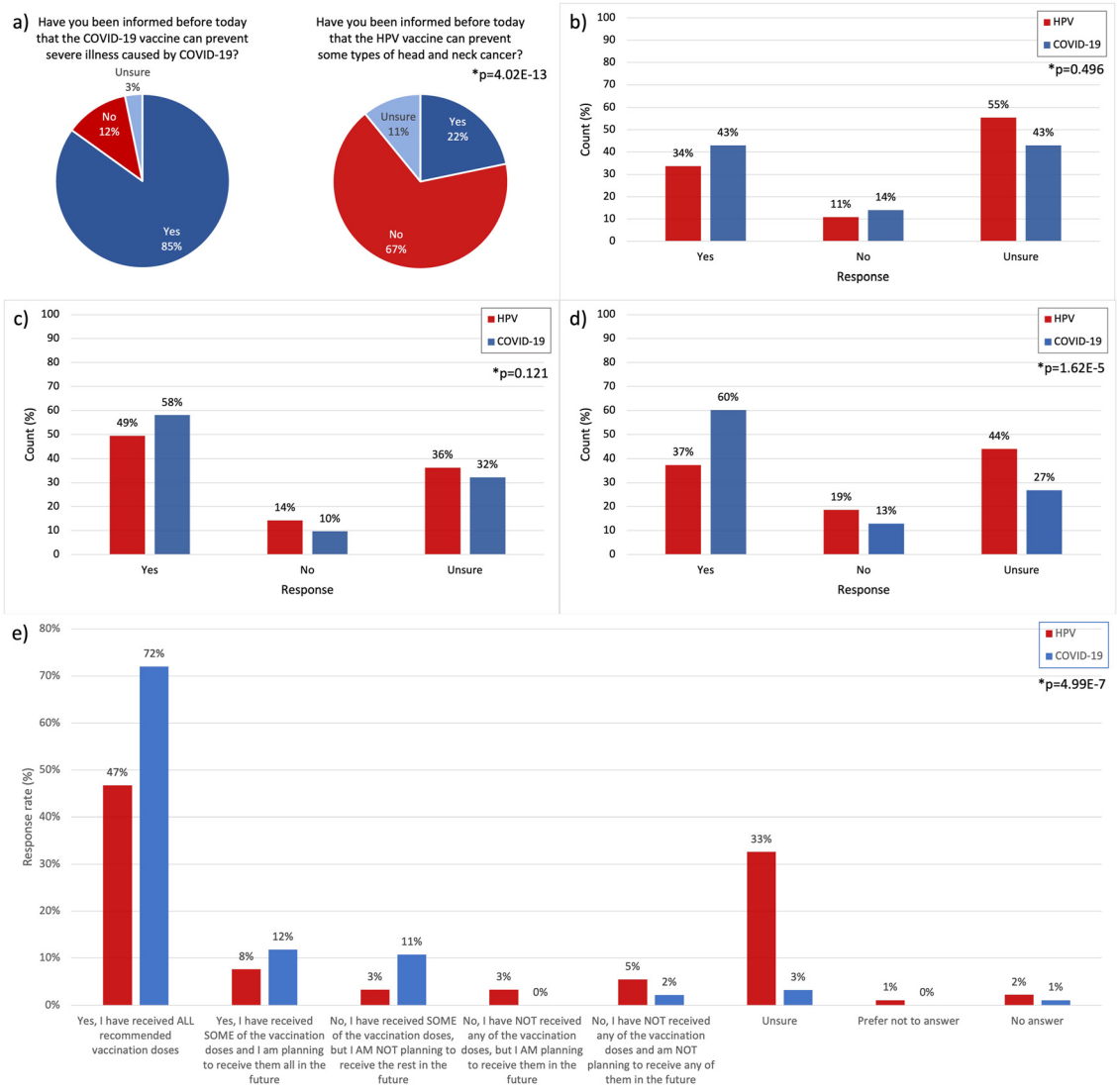

Figure 1: Graphical representation of survey response distribution by question, divided into COVID-19 and HPV categories. (a) Vaccine knowledge was significantly higher for COVID-19 than HPV vaccines. (b) Belief that dentists are qualified to educate was similar between COVID-19 and HPV. (c) Comfort discussing vaccines was similar between COVID-19 and HPV. (d) Comfort with dentist administration was significantly higher for COVID-19 then HPV vaccines. (e) More adolescents were fully vaccinated for COVID-19 compared to HPV.

yielding a decrease in perceived risk of HPV infection as many believe that HPV vaccination is not needed in the absence of sexual activity [30, 33]. As adolescents and young adults are particularly susceptible to misinformation, education should target this population [30]. It is also possible that participants are more comfortable getting vaccinated with COVID-19 than HPV in general, unrelated to receiving the vaccine from a dentist or not. This is supported by our data showing that more adolescents were fully vaccinated for COVID-19 compared to HPV and could be explained by factors such as increased knowledge and vaccine mandates. Furthermore, the discrepancy observed may also be due to familiarity with dentists-administered vaccines [8, 9].

Adolescent responses to education qualifications and comfort discussing vaccines were similar between HPV and COVID-19 vaccines. This may suggest that support for dentists acting as educators is not impacted by vaccine type. Among the modes of dentist involvement, participants were most receptive to vaccine discussion. Given the low barrier to entry, this method may be a propitious starting point for dentist involvement, especially since patient rapport, communication, and education are important components of dentistry [34]. On the other hand, respondents were least confident in dentists' qualifications to educate about both vaccines, though the majority of respondents still reported either agreement or being unsure. Oral health is associated with systemic

Table 2: Results of Wilcoxon signed rank tests evaluating differences in participants' past experiences and perception towards dentist roles in COVID-19 and HPV vaccination. Note: for question 1, we coded 0–5 to quantify the answers. 5=Yes, I have received ALL recommended vaccination doses; 4=Yes, I have received SOME of the vaccination doses and I AM planning to receive them all in the future; 3=No, I have NOT received any of the vaccination doses, but I AM planning to receive them in the future; 2=No, I have received SOME of the vaccination doses, but I AM NOT planning to receive the rest in the future, 1=No, I have NOT received any of the vaccination doses and am NOT planning to receive any of them in the future; 0=Prefer not to answer or Unsure. For questions 2–5, we coded 0 as unsure, 1 as yes, and −1 as no. Results where $\alpha \leq 0.05$ are shown in bold text.

Dimensions	COVID-19		HPV		Statistic	p-Value two-tailed
	Median	Interquartile range	Median	Interquartile range		
Q1: Are you, or do you plan to become, up to date on your COVID-19/ HPV vaccinations?	5	1	4	5	975.5	**<0.001**
Q2: Have you been informed before today that the COVID-19 vaccine can prevent severe illness caused by COVID-19?/ the HPV vaccine can prevent some types of head and neck cancer?	1	0	−1	1	1,885.0	**<0.001**
Q3: Do you believe that dentists are qualified to educate you about the COVID-19/HPV vaccine(s) available?	0	1	0	1	247.5	0.496
Q4: Would you feel comfortable discussing COVID-19/HPV vaccines with your dentist?	1	1	0	1	217.5	0.121
Q5: Would you feel comfortable allowing a dental provider to administer a COVID-19/HPV vaccine for you (assuming they received proper training)?	1	1	0	1	289	**<0.001**

Table 3: Comparison of participant responses to validated survey instruments according to demographic factors, including results of $\chi 2$ analysis on categorical demographic variables and Spearman correlation coefficient for continuous variables (age). Significant results are highlighted using bold text, $p<0.05$ for categorical variables. HPV=human papillomavirus.

Variable	Gender assigned at birth, p-Value	Race, p-Value	Education, p-Value	Household income, p-Value	Age, correlation coefficient
Vaccination status					
COVID-19	0.588	0.343	0.494	0.831	0.141
HPV	0.417	**0.027**	0.502	0.086	0.060
Previous knowledge					
COVID-19	0.700	0.538	0.542	0.050	0.024
HPV	0.127	0.827	0.131	0.112	0.053
Dentists qualified to educate about					
COVID-19	0.564	0.073	0.957	0.749	−0.043
HPV	0.649	0.422	0.665	0.938	−0.155
Comfortable to discuss					
COVID-19	0.425	0.266	0.640	**0.020**	0.288
HPV	0.661	0.739	0.477	0.803	0.169
Dentists qualified to administer vaccine					
COVID-19	0.462	0.195	0.634	0.854	0.062
HPV	0.663	0.859	0.953	0.670	0.056

conditions, but many fail to realize the scope of dentist knowledge on systemic health, including preventive measures [35]. Thus, there is a need to raise awareness of dentists' knowledge and ability to educate on health topics. That being said, more research is needed to determine precisely why patients lack confidence in this area. In fact, a study conducted by the American Dental Association has discovered that vaccine training for dentists is deficient, with 75 % of dentists reportedly receiving no didactic training, 81 % receiving no clinical training, and 59 % unaware of the resources available

[19]. Other studies have also shown that HPV training needs to be strengthened among dentists, and that dentists are interested in learning how to communicate information about HPV [21, 22, 36].

When evaluated according to demographic characteristics, there were few distinctions. There was a significant association between race and HPV vaccination status, indicating varying vaccination rates among racial groups, consistent with other studies. HPV vaccination rates are lower in racial minorities and efforts have been proposed to increase these rates through increased education and access [37]. There was also a relationship between higher incomes and increased comfort discussing COVID-19 vaccines. This may be related to less trust in providers within populations of lower socioeconomic status [38]. Moreover, age was weakly associated with all COVID-19 and HPV question responses, indicating an impact on all aspects of dentist involvement. Older participants were more likely to be vaccinated, had increased vaccine knowledge, felt comfortable discussing and being administered vaccines by dentists, and were less likely to believe that dentists could educate about vaccines. This finding is consistent with the pilot study conducted by our group, which demonstrated higher rates of acceptance for dentist involvement in COVID-19 and HPV vaccination among young adults compared to our adolescent population [16].

The dental office is a promising alternative site for vaccination. Various settings for vaccination have been investigated, including schools and pharmacies, which are generally seen favorably. Reasons for parents disliking schools as an alternative site include wanting to be present during vaccination and believing that school should be separate from health issues, concerns that would not apply to the dental office [39]. Additionally, dentists already receive training on administering injections in order to deliver anesthesia for dental procedures. As adolescents also typically see dentists more than physicians, increasing dentist involvement may be a viable option to maximize vaccination and overall provision of preventive care [40].

While this study provides initial evidence of adolescent opinions around dentist roles in vaccination, it does suffer limitations that create opportunities for further study. Our study was conducted in an orthodontic clinic in an urbanized area and thus may suffer from selection bias and not reflect the opinions of all populations. Additionally, given this design, patients may have been focused on considering the orthodontist's role, and not dentists in general. The setting of the study may also reflect our lack of adolescents aged 11 and 12 in respondents despite their qualification in the study, which may skew our results toward patients who have already considered HPV vaccination, as this is the recommended age for vaccine provision. Future studies should expand the project to other populations, locations, and clinic types. Other limitations to survey-based research include self-reporting bias, which may include participants misunderstanding questions or memory inaccuracy, social desirability bias, and the inability to ask further questions or confirm their responses. Despite meeting sample size requirements to determine differences between opinions around COVID-19 and HPV vaccines, this study also presents a small sample size that should be expanded in future studies.

Conclusions

This study assessed adolescent receptiveness to dentist involvement in COVID-19 and HPV vaccination. Our results demonstrated mixed comfort from adolescents regarding including dentists in vaccinations, with few against involvement. Respondents were significantly more knowledgeable about and more comfortable with dentists administering COVID-19 vaccines compared to HPV vaccines. Efforts to advance HPV knowledge and its connection to HNC are needed and may change patient perspectives. This presents an opportunity for dentists to be involved in vaccine discussion as a favorable starting point. However, vaccine training for dental professionals must be strengthened first. In general, increasing dentist involvement in vaccinations may lead to improvements in vaccination rates, disease prevention, and overall patient well-being. Future studies should investigate the part dentists can play in vaccine education as well as the hesitancy regarding dentists' role in vaccinations, including around dentists' educational and practical qualifications.

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Research ethics: This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the local Institutional Review Board on June 26, 2023 (#853747).

Informed consent: Informed consent was obtained from all individuals included in this study, or their legal guardians or wards.

Author contributions: All authors have accepted responsibility for the entire content of this manuscript and approved its submission. By contribution: Angelina Ge: conceptualization, methodology, investigation, writing-original draft, writing-review and editing, visualization.

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Data availability: Original data is available on reasonable request of the corresponding author.

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