


Factors Influencing Human Papillomavirus Vaccination Among Asian Immigrant College Students During the COVID-19 Pandemic

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Abstract

Despite strenuous efforts to increase vaccination rates against human papillomavirus (HPV), the rate of vaccination remains low in the U.S. The COVID-19 pandemic poses an additional challenge to HPV vaccination. This study aimed to explore the factors that contribute to HPV vaccination among Asian immigrant college students, based on the Theory of Planned Behavior (TPB), with HPV vaccine literacy and HPV vaccine hesitancy as additional constructs. This cross-sectional survey used convenience sampling, with 133 Asian immigrant college students from New York City as study participants. Data were collected online using self-reported measures of the following study variables: HPV vaccine literacy, attitudes, subjective norms, self-efficacy, vaccine hesitancy, vaccination intention, and HPV vaccination. The data were analyzed using path analysis. Vaccine literacy and vaccination intention directly affected HPV vaccination. Vaccine subjective norms and literacy directly affected vaccination intention. Moreover, vaccine attitudes and self-efficacy directly and negatively affected vaccine hesitancy. These results indicate the importance of developing a multifaceted intervention that considers vaccine literacy and subjective norms to promote HPV vaccination of Asian immigrant college students. Interventions to decrease vaccine hesitancy during the COVID-19 pandemic should focus on improving positive attitudes and self-efficacy toward HPV vaccination.

Keywords

human papillomavirus vaccination, Asian immigrant college students, theory of planned behavior, literacy, vaccine hesitancy, COVID-19

Human papillomavirus (HPV) causes the most common sexually transmitted infection, as well as cervical cancer, genital warts, and anogenital and oropharyngeal cancers (de Martel et al., 2017; Hirth, 2019). The Centers for Disease Control and Prevention (CDC, 2020) reported both that approximately 79 million Americans were infected with HPV in 2020 and that approximately 36,000 cases of cancer in men and women are caused by HPV every year. HPV vaccination constitutes the most effective preventive intervention for all HPV-related infections and cancers. The CDC (2020) recommends two or three doses of HPV vaccine (9-valent HPV vaccine [9vHPV]) at least 6 months apart for those who initiate the vaccination series at ages 11 to 12 and at ages 15 to 26, respectively. Despite the public-health recommendation to take, and the general availability of, HPV vaccines, HPV vaccination coverage remains suboptimal among college-age and/or young adults (Ding et al.,

2019; You et al., 2020). The National Center for Health Statistics reported that young adults aged 18 to 26 who received the recommended number of doses of HPV vaccine increased from 13.8% in 2013 to 21.5% in 2018 (Boersma & Black, 2020). However, despite the above-mentioned increase, vaccination rates remain low while demonstrating considerably lower rates among ethnic and racial minorities (Adjei Boakye et al., 2018; Bhattacharya et al., 2019; Ding et al., 2019; Hirth, 2019;

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Si et al., 2021; Vu et al., 2020). Participants born outside the US have significantly lower HPV vaccination uptake than their US-born counterparts, particularly in Asian populations (Adjei Boakye et al., 2018; Ding et al., 2019; McElfish et al., 2021). Moreover, people born outside the US have a higher prevalence of HPV infection (Bhattacharya et al., 2019; Vu et al., 2020).

Previous studies also reported that Asian immigrant college students and their family members were more likely to preserve the characteristics of their native culture (e.g. interdependent self-construal) regarding HPV vaccination (Liu et al., 2020; Zhao et al., 2014). Yet such students are nevertheless frequently combined with US-born Asian-American students (who may have cultural attitudes toward vaccination that differ from those of Asian immigrant college students) in HPV research studies. College is a prime time for students to assert health autonomy, especially due to the initiation of sexual activities, which may result in a high prevalence of HPV-related diseases (Hirth, 2019). Hence, it is crucial to examine the factors affecting HPV vaccination among Asian immigrant college students, in order to develop comprehensive intervention programs that promote such students' vaccine uptake.

More broadly, the COVID-19 pandemic has negatively affected HPV vaccination efforts (Gabutti et al., 2021). The pandemic has dramatically disrupted the public health system, resulting in delays or cancellations of necessary healthcare interventions, including routine immunization (Daniels et al., 2021; Toh et al., 2021). Additionally, the pandemic has exacerbated socioeconomic inequalities and health disparities, particularly in racial and ethnic minorities (Tai et al., 2021). Furthermore, the increasing global prevalence of vaccine skepticism during the pandemic has also adversely impacted non-mandated vaccines, such as the HPV vaccine, among adolescents and young adults (Gabutti et al., 2021; Gilkey et al., 2020). Therefore, the vaccine hesitancy that emerged during the pandemic may have posed a significant challenge to vaccine acceptance, including HPV vaccination (Coustasse et al., 2021).

The Theory of Planned Behavior (TPB) offers a well-grounded framework to predict HPV vaccination behavior (Britt & Englebert, 2018; Catalano et al., 2017; S. Y. Kim et al., 2021; Shah et al., 2021) and vaccine hesitancy (Hossain et al., 2021). The TPB depicts three determinants (i.e., attitudes toward the behavior, subjective norms, and perceived behavioral control) to predict an individual's intention to engage in a particular behavior (Ajzen, 1991). Research shows that attitudes, subjective norms, and self-efficacy toward the HPV vaccine significantly predicted HPV vaccine intention to get vaccinated. Researchers have also recommended that, although the TPB is a robust model, additional constructs may need

to be considered in the TPB to understand the specific behavior comprehensively (Ajzen, 1991; Li & Li, 2020).

In general, vaccine literacy acts as a powerful predictor of HVP vaccination in ethnic minorities (Kellogg et al., 2019; M. Kim et al., 2017, 2019; Vu et al., 2020). Vaccine hesitancy also has a critical impact on HPV vaccination (Rositch et al., 2022). Therefore, our study includes vaccine literacy and vaccine hesitancy in the TPB model (Chen et al., 2021; Husain et al., 2021; Turhan et al., 2022; Vu et al., 2020).

Meanwhile, attitudes toward the HPV vaccine are positively associated with vaccination intention and completion of vaccination (M. Kim et al., 2019; Si et al., 2021; Suryadevara et al., 2016; Vu et al., 2020). Subjective norms might constitute a unique cultural-behavioral factor for understanding vaccination behavior (M. Kim et al., 2019; S. Y. Kim et al., 2021; Si et al., 2021). When there is a stronger affinity for the reference group, an individual's behavior is more likely to be influenced by the norms of others (e.g., parents, friends, or healthcare providers) (Britt & Englebert, 2018; S. Y. Kim et al., 2021). Previous studies have shown that subjective norms, social pressure, and opinion positively affect vaccination intention and vaccination (M. Kim et al., 2019; S. Y. Kim et al., 2021; Stout et al., 2020).

Self-efficacy as a perceived behavioral control in the TPB is a decisive factor in vaccine uptake (Thaker & Ganchoudhuri, 2021), and individuals who believe they can control vaccination are more likely to receive HPV vaccinations. Self-efficacy is associated with HPV vaccination intention and vaccination among both college students (S. Y. Kim et al., 2021; Si et al., 2021; Stout et al., 2020) and mothers of adolescents (Khodadadi et al., 2020). In a systematic review of factors that influence HPV vaccination intention in the Southeast Asian and Western-Pacific regions, Santhanes et al. (2018) reported that low confidence in the safety and efficacy of the vaccine negatively affected the intention to get vaccinated. Similarly, among male college students, self-efficacy in receiving a vaccine was a significant predictor of HPV vaccine acceptance (Fernandez et al., 2016).

Among the factors determining HPV vaccination, vaccine literacy plays a key role in predicting HVP vaccine intention and vaccination (Kellogg et al., 2019; M. Kim et al., 2017, 2019; Lee et al., 2015; Vu et al., 2020). Individuals more knowledgeable about the HPV vaccine have more favorable attitudes, positive norms, high perceived behavioral control, and good behavioral intentions toward vaccination (Chen et al., 2021). In addition, vaccine literacy has an impact on vaccine hesitancy. Individuals with a low level of vaccine literacy showed a higher level of vaccine hesitancy (Turhan et al., 2022). Previous research reported that vaccine hesitancy was

significantly associated with attitudes toward vaccines and beliefs about vaccine efficacy (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015; Thaker & Ganchoudhuri, 2021). Subjective norms are also key to vaccine hesitancy and intention (Husain et al., 2021). However, previous studies on Asian-American populations do not explicitly examine Asian immigrant populations in HPV vaccination. Thus, their findings may have limited applicability to Asian immigrants, of which there are an estimated several hundred thousand in the US today (Asian Americans Advancing Justice, 2019).

In summary, in the present study we incorporated vaccine literacy and vaccine hesitancy, two influential factors in HPV vaccination, with the TPB factors to examine Asian immigrant college students' HPV vaccination behavior. Investigating interrelationships between the factors contributing to HPV vaccination among Asian immigrant college students is needed to develop culturally tailored interventions during the COVID-19 pandemic (a crisis that has further increased vaccine hesitancy among the general population) and beyond. Moreover, an overall understanding of HPV vaccination among the study population can suggest affordable vaccine programs that may reduce cultural and structural barriers to health access and, eventually, alleviate health disparities.

This study therefore aimed to examine the different factors that may contribute to HPV vaccination, or lack thereof, among Asian immigrant college students in the US. We hypothesized that (1) the study variables (i.e., vaccine literacy, attitudes, subjective norms, and self-efficacy) directly affect vaccination intention and vaccine hesitancy, and indirectly affect HPV vaccination; and that (2) vaccination intention and vaccine hesitancy mediate HPV vaccination.

Methods

Study Design

We employed a descriptive, cross-sectional design to examine the factors influencing HPV vaccination.

Sample and Setting

In this study, we identified and included 133 undergraduate college students in New York City, NY, US via convenience sampling. The eligibility criteria were: (1) aged 18 years or older; (2) being a college student; and (3) birth outside the US or as a member of an immigrant family. Therefore, the researchers screened the eligible students and selected 137 participants who met the inclusion criteria. However, four questionnaires with incomplete answers were excluded, and 133 participants were included for the final analysis.

Data Collection

The study protocol was approved by the institutional review board at the first author's college (#2020-0420). After approval was obtained from the department chairs and directors, flyers were distributed at the study sites, and emails were sent for recruitment. In addition, we posted the study flyers on the websites of Asian student clubs, and interested students individually accessed the SurveyMonkey™ link through which data were collected online. Potential participants received an informed consent form with information about the study's purpose; the participant's rights to confidentiality, voluntary participation, and withdrawal; and the study's risks and benefits. Those who provided informed consent were enrolled, completed the study questionnaire, and provided information regarding their demographics. All participants received a \$10 gift card for completing the questionnaires. The survey took approximately 20 minutes to complete. Data were collected from June through August 2021.

Measures

HPV Vaccine Literacy

HPV vaccine literacy was measured using the 5-item HPV Vaccine Literacy Scale (Lee et al., 2015). Each item (e.g., "The HPV vaccine, a series of HPV shots, protects against cervical cancer.") was answered "yes" or "no" and the total score ranged from 0 to 5, with a higher scoring indicating a higher HPV vaccine literacy. This scale was validated with young Asian American and Pacific Islander undergraduates in the US (Lee et al., 2015). The Cronbach's alpha was .85 in this study.

HPV Vaccine Attitudes

The participants' attitudes toward the HPV vaccine were measured with the 11-item HPV Attitude Scale (Kang & Moneyham, 2010), wherein each item (e.g., "I am afraid of the side effects of the HPV vaccine.") is rated on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*; score range = 11–55) and high scores indicate a more positive attitude toward the HPV vaccine. This scale was validated in a previous study (Kang & Moneyham, 2011; S. H. Kim & Sung, 2017). The Cronbach's alpha was .86 in this study.

HPV Vaccine Subjective Norms

The subjective norms associated with the HPV vaccine were measured with a 4-item HPV vaccine subjective norms scale, based on the beliefs of the expectations of four referents (i.e., family, friends, healthcare providers,

and social norms) regarding normative beliefs and motivation to comply (Britt & Englebert, 2018). Each item (e.g., “My health care providers think that I should get the HPV vaccine.”) is rated on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) with a higher total score indicating higher levels of conformity to subjective norms. This scale was validated with college students in the US (Britt & Englebert, 2018). The Cronbach’s alpha was .91 in this study.

HPV Vaccine Self-Efficacy

HPV vaccine self-efficacy was measured with a 3-item HPV Self-efficacy Scale (Gerend & Shepherd, 2012). Each item (e.g., “I feel confident in my ability to get vaccinated for HPV, even if it is expensive.”) is rated on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). A higher total score indicates higher levels of HPV self-efficacy. This scale was validated with undergraduates, including Asian students, in the US (Gerend & Shepherd, 2012; Stout et al., 2020). The Cronbach’s alpha was .89 in this study.

HPV Vaccine Hesitancy

HPV vaccine hesitancy was measured with regard to 3 items (e.g., “I am hesitant to receive the HPV vaccine because of the uncertainty caused by the COVID-19 pandemic”) Each item is rated on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*) and a higher total score indicates higher levels of HPV vaccine hesitancy. The Cronbach’s alpha was .93 in this study.

HPV Vaccination Intention

HPV vaccination intention was measured with 1 item (“How likely is it that you would get vaccinated?”). This item is rated on a 7-point Likert scale, ranging from 1 (*not at all*) to 7 (*extremely likely*). A higher total score indicates higher levels of the intention to receive HPV vaccination.

HPV Vaccination

Participants were asked whether they had ever received the HPV vaccine (answer: “yes” or “no”). Participants who were vaccinated with at least one dose of the HPV vaccine were considered to have been vaccinated.

Demographics

The participants’ social demographics were assessed with regard to age, sex, marital status, medical insurance, socioeconomic status, ethnicity, duration of residence in the US, and native language(s).

Data Analysis

Data were analyzed using IBM SPSS Statistics (Version 26) and Mplus Version 8.7 (Muthén & Muthén, Los Angeles, CA, USA). Descriptive statistics were used to summarize the participants’ characteristics. The reliability of scales was measured using the Cronbach’s alpha coefficient. The normal distribution of the study variables was assessed using skewness and kurtosis. Data were considered non-normally distributed if an absolute value is above 2.0 for skewness and 7.0 for kurtosis (West et al., 1995). Additionally, multicollinearity was assessed with the tolerance and variance inflation factor (VIF). For path analysis, Mplus 8.7 was used. We conducted path analysis to test the model because it is possible to simultaneously evaluate the relationships between variables and mediation effects. Due to the dichotomous primary outcome variable, we used a weighted least-squares estimator with mean and variance adjustment. Model fit was assessed with several fit indices, including chi-square (χ^2), the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). An acceptable model fit was defined by the following criteria: χ^2 value ($p > .05$), RMSEA and SRMR (≤ 0.08), and CFI and TLI (≥ 0.90). A bootstrapping approach (1,000 times) was used to test the significance of the mediation effect. All path coefficients are reported as standardized estimates.

Results

Participant Characteristics

In this study, the mean age was 25.12 years (standard deviation [SD] = 5.38, range 18–44), and 69.9% of the participants were women. Among the participants, 63.9% were never married, 20.3% were married, and 6.0% lived with a partner. On average, the participants had resided in the US for 11.33 years (SD = 8.21), with 50.4% of the participants accounting for the “less than 10 years” category. Regarding medical insurance, the participants had private (27.1%), Medicare (15.8%), Medicaid (40.6%), or other types of insurance (10.5%), whereas 4.5% had no insurance. Almost half of the participants perceived their socioeconomic status as low (49.6%), followed by middle class (46.6%) and high class (2.3%). Among the participants, most were Chinese/Taiwanese (34.6%) or Korean (25.6%), followed by Tibetan (9.0%), Nepali (7.5%), Indian (5.3%), Filipino (5.3%), and others (12.7%). The major native languages of the participants were Cantonese/Mandarin, followed by Korean, Tibetan, Nepali, Bengali, and Hindi.

Table 1. Study Variables and Correlation Between the Variables (N = 133).

Variables	r					M ± SD	Range	Skewness	Kurtosis
	1	2	3	4	5				
1. HPV vaccine attitudes	1					3.68 ± .65	1-7	0.29	-0.69
2. HPV vaccine subjective norms	.51 (<.001)	1				5.28 ± 1.42	1-5	-0.82	0.60
3. HPV vaccine self-efficacy	.49 (<.001)	.50 (<.001)	1			4.93 ± 1.54	1-7	-0.37	-0.49
4. HPV vaccine literacy	.55 (<.001)	.47 (<.001)	.30 (<.001)	1		3.31 ± 1.83	0-5	-0.69	-0.99
5. HPV vaccination intention	.52 (<.001)	.71 (<.001)	.47 (<.001)	.56 (<.001)	1	5.47 ± 1.77	1-7	-1.12	0.44
6. HPV vaccine hesitancy	-.55 (<.001)	-.26 (.003)	-.45 (<.001)	-.31 (<.001)	-.29 (.001)	2.30 ± 1.01	1-5	0.23	-0.91

Note. HPV = human papillomavirus; M = mean; SD = standard deviation.

Descriptive Statistics and Correlations

Descriptive statistics of the study variables as well as the bivariate correlations among the study variables are shown in Table 1. Tolerance ranged from 0.42 to 0.65 and VIF ranged from 1.54 to 2.38, which indicated no multicollinearity between the measured variables. Approximately half of the participants (47.4 %) had been vaccinated against HPV. HPV vaccination intention was significantly positively correlated with HPV vaccine attitudes ($r = .52, p < .001$), HPV vaccine subjective norms ($r = .71, p < .001$), HPV vaccine self-efficacy ($r = .47, p < .001$), and HPV vaccine literacy ($r = .56, p < .001$). HPV vaccine hesitancy was significantly correlated with HPV vaccine attitudes ($r = -.55, p < .001$), HPV vaccine subjective norms ($r = -.26, p = .003$), HPV vaccine self-efficacy ($r = -.45, p < .001$), HPV vaccine literacy ($r = -.31, p < .001$), and HPV vaccination intention ($r = -.29, p = .001$).

Testing the Path Model

We first tested the model and the fit indices demonstrated an acceptable fit between the data and the modified model: $\chi^2(3) = 4.035, p = 0.26, CFI = .99, TLI = .93, SRMR = 0.15, RMSEA = 0.05$, and 90% CI [0.000, 0.163]. As hypothesized, HPV vaccine literacy ($\beta = .27, p = .037$) and HPV vaccination intention ($\beta = .49, p = .001$) directly affected HPV vaccination. HPV vaccine subjective norms ($\beta = .54, p < .001$) and HPV vaccine literacy ($\beta = .24, p = .002$) directly influenced HPV vaccination intention. In addition, HPV vaccine attitudes ($\beta = -.48, p < .001$) and HPV vaccine self-efficacy ($\beta = -.28, p = .001$) negatively and directly affected HPV vaccine hesitancy. The indirect effects of hesitancy as a mediator in the relationship between literacy and HPV vaccination ($\beta = .00, 95\% \text{ CI} [-0.022, 0.030]$), as well as that between self-efficacy and HPV vaccination ($\beta = .02, 95\% \text{ CI} [-0.055, 0.089]$), were not significant. The indirect effect of intention as a mediator in the relationship between literacy and HPV vaccination ($\beta = .13, 95\% \text{ CI} [0.049, 0.224]$) was significant. Table 2 shows the effects of the study variables on HPV vaccination. Overall, the final model revealed 61.9, 35.6, and 38.4% variances in HPV vaccination intention, HPV vaccine hesitancy, and HPV vaccination, respectively. A final path model that was created with the standardized coefficients is presented in Figure 1.

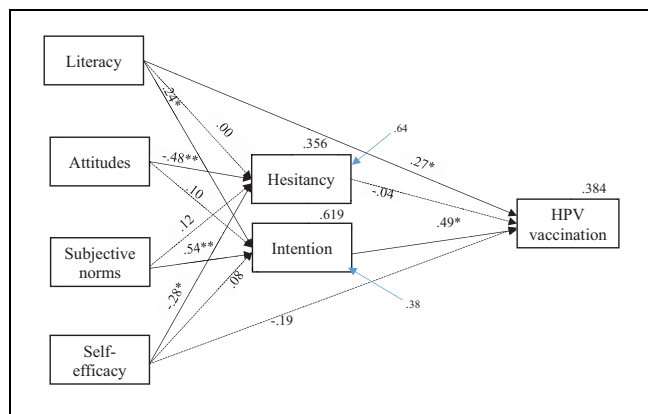
Discussion

This study investigated factors that contributed to HPV vaccination among Asian immigrant college students during the COVID-19 pandemic. The study found that the factors influencing HPV vaccination included

Table 2. Path Analysis Findings: Total, Direct, and Indirect Effects ($n = 133$).

Endogenous variables	Exogenous variables HPV vaccine	Direct β (p)	Indirect β (p)	Total β (p)	SMC
HPV vaccine hesitancy	Attitudes	-.48 (<.001)		-.48 (<.001)	0.356
	Self-efficacy	-.28 (.001)		-.28 (.001)	
	Subjective norms	.12 (.141)		.12 (.141)	
	Literacy	.00 (.971)		.00 (.971)	
HPV Vaccination Intention	Attitudes	.10 (.234)		.10 (.234)	0.619
	Self-efficacy	.08(.322)		.08(.322)	
	Subjective norms	.54 (<.001)		.54 (<.001)	
	Literacy	.24 (.002)		0.24 (.002)	
HPV Vaccination	Intention	.49 (.001)		.49 (.001)	0.384
	Hesitancy	-.04 (.728)		-.04 (.728)	
	Attitudes		.07(.300)	.07(.300)	
	Self-efficacy	-.19 (.259)	.05(.359)	-.14 (.384)	
	Subjective norms		.26 (.002)	.26 (.002)	
	Literacy	.27 (.037)	.12 (.024)	.39 (<.001)	

Note. HPV = human papillomavirus; SMC = squared multiple correlations.

**Figure 1.** Path model of HPV vaccination with standardized path coefficients ($n = 133$).

Note. HPV = human papillomavirus.

* $p < .05$. ** $p < .001$.

vaccination intention, vaccine literacy, and vaccine subjective norms. The results corroborate the findings of previous studies that reported a significant positive relationship between vaccine literacy and vaccination intention, and vaccination among Asian college students (Chen et al., 2021; M. Kim et al., 2017, 2019; Lee et al., 2015). These results suggest the importance of developing an interventional program that promotes vaccination intention and literacy about HPV and its vaccination. Similarly, previous studies have reported the significant influence of subjective norms on vaccination intention and vaccination among Asian college students (S. Y. Kim et al., 2021; Li & Li, 2020; Vu et al., 2020).

This study's results revealed that vaccine attitudes and self-efficacy negatively affected HPV vaccine hesitancy. These findings are in congruence with previous findings, which indicate that HPV vaccine self-efficacy was

associated with vaccine hesitancy (Khodadadi et al., 2020), and low confidence in HPV vaccine results in a lack of vaccination (M. Kim et al., 2019; Santhanes et al., 2018; Vu et al., 2020). In this study, vaccine hesitancy was not directly linked to HPV vaccination. Additionally, HPV attitudes and self-efficacy did not affect HPV vaccination intention, unlike a previous study (Shah et al., 2021). This may be owing to significant systemic and cultural barriers to HPV vaccination, considering participants' demographic characteristics of the this study, such as low socioeconomic status, limited English proficiency, unfamiliarity with navigating health-care services, and availability of health insurance (Vu et al., 2020). Future studies with a larger sample size are warranted to confirm our findings. Furthermore, developing culturally appropriate interventions to target significant determinants of HPV vaccination in this population is crucial (Vu et al., 2020).

The results of this study suggest a need for comprehensive intervention programs based on the influence of vaccine literacy and subjective norms on campus. For instance, a student health center may collaborate with a nursing program to create a peer-led education session: Students would hear HPV vaccination experiences of other students, receive positive messages and encouragement from their peers, and receive information on HPV vaccination presented by student health care center providers. Among college students, rather than with peer-alone (influence of subjective norms) or expert-alone intervention (influence of vaccine literacy), vaccination intention and vaccination increased the most when both friends and experts were supportive of vaccination (Stout et al., 2020). Hearing positive opinions and encouragement about vaccination from friends alongside expert messages may increase the willingness to be vaccinated.

In addition, to enhance HPV vaccine literacy, information about HPV vaccination could be offered during campus events, such as free flu shot events, healthcare treatment visits, on-campus health fairs, first-year orientation, and seminars (Thompson et al., 2017). Considering that social media is a significant source of health information and that college students are one of the most active groups using it (Benetoli et al., 2017), effective utilization of social media is crucial to promote literacy on HPV and HPV vaccination for this population. For instance, college administrators and student health center staff could disseminate information on HPV and HPV vaccines through college Facebook/Instagram and Asian student club websites to enhance HPV vaccine literacy, which, in turn, would facilitate the students' decisions to be vaccinated.

The current COVID-19 pandemic has negatively affected HPV vaccination (Gabutti et al., 2021). Thus, the findings of this study suggest that to reduce vaccine hesitancy during the COVID-19 pandemic, interventional programs should focus on addressing misinformation through online and offline public campaigns to provide evidence-based health information, which may improve positive attitude and self-efficacy toward vaccination (Margolis et al., 2019; Toh et al., 2021). As the COVID-19 pandemic continues to rage worldwide, primary healthcare providers who serve the adolescent and young adult population need to undertake intensive efforts to recommend the HPV vaccine at every clinical encounter (Daniels et al., 2021; Gerend et al., 2016, 2020; Gilkey et al., 2020). Furthermore, partnering with COVID-19 vaccination hubs to disseminate information about HPV and HPV vaccine could increase vaccine literacy and intention, thus promoting vaccination behavior. Onsite campus vaccination or the provision of alternative settings, such as college health centers or pharmacies, for vaccine appointments with follow-up reminder/recall messages during the pandemic may be suggested for promoting HPV vaccination in this population (Gerend et al., 2020; Gilkey et al., 2020). Further, educational institutions should set a goal to vaccinate a specific percentage of the student population to increase vaccination rates.

The COVID-19 pandemic exacerbates socioeconomic inequalities and health disparities, particularly in racial and ethnic minorities, including immigrants (Tai et al., 2021). The lack of health insurance and out-of-pocket costs could deter the decision for receiving HPV vaccination. Providing affordable vaccine programs to facilitate access to free or low-cost vaccines may encourage vaccine-friendly behaviors (Gilkey et al., 2020). In addition, we suggest that the CDC promote vaccination for all individuals aged over 26 years at the national level. Moreover, health insurance should be modified to

extend the coverage for HPV vaccine for people aged 26 years and older. These measures will help reduce the cases of HPV-induced cancers and condylomas and eventually alleviate health disparities.

The aforementioned findings should be considered in light of the following limitations. This study was conducted in one of the most diverse Asian-American-residing regions in the US, New York City. Future studies could enhance the generalizability of the research findings by recruiting participants from other geographic locations, including rural areas. Further, future studies should examine the heterogeneity among various subgroups within an Asian immigrant college community. Additionally, this study relied on self-reporting of vaccination data. The utilization of medical provider-verified vaccination records will enhance the accuracy of vaccination data in future studies. Finally, this study used a cross-sectional design that precludes the evaluation of a causal relationship among the variables of interest. A reasonable next step would be experimental or longitudinal research for a clearer understanding of the variables' interrelations over time as well as identify causal implications in future studies. In addition, randomized controlled studies are needed to test the effectiveness of interventional programs focusing on vaccine literacy and subjective norms while specifically considering vaccine hesitancy.

Conclusions

This study examined critical factors that contribute to HPV vaccination among Asian immigrant college students in the US. This study highlights the importance of developing a multifaceted intervention focusing on vaccination intention and vaccine literacy to promote HPV vaccination. Interventional programs that include informational sessions, positive testimonials on vaccination, and encouragement from multiple normative groups would benefit Asian immigrant college students. When planning interventions to decrease vaccine hesitancy, it is recommended to focus on improving positive attitudes and self-efficacy toward HPV vaccination. Thus, we suggest implementing programs that address misinformation, assign alternative settings for appointments, and reduce structural barriers to healthcare access. Moreover, we recommend partnering with schools and Asian communities to eventually improve vaccination among the population.



Declaration of Conflicting Interests

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