Exploring the Impact of Social Media, Health Communication, and Social Influences on College Students' Perceived Effectiveness of the HPV Vaccine

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Abstract

Despite the demonstrated potential of the HPV vaccine in preventing 90% of HPV infections, a large proportion of young adults remain unvaccinated. Given the influence of social media and interpersonal factors on HPV vaccine uptake, our study aims to examine the impact of social media, internet-based health communication, and social influences on perceived effectiveness of the HPV vaccine among college students in the US. Using data from a national sample of 2400 college students, we employed structural equation modeling to explore the relationship between social influence, social media, internet-based health communication, and perceived HPV vaccine effectiveness. Being female ($\beta = 0.08$, $p<0.05$) and white ($\beta = 0.15$, $p<0.05$) were significantly and positively associated with increased social media use. Conversely, being white was negatively associated with vaccine effectiveness ($\beta = -0.91$, $p<0.05$), while being female showed a positive association ($\beta = 0.44$, $p<0.05$). Social media use exhibited a positive association with social influence ($\beta = 0.21$, $p<0.05$). Findings revealed no statistically significant relationships between social influence, social media, internet-based health communication and HPV vaccine effectiveness ($p<0.05$). Further exploration is warranted to understand the nuanced dynamics of internet use and social influence in the context of HPV vaccine effectiveness.

Keywords: HPV, social media, social influence, health communication, effectiveness

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Introduction

Human Papillomavirus (HPV) is the most predominant sexually transmitted infection in the US, with a significant portion of cases emerging among adolescents and young adults, (Kreisel et al., 2021) and is responsible for approximately 90% of cervical cancer cases (CDC, 2022). The HPV vaccine was initially launched in 2006 and has since undergone various reforms regarding the recommended age groups for vaccination (Prabhu et al., 2021). Currently, the Advisory Committee on Immunization Practices (ACIP) recommends the HPV vaccine for all individuals aged 9-26 (CDC, 2021).

Despite the HPV vaccine's proven safety and effectiveness against HPV-related cancers (Balcezak et al., 2022), a concerning proportion of young adults remain unvaccinated, representing missed opportunities. Currently, only 62.6% of adolescents ages 13-17 years are up to date with the HPV vaccine (Pingali et al., 2023). This low uptake among adolescents results in a sizable population of under-vaccinated young adults. Recent statistics show that only 47.4% of adults ages 18-26 years have

received one or more doses of the HPV vaccine (Sonawane et al., 2024), underscoring the urgent need to improve HPV vaccination uptake and awareness. This is particularly critical for 18–26-year-olds, who constitute a catch-up population for HPV vaccination.

One prominent gap in HPV research involves addressing the challenge of fostering vaccine confidence through social media platforms (Reiter et al., 2018). While social media holds significant influence in the realm of vaccine literature, its negative impact on vaccine uptake often outweighs the positive. For example, parents exposed to a combination of positive and negative HPV vaccine narratives are equally inclined to decline vaccination as those who encounter solely negative stories (Margolis et al., 2019). This problem is compounded by widespread dissemination of negative information about HPV (Briones et al., 2012; Dunn et al., 2017; Ekram et al., 2019; Keelan et al., 2007; Luisi, 2021 Massey et al., 2020). However, there remains a notable deficiency in systematic and rigorous studies investigating the effects of social media on HPV-related knowledge, attitudes, and behaviors (Ortiz et al., 2019). This gap warrants further examination, particularly as social media increasingly emerges as a prominent source of health information.

In addition to social media, various internet platforms serve as important sources of health-related information for patients, with 59% of all US adults having used the internet for health information (Ekram et al., 2019). Studies show that websites and blogs promoting anti-vaccination sentiments play a vital role in shaping vaccine-related risk perceptions and intentions to vaccinate (Nan et al., 2012). Furthermore, parents who decline vaccination for their children are more likely to have sought vaccine information from the internet compared to parents of vaccinated children (Salmon et al., 2005).

Social factors, including family, religion, and healthcare providers, also influence HPV vaccine behaviors. Provider recommendation, for instance, has been identified as the strongest predictor of HPV vaccine uptake (Oh et al., 2021). Moreover, religiosity also plays an important role in governing HPV vaccine decisions, with variations observed across different religious affiliations (Olagoke et al., 2022). Additionally, greater support for HPV vaccination from one's friends, parents, and doctor are associated with greater HPV vaccine self-efficacy, leading to increased vaccine intentions (Stout et al., 2020).

Previous research shows that our outcome variable, perceived effectiveness of the HPV vaccine, is a strong predictor of HPV vaccine uptake. In a review of 28 studies, perceived effectiveness consistently exhibited a positive correlation with HPV vaccination intentions among vaccine-eligible women and parents/guardians of adolescent girls (Brewer et al., 2007). Moreover, perceived HPV vaccine effectiveness has been linked with more favorable vaccination intentions among both parents of adolescents and adults seeking vaccination for themselves (Chelimo et al., 2013). Given the importance of social factors, internet use, and social media on HPV vaccine intentions, it is crucial to investigate the influence of social factors on the perceived effectiveness of the HPV vaccine among young adults. Therefore, our study aims at investigating the impact of social media and internet-based health communication, along with broader social influences, on perceived HPV vaccine effectiveness.

Methods

Sample

We conducted an online survey utilizing the Qualtrics recruitment panel to reach a

demographic of U.S. college students aged 18-26. Data were collected using the survey from July 2019 to September 2019. A total of 2,400 students participated in the survey, which included items about HPV-related knowledge, attitudes, vaccination status, social influences in vaccine-related decision-making, as well as the utilization of internet and social media for health information exchange.

Measures

***Social influence*.** Social influence was assessed using the question: "How much does the opinion of the following people influence your decision about getting the HPV vaccine?" Participants rated the influence of their current sexual or steady partner, parents, best friend, religious leader, and healthcare provider on a scale from 1 to 4, with response options ranging from "very much" to "not at all." Responses were recoded and dichotomized, with 0 representing "not very much" and "not at all," and 1 representing "very much" and "somewhat."

***Social media use*.** Social media use was assessed with the question: "In the last 12 months, have you used the internet to visit a social networking site, such as Facebook or LinkedIn?". Participants' responses were coded as 1 for "yes" and 0 for "no," aligning with our dichotomous variables.

***Internet-based health communication*.** Internet-based health communication was measured with the question: "In the last 12 months, have you used the internet for any of the following reasons?" Participants indicated whether they engaged in the following activities: writing in an online diary or blog, participating in an online forum or support group for people with similar health or medical issues, and watching a health-related video on YouTube. Each of these items had response options "yes" or "no" that were coded as was 1 and 0, respectively.

***Perceived HPV vaccine effectiveness*.** The outcome variable perceived HPV vaccine effectiveness was measured using the question "In your opinion, how likely is it that the HPV vaccine prevents getting HPV?" Participants rated their response on a scale from 1 to 5, with options ranging from "extremely unlikely/somewhat unlikely" to "extremely likely." Responses were dichotomized, with 0 representing "extremely unlikely," "somewhat unlikely," and "neither likely nor unlikely" and 1 representing "slightly likely" and "extremely likely."

Data analysis

We used Mplus Editor 8.8 (Byrne, 2012) for conducting structural equation modeling and Stata (version S.E. 18.0, College Station, Texas) for data cleaning, preparation, and descriptive analysis. Model development comprised two stages. Initially, confirmatory factor analysis (CFA) was conducted to investigate the relationship between latent constructs (social influence and internet-based health communication) and their underlying indicators (Marsh et al., 2020). We evaluated goodness of fit using the comparative fit index (CFI), Tucker–Lewis Index (TLI), root mean square error of approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) indices. Criteria for model fit included RMSEA values below 0.08, CFI and TLI above 0.95, and SRMR values below 0.08 (Bentler & Chou, 1987; Hooper, 2008). Subsequently, a comprehensive structural model was constructed to assess the adequacy of our proposed model in approximating the data. Given the

categorical nature of our response variables, we employed the weighted least squares mean and variance adjusted (WLSMV) method to estimate parameters (Degarege et al., 2019; Muthen et al., 2015). The WLSMV technique adopted a pairwise deletion approach to address missing data (Muthen et al., 2015).

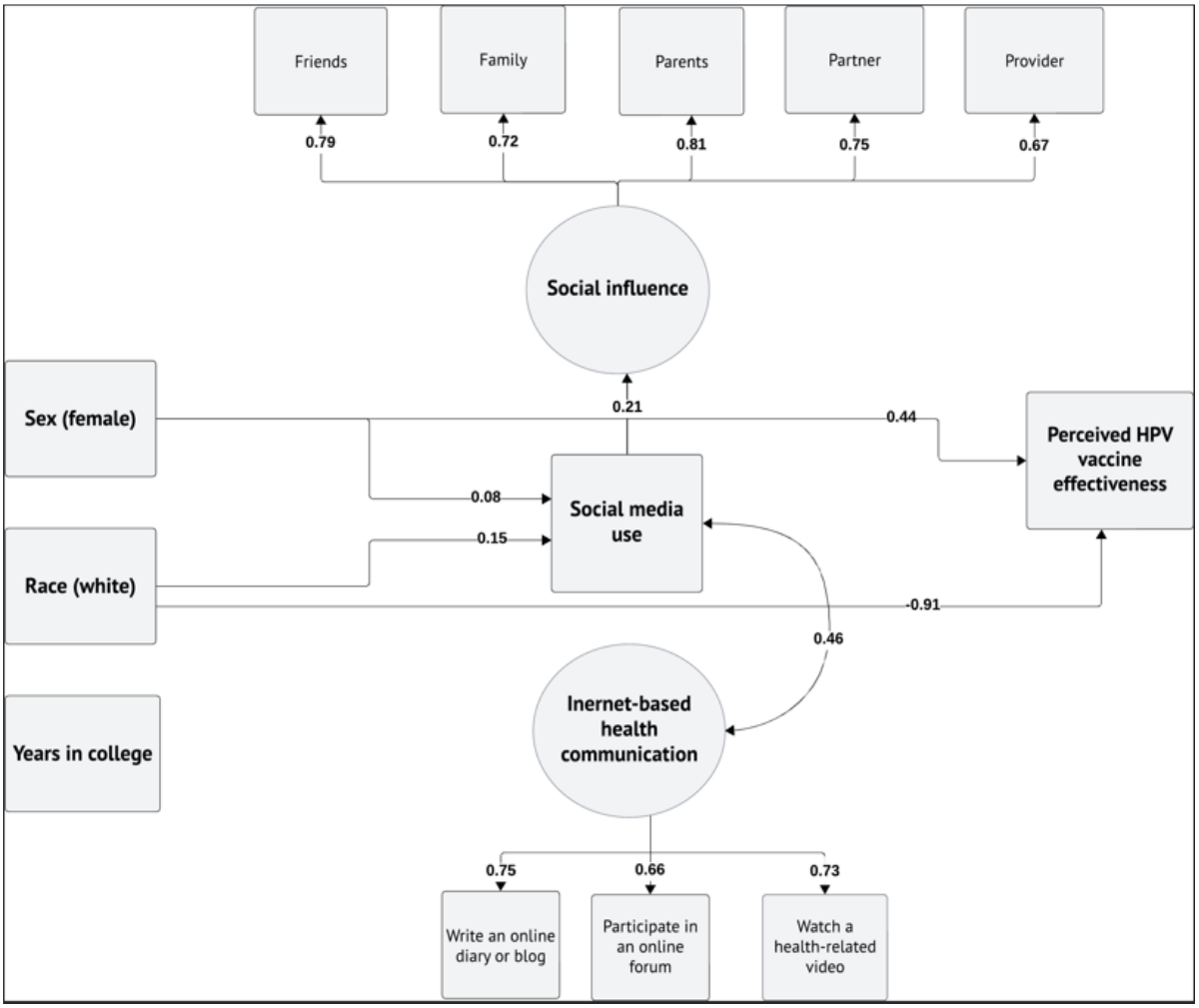
Results

Sample Characteristics

Table 1 presents the sample characteristics of the study participants. Our sample included 2,400 students between ages 18 and 26 who were actively enrolled in a US college or university. The majority were female [n=1,338 (56%)], non-Hispanic white [n=1,440 (60%)], and heterosexual [n=1,810 (75%)], with a mean age of 20.6 ± 0.044 SD.

Social influences regarding the decision to get the HPV vaccine were as follows: parents or caregivers [n=1,402 (59%)], healthcare providers [n=1,330

Figure 1. *Full-scale structural model Depicting the Interplay between Social Media Use, Social Influence, Internet-Based Health Communication, and Perceived Effectiveness of the HPV Vaccine*



Note. Only statistically significant pathways ($p<0.05$) have been presented in the model.

Table 1. *Sample Characteristics of National Sample of Young Adults (n=2400)*

Characteristic	**n**	**%**
Mean ± SD: 20.6 ± 0.44		
Time in college (in years)		
Mean ± SD: 3.16 ± 0.84		
Gender		
Woman	1,338	(55.7)
Man	1000	(41.7)
Nonbinary, another gender, or other	62	(2.6)
Race/ethnicity		
Non-Hispanic White	1440	(60.0)
Black or African American	480	(20.0)
Asian	208	(8.7)
Native Hawaiian or other Pacific Islander	7	(0.3)
American Indian or Alaska Native	15	(0.6)
Other	43	(1.8)
Hispanic/Latino	207	(8.6)
Sexual orientation		
Heterosexual	1810	(75.4)
Homosexual	116	(4.8)
Bisexual	332	(13.8)
Other/not sure	142	(5.9)
Relationship status		
Single (in a monogamous relationship)	1378	(57.4)
Single (not in a monogamous relationship)	816	(34.0)
Married	104	(4.3)
Divorced	4	(0.2)
Other	98	(4.1)
Health insurance		
Yes	2139	(89.1)
No	261	(10.9)
Social influence		
Current or steady sexual partner		
Very much/somewhat	748	(31.2)
Not very much/not at all	1652	(68.8)
Parents or caregivers		
Very much/somewhat	1402	(58.5)
Not very much/not at all	998	(41.5)
Healthcare provider		
Very much/somewhat	1330	(55.4)
Not very much/not at all	1070	(44.6)
Friends		
Very much/somewhat	589	(24.6)

Not very much/not at all	1811	(75.4)
Religious leader		
Very much/somewhat	325	(13.6)
Not very much/not at all	2075	(86.4)
Internet-based health communication		
Write an online diary or blog		
Yes	376	(15.7)
No	1999	(83.3)
Participate in an online forum		
Yes	425	(17.7)
No	1950	(81.3)
Share health information on social networking site		
Yes	636	(26.5)
No	1739	(72.5)
Social media use		
Yes	2045	(85.2)
No	330	(13.8)
Perceived HPV vaccine effectiveness		
Extremely/slightly likely	1,864	(77.6%)
Extremely/somewhat unlikely	214	(8.9%)
Neither likely nor unlikely	322	(13.4%)

Table 2. *Goodness of fit CFA results*

Statistic	Estimate
Social influence	
RMSEA	0.02
CFI	0.97
TLI	0.98
SRMR	0.03
Internet-based health communication	
RMSEA	0.03
CFI	0.96
TLI	0.99
SRMR	0.04
Full-scale model	
RMSEA	0.04
CFI	0.95
TLI	0.92
SRMR	0.06

(55%)], sexual partner [n=748 (31%)], friends [n=589 (25%)], and religious leaders [n=325 (14%)]. Internet use for health communication included visiting social network sites [(n=2045 (85%)], sharing health information on social networking sites [(n=636 (27%)], participating in online forums [(n=425 (18%)], and writing an online diary or blog [n=376 (16%)]. The majority perceived the likelihood of the HPV vaccine preventing HPV infection as slightly/extremely likely [n=1,864 (77%)].

Confirmatory Factor Analysis

Table 2 outlines the Goodness of Fit indices for the latent constructs and full-scale structural model. The goodness of fit indices for the two latent constructs, social influence (RMSEA= 0.02, CFI=0.97, TLI=0.98, SRMR=0.03) and internet-based health communication (RMSEA= 0.03, CFI=0.96, TLI=0.99, SRMR=0.04), indicate a strong fit with the data. Similarly, the RMSEA (0.04), CFI (0.99), TLI (0.98), and SRMR (0.07) statistics for the full-scale structural model denote a good fit with the observed data.

Statistically significant standardized path coefficients (β, $p < 0.05$) indicating the relationship between socio-demographic factors (sex, race, number of years in college), social influence, social media use, and internet-based health communication are depicted in Figure 1. Among demographic factors, being female ($\beta = 0.08$, $p<0.05$) and white ($\beta = 0.15$, $p<0.05$) were significantly and positively related to increased social media use. Being white was negatively associated with perceived effectiveness ($\beta = -0.91$, $p<0.05$), while being female showed a positive association ($\beta = 0.44$, $p<0.05$). Interestingly, the number of years in college showed no significant relationship with any of the three constructs. Social media use exhibited a positive association with social

influence ($\beta = 0.21$, $p<0.05$). Lastly, none of the three constructs were found to be related to perceived effectiveness.

Discussion

Our study aimed to explore the impact of social media, health communication, and social influences on college students' perceived HPV vaccine effectiveness. Our findings indicated a lack of statistically significant relationships between the three constructs (i.e., social media use, social influence, and health communication) on perceived HPV vaccine effectiveness. Social media use was positively influenced by being female and white. Perceived effectiveness of the HPV vaccine, conversely, was negatively associated with being white and positively associated with being female. Social media use exhibited a positive association with social influence.

Our findings contribute to the ongoing discourse surrounding the relationship between social media use and HPV vaccine knowledge, attitudes, intentions, and uptake. In their systematic review, Ortiz and colleagues highlighted the lack of systematic and rigorous research of the effects of social media on HPV-related knowledge, attitudes, and behaviors (Ortiz et al., 2019). Given the rising spread of HPV misinformation across various social media platforms (Thompson et al., 2022), there's a critical need to counter misinformation and reduce its dissemination through a thorough analysis of ways to authenticate information and mitigate misinformation (Sørensen et al., 2012). The lack of significant findings in our study could be attributed to the fact that the social media measure in our study focused on general use rather than specifically targeting HPV vaccine-related content. Moving forward, research should explore social media use specifically related to the HPV vaccine as a measure.

Given that the internet ranks as the second most popular source of information on human papillomavirus (HPV) after healthcare providers (Patel et al., 2014), the lack of significance in our findings related to internet-based health communication and perceived HPV vaccine effectiveness warrants further exploration regarding the impact of specific internet-based communication platforms on HPV vaccine intentions. Furthermore, although generic social media platforms like Facebook, Instagram, and TikTok have been thoroughly examined in the context of HPV (Bravo et al., 2024; Kearney et al., 2019; Margolis et al., 2019; Thompson et al., 2021), there is a need for more focused attention on participation in online forums, blogs, and other forms of social network engagement. By understanding the influences of these platforms, experts can develop more targeted strategies, tailored specifically to combat misinformation on these platforms.

While social influence has been shown to impact HPV-related knowledge (Benavidez et al., 2020) and vaccine uptake (Tung et al., 2022), it is intriguing that our study did not yield statistically significant findings in this regard. This could be attributed to social influence being a latent variable with five underlying constructs, each varying in degree of influence among participants, resulting in an overall nonsignificant impact on perceived vaccine effectiveness. The positive relationship between social media use and social influence is supported by previous literature, indicating how social media can foster positive community connections and support, ultimately leading to greater perceived social influence (Deters et al., 2013; Uhls et al., 2017).

The negative association between being white and perceived HPV effectiveness is somewhat supported by recent studies suggesting that white individuals may

exhibit more hesitancy toward HPV vaccination (Szilagyi et al., 2020; Warner et al., 2017). Moreover, previous literature demonstrating higher awareness among women regarding HPV and the HPV vaccine, explains their higher perceived effectiveness (Adjei et al., 2017). This higher awareness may be reminiscent of the feminization of HPV and the HPV vaccine as this was predominately framed as a women's health issue (Daley et al., 2017).

Our study has some limitations. First, the sample was recruited through a national, but not nationally representative Qualtrics panel, thereby limiting generalizability to all US college students. Second, given our study was a cross-sectional study, we cannot derive causal relationships. Third, our sample predominantly consisted of students aged 18-20, potentially underrepresenting individuals aged 21-26. Fourth, the measures used for social media and health communication were not specifically tailored for HPV, potentially missing participants' engagement with HPV-related content on these platforms. The lack of HPV-related specificity of these items may have contributed to non-significant relationships in the current study. Future studies are recommended to include survey measures that ask about social media and internet use pertaining to HPV to further understanding about how these technology-based communication channels shape HPV-related perceptions. Additionally, our survey question about social media use specifically inquired about internet use for accessing Facebook and LinkedIn, potentially excluding respondents' use of other social media platforms and applications to access these sites directly. This single item did not ask about participants' use of other relevant social media platforms such as Instagram or TikTok. Future studies are encouraged to develop survey instruments to better capture HPV-related social media use, focusing on platforms highly utilized by college students. Finally, our outcome measure, perceived effectiveness of the HPV vaccine, while closely related, does not directly measure participants' actual uptake of the HPV vaccine. Subsequent studies should aim to address this gap by directly measuring vaccine uptake among participants.

Implications for Health Behavior Research

It is important to note that our study was conducted before the COVID-19 pandemic. The COVID-19 pandemic caused a decrease in vaccine confidence, which may have increased vaccine hesitancy and reduced HPV vaccination uptake post COVID-19 (Siani & Tranter, 2022). Since the pandemic, there has been a considerable rise in the development of digital and internet-based methods aimed at accessing and sharing health information (Cascini et al., 2022). Therefore, the current study should be replicated with a comparable sample post COVID-19, given the significant increase in internet and social media utilization for obtaining health-related information since the pandemic began (Chen et al., 2021). Second, considering that about a quarter of our sample of college students still do not perceive the HPV vaccine as effective, it is imperative to continue delivering interventions that promote HPV awareness and highlight the benefits of the HPV vaccine. This is particularly critical because college students often represent those who may have missed opportunities for HPV vaccination. Finally, with the increasing prominence of social media and digital platforms for sharing health information, there is a growing opportunity to encourage influencers to share their positive experiences with the HPV vaccine, given their impact on college-aged adults and

students. This can help foster a more positive atmosphere surrounding the vaccine and promote open dialogue to highlight its benefits.

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