RESEARCH PAPER

Social media use and human papillomavirus awareness and knowledge among adults with children in the household: examining the role of race, ethnicity, and gender

Yuki Lama ^a, Sandra Crouse Quinn ^a, Xiaoli Nan ^b, and Raul Cruz-Cano ^c

^aDepartment of Family Science, University of Maryland, College Park, MD, USA; ^bDepartment of Communication, University of Maryland, College Park, MD, USA; ^cDepartment of Epidemiology and Biostatistics, University of Maryland, College Park, MD, USA

ABSTRACT

Background: Though human papillomavirus (HPV) vaccination is a safe and effective method of protecting against associated cancers, uptake rates remain low among adolescents. Few studies have examined how social media use contributes to HPV-related knowledge gaps among parents and caregivers.

Objective: To investigate the association between social media use and HPV-related awareness and knowledge with a focus on differences by gender and race/ethnicity among a nationally representative sample of adults with children in the household.

Methods: We used data from the Health Information National Trends (HINTS) Survey (2017–2019) (N = 2,720). Multivariate logistic regressions were used to examine the association of social media use on HPV awareness and knowledge outcomes.

Results: Compared to non-users, engaging in one, two, three, or four social media behaviors were associated with greater HPV awareness (aOR: 2.09; 95%CI: 1.18–3.70, aOR: 2.49; 95%CI: 1.40–4.42, aOR: 2.64; 95%CI: 1.15–6.05, and aOR: 2.44; 95%CI: 1.11–5.36, respectively). Increased social media use was associated with increased HPV vaccine awareness. Men, African American, Hispanic, and Asian American respondents were less likely to be aware of HPV or HPV vaccine. Social media use was not associated with cancer knowledge.

Conclusions: Increased social media use is associated with an increased awareness of HPV and HPV vaccine for adults with children in the household. Social media-based efforts can be utilized to increase knowledge of the benefits of HPV vaccination as cancer prevention, which may be a precursor to reducing HPV vaccine hesitancy and encouraging uptake to decrease cancer incidence rates among vulnerable populations.

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infections (STI) and can lead to several types of cancer among men and women. Adverse outcomes can be prevented by vaccination, which has been recommended for children beginning 9 to 11 years old in the United States. The nonavalent vaccine protects against strains of HPV 16 and 18, which are associated with cancers of the cervix, penis, anus, mouth, oropharynx, larynx, vulva, and vagina, as well as HPV 6 and 11, which cause 90% of genital warts cases.¹ However, uptake remains low in the US, with only 49.5% for females and 37.5% for males aged 13–17 completing the recommended series.²

Social media, defined as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content” (p 61),³ can be utilized for surveillance and communication of health-promoting behaviors. Social media use is common among American parents, as the majority use Facebook (74%). Mothers are more likely to use Facebook (81%), Pinterest (40%), and Instagram (30%), compared to fathers (66%, 15%, and 19%, respectively).⁴ According to Pew data, in the US, parents interact with their social

networks as opposed to only reading or viewing content, with 37% of mothers frequently sharing, posting, or commenting on Facebook. Social media also serves as a source for parenting advice and information, with 59% of parents finding parenting information on social media content, 42% receiving social support on parenting issues, and 31% asking parenting questions.⁴

Social media use and health information seeking online is increasing, with 69% of American adults use at least one social media site, 72% of US adults looked for health information online, and over one-third used the Internet to try to diagnose a medical condition.⁵ Indeed, it is critical to address research gaps on how social media may inform HPV and HPV vaccine awareness and knowledge, which may inform decisions on vaccine uptake. Multiple studies have examined HPV sentiment and content on various social media platforms such as YouTube,^{6,7} microblogs,⁸ Pinterest,⁹ Twitter,^{10,11} and Instagram.^{12,13} On YouTube, the most viewed videos related to HPV and HPV vaccine were anti-vaccine (57%) compared to pro-vaccine (31%) and neutral (11%) in nature.⁸ In contrast, Briones et al. (2012) found that 33% of videos were pro-vaccine, potentially indicating the increase in anti-vaccine content on YouTube.⁶ Similarly, Keim-Malpass et al. (2017) found

that on Twitter, 51% of the tweets were classified as “positive” and 44% of the Tweets were considered “negative”¹⁴

Similarly, on Pinterest, vaccine side-effects and safety were primary concerns of users. An overwhelming majority of “pinned” images were anti-vaccine (74%) compared to pro-vaccine content (18%).⁹ Proliferation of anti-vaccine content and “false” (i.e. misinformation) vaccine information through malicious actors on social media may amplify negative sentiment and drive hesitancy.¹⁵ Margolis et al. (2018) found that parents of adolescents who heard negative stories of HPV (e.g. side effects) were less likely to initiate HPV vaccination compared to parents who heard positive or no stories.¹⁶ As the use of social media continues to spread, the need to examine the role of social media on HPV-related knowledge becomes increasingly clear.

Exposure to health information on social media may shape knowledge, attitudes, and beliefs, which, in turn, may shape parents’ intentions to get their children vaccinated against HPV. Prior studies have examined how online health-seeking behaviors contribute to HPV-knowledge disparities¹⁷ and the role of social media on impacting individuals’ awareness of HPV.¹⁸ However, focus has been largely on adolescents and young adults, highlighting a need to investigate social media use among parents and caregivers related to HPV. Additionally, research indicates that HPV awareness and knowledge are lower among racial/ethnic minorities and men, which is troubling as HPV can result in several types of cancers among men and women, with ethnic/racial minorities bearing disproportionate burden of disease.¹⁹

Minority women are more likely to be at risk for cervical cancer compared to white women,^{19,20} with the highest incidence rate of cervical cancer among Latina women (9.7 per 100,000 women), followed by African-American women (9.2 per 100,000 women). African-American and Latina women also have higher rates of vaginal and vulvar cancers compared to white women. Men who are minorities disproportionately experience HPV-related cancer disparities. Black men had the highest rates of HPV-associated anal cancer (1.5 men per 100,000), compared to white (1.1 men per 100,000) and Hispanic (0.7 men per 100,000) men.¹⁹ Hispanic men have higher rates of penile cancer than non-Hispanic men.²¹ For oropharyngeal (head and neck) cancers, black men had the second highest rates (6.8 men per 100,000). Given that HPV-attributable oropharyngeal cancers currently exceed cervical cancer rates²¹ and that these cancers are often detected at advanced stages,²² increasing male HPV vaccination rates is a public health imperative. Additionally, vaccinating males confers additional protection among men who have sex with men (MSM) who do not benefit from female-only vaccination.

Racial, ethnic, and gender disparities are observed with HPV vaccine initiation and completion. National Immunization Surveys (NIS)-Teen data reported that Latino and African American adolescents are more likely to begin initiation of HPV vaccination, but are less likely to complete the vaccine series, compared to Whites.^{23,24} An examination from the 2013 National Health Interview Survey (NHIS) found that African Americans and males were less likely to initiate HPV vaccination.²⁵ Similarly,

Daniel-Ulloa et al. (2016) found that women were more likely to report receiving the HPV vaccine (30%) compared to men (5%), consistent with recent research.^{26,27} Further, African American women had lower odds of HPV vaccine series initiation. Among women who initiated HPV vaccination, African American and Latina women had approximately were less likely to complete the series compared to White women,²⁶ potentially due to gaps in continuity of care, insurance coverage, access to healthcare as well as lower quality of care.²⁸ Concerted, culturally relevant efforts need to be placed on promoting vaccines among women and men, particularly racial/ethnic minorities to prevent worsening HPV-related disease rates and promote health and well-being.

Investigating the role of social media use on HPV awareness and knowledge and any differences by race/ethnicity and gender may help guide efforts to promote HPV vaccination and reduce cancer incidence rates among vulnerable populations. This study seeks to address these gaps by investigating the association between social media use and HPV-related awareness and knowledge outcomes among a nationally representative sample of adults with children in the household. Further, racial/ethnic and gender disparities in HPV and HPV vaccine awareness and knowledge will be assessed.

Methods

Population and study sample

Data were obtained from Health Information National Trends Survey (HINTS) 5, cycles 1-3, administered by the National Cancer Institute. HINTS is a nationally-representative, publicly available, probability survey of adults aged 18 or older in the civilian non-institutionalized population of the United States. The sampling strategy was a two-stage design. In the first stage, a stratified sample of addresses was selected from a file of residential addresses and in the second stage, one adult was selected within each sampled household. Cycle 3 data were collected from January through May, 2019 (response rate = 30.3%; N = 5,438). Cycle 2 data were collected from January through May, 2018 (response rate = 32.8%; N = 3,504); Cycle 1 data were collected January through May, 2017 (response rate = 32.4%; N = 3,191). All three cycles were paper-mail surveys, however Cycle 3 introduced a Web Pilot wherein respondents were offered a choice between responding via paper or web. HINTS contained both final sample weights that helped obtain population-level estimates and a set of 50 replicate sampling weights to obtain the correct standard errors. Sampling weights ensure valid inferences from the responding sample to the population, correcting for nonresponse and noncoverage biases. Full descriptions of HINTS survey methodology have been published elsewhere.²⁹

Analyses focused on a subset of survey data comprising of men and women with at least one child in the household <18 years old across HINTS 5.1, 5.2, and 5.3 (N = 2,720). Racial/ethnic groups were restricted to non-Hispanic African American, Hispanic, Asian American, and non-Hispanic White adults.

Outcomes

HPV and HPV vaccine awareness

HPV awareness was drawn from the following item asking: “Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes.” HPV vaccine awareness was drawn from this item: “A vaccine to prevent HPV infection is available and is called the cervical cancer vaccine or HPV shot. Before today, have you ever heard of the cervical cancer vaccine or HPV shot?”. Both item responses were coded as a categorical variable (yes/no).

HPV cancer knowledge

HPV cancer knowledge were assessed with the following items: (1) “Do you think HPV can cause cervical cancer?”; (2) “Do you think HPV can cause penile cancer?”; (3) “Do you think HPV can cause anal cancer?”; (4) “Do you think HPV can cause oral cancer?”. Responses to survey items were dichotomized to be “yes” versus “no,” which consisted of “no” and “not sure” to reflect uncertainty or lack of cancer knowledge.

Predictors

Social media use

A composite social media use variable was created as the sum of responses to the following questions regarding behaviors in the past 12 months: (1) social networking site (SNS) use; (2) social networking site (SNS) use to share health information; (3) participation in online forum or support groups for health issue; and (4) watching health-related videos on YouTube. Responses to survey item were dichotomized to “yes” (1) or “no” (0). Yes responses were summed to create the composite social media variable. Cronbach alpha for the four social media items was 0.91, demonstrating robust internal consistency.

Covariates

Sociodemographic, cultural, and healthcare variables

The following covariates were included: age (18–34, 35–49, 50–65, >65 years old), gender (male, female), marital status (married/living as married, divorced/separated/widowed and single, never married), education (less than high school, high school graduate, some college, college graduate, or more), household income (\$0 to 19,999, USD 20,000 USD to 34,999, USD 35,000 USD to 49,999, USD 50,000 USD to 74,999, USD 75,000 to 99,999, USD 100,000 USD or more), race/ethnicity (non-Hispanic African American, non-Hispanic White, Hispanic, Asian American), English language proficiency (very well/well, not very well/not at all), regular provider status (yes/no), and general health status (excellent/very good, good, fair/poor). Measures were selected and categorized based on previous studies.^{30,31}

Statistical analysis

Data were analyzed using Stata 15.1. Descriptive statistics were reported for outcome and sociodemographic predictor variables. Bivariate relationships between the predictors (social media use) and outcomes (HPV and HPV vaccine awareness

and knowledge) were examined using chi-square tests at the at $p < .05$ significance level. Multivariate logistic regressions were used to examine the association between social media use and HPV and HPV vaccine awareness and cancer knowledge. Following HINTS analytic recommendations, survey-specific procedures were used to account for the complex sampling design. Replicate weights were used to compute accurate standard errors for statistical testing procedures and to represent the U.S. population. Missing data were excluded from analysis.

Results

Sample

Table 1 summarizes the sociodemographic, cultural, health-care, and behavioral characteristics as well as HPV and social media related outcomes of respondents who reported living with children under 18 years old in the household (N = 2,720). Participants had a mean age of 43.6 years (SE = 0.3) and were mostly between the ages of 35–49 (50.5%) and female (56.2%).

Table 1. Respondent characteristics with children <18 in the household, 2019–2017 (N = 2,720).

Characteristic	N (%)
Age	
18–34	688 (25.3)
35–49	1,374 (50.5)
50–65	588 (21.6)
>65	71 (2.6)
Gender	
Male	1,191 (43.8)
Female	1,529 (56.2)
Marital status	
Married/living as married	1,923 (70.7)
Divorced/separated/widowed	254 (9.35)
Single, never been married	541 (19.9)
Education	
Less than high school	250 (9.2)
High school graduate	579 (21.3)
Some college	966 (35.5)
College graduate or more	925 (34.0)
Household income	
\$0 to \$19,999	400 (14.7)
\$20,000 to \$34,999	286 (10.5)
\$35,000 to \$49,999	359 (13.2)
\$50,000 to \$74,999	457 (16.8)
\$75,000 to \$99,999	373 (13.7)
\$100,000 or more	846 (31.1)
Race/ethnicity	
Non-Hispanic African American	302 (11.1)
Non-Hispanic White	1,485 (54.6)
Asian	174 (6.4)
Hispanic	653 (24.0)
English language proficiency	
Very well/well	2,595 (95.4)
Not very well/not at all	125 (4.6)
Regular provider status	
Yes	1,654 (60.8)
No	1,066 (39.2)
General health status	
Excellent/very good	1,352 (49.7)
Good	1,020 (37.5)
Fair/poor	351 (12.9)
Outcomes	
No social media use	394 (14.5)
Engaged in one social media behavior	1,140 (41.9)
Engaged in two social media behaviors	732 (26.9)
Engaged in three social media behaviors	313 (11.5)
Engaged in four social media behaviors	141 (5.2)

HPV: Human papillomavirus

The racial demographics of the respondents were non-Hispanic White (54.6%), non-Hispanic Black (11.1%), Hispanic (24.0%), and Asian (6.4%). Of the respondents, 72.9% had heard of HPV and 70.5% had heard of the HPV vaccine. Related to HPV cancer knowledge, respondents were most familiar with HPV linkage to cervical cancer (78.2%), followed by penile cancer (33.4%), oral cancer (30.6%) and anal cancer (29.5%). Nearly 41% of respondents had used one form of social media, 5.5% had engaged in all four behaviors, while 14.1% had not used any social media in the past 12 months (Figure 1). In contrast, the overall population of adults, including adults with and without children in the household, skewed older with a mean age of 53.6 years (SE = 0.2) and were mostly between the ages of 50–65. Consisting of 51.3% women, the overall population consisted of 10.8% non-Hispanic African American, 15.5% Hispanic, 5.2% Asian American, and 65.7 non-Hispanic White. This population had lower awareness of HPV and HPV vaccination (62.1% and 63.0%, respectively) compared to the analytic sample. Knowledge of cervical cancer was similar to the analytic sample at 78.2%, however lower for penile (30.0%), oral (29.3%), and anal (26.5%) cancers. Twenty-six percent of the overall population had not used any social media in the past 12 months, whereas 39.5% had engaged in at least one behavior, and 2.9% had engaged in all four behaviors.

HPV awareness

Bivariate analyses using chi-square tests revealed that increased social media use was associated with higher HPV awareness ($p < .001$). Compared to non-users (47.5%), those that engaged in three (81.9%) or all four (80.9%) behaviors had the greatest HPV awareness. In the first multivariable logistic regression model, increased social media use was associated with increased odds of being aware of HPV (Table 4). Compared to non-users, engaging in one, two, three, or four social media behaviors were associated with a greater likelihood HPV awareness (aOR: 2.09; 95%CI: 1.18–3.70, aOR: 2.49; 95%CI: 1.40–4.42, aOR: 2.64; 95%CI: 1.15–6.05, and aOR: 2.44; 95%CI: 1.11–5.36, respectively).

Men had significantly decreased odds of being aware of HPV compared to women (aOR: 0.38; 95%CI: 0.25–0.58).

Figure 1. Estimates of social media use among respondents with children <18 in the household, 2019–2017 (N = 2,720).

Those with lower educational attainment had decreased odds of HPV awareness, particularly for those with less than high school education ($p < .001$) and high school graduates ($p < .001$), compared to college graduates. Compared with non-Hispanic whites, African Americans (aOR: 0.53; 95%CI: 0.31–0.92) and Asians had significantly lower odds of being aware of HPV (aOR: 0.17; 95%CI: 0.09–0.32).

HPV vaccine awareness

Bivariate analyses demonstrated that increased social media use was associated with higher HPV vaccine awareness ($p < .001$), with adults that engaged in three (84.9%) or all four (82.9%) behaviors having the greatest awareness (Table 2). Multivariate analyses demonstrated that increased social media use was associated with increased odds of HPV vaccine awareness (Table 4). Compared to adults that did not use any social media, engaging in one, two, three, or four social media behaviors was associated with a greater HPV vaccine awareness (aOR: 2.21; 95%CI: 1.29–3.79, aOR: 2.89; 95%CI: 1.70–4.91, aOR: 5.16; 95%CI: 2.51–10.60, and aOR: 3.61; 95%CI: 1.53–8.53, respectively).

Similar to HPV awareness, men had significantly decreased odds of being aware of HPV vaccination compared to women (aOR: 0.38; 95%CI: 0.25–0.58). Those with lower educational attainment had decreased odds of HPV vaccine awareness, particularly for those with less than high school education ($p < .001$) and high school graduates ($p < .001$), and some college ($p < .001$), compared to college graduates. Compared with non-Hispanic whites, African Americans (aOR: 0.48; 95%CI: 0.29–0.81), Hispanic (aOR: 0.62; 95%CI: 0.41–0.93), and Asians had significantly lower odds of being aware of HPV vaccination (aOR: 0.16; 95%CI: 0.09–0.28).

HPV cancer knowledge

Social media use was not associated with knowledge that HPV causes cervical, penile, oral, and anal cancers (Table 3). Multivariate analyses demonstrated that social media use was not associated with HPV-associated cancer knowledge (Table 5). Men had significantly lower odds of knowing that HPV causes cervical cancer (aOR: 0.58; 95%CI: 0.38–0.88) compared to women. Those who were high school graduates ($p < .01$) or had less than high school ($p < .01$) education were less likely to be knowledgeable that HPV causes cervical

Table 2. Weighted frequencies and bivariate associations between HPV awareness and HPV vaccine awareness and social media use variables.

Social media use	Aware of HPV		Aware of HPV vaccine	
	%	P-value	%	P-value
No social media use	47.5	<.001	42.0	<.001
Engaged in one social media behavior	75.3		71.3	
Engaged in two social media behaviors	77.8		73.7	
Engaged in three social media behaviors	81.9		84.9	
Engaged in four social media behaviors	80.9		82.9	

HPV: Human papillomavirus

Table 3. Weighted frequencies and bivariate associations between HPV cancer knowledge and social media use variables.

Social media use	Knowledgeable That HPV Is a Cause of Cervical Cancer %		Knowledgeable That HPV Is a Cause of Penile Cancer %		Knowledgeable That HPV Is a Cause of Anal Cancer %		Knowledgeable That HPV Is a Cause of Oral Cancer %	
	%	P-value	%	P-value	%	P-value	%	P-value
No social media use	71.3	$P = .067$	35.2	$P = .391$	30.0	$P = .507$	27.7	$P = .772$
Engaged in one social media behavior	77.5		31.6		26.5		29.3	
Engaged in two social media behaviors	77.5		32.3		32.5		29.0	
Engaged in three social media behaviors	85.6		40.9		34.8		35.2	
Engaged in four social media behaviors	84.3		38.9		32.9		33.0	

HPV: Human papillomavirus

Table 4. Weighted, fully adjusted multivariable logistic regression of the association between social media use and HPV and HPV vaccine awareness, 2019–2017.

	Heard of HPV (N = 2,436) aOR (95%CI)	Heard of HPV Vaccine (N = 2,419) aOR (95%CI)
Social media use		
No social media use	Ref	Ref
Engaged in one social media behavior	2.09* (1.18–3.70)	2.21** (1.29–3.79)
Engaged in two social media behaviors	2.49** (1.40–4.42)	2.89** (1.70–4.91)
Engaged in three social media behaviors	2.64* (1.15–6.05)	5.16*** (2.51–10.60)
Engaged in four social media behaviors	2.44* (1.11–5.36)	3.61** (1.53–8.53)
Covariates		
Age		
18–34	Ref	Ref
35–49	0.91 (0.57–1.44)	1.00 (0.60–1.68)
50–65	0.58 (0.34–1.01)	0.96 (0.50–1.85)
>65	0.30** (0.13–0.69)	0.54 (0.23–1.26)
Gender		
Male	0.38*** (0.25–0.58)	0.33*** (0.24–0.45)
Female	Ref	Ref
Marital status		
Married/living as married	Ref	Ref
Divorced/separated/widowed	1.02 (0.61–1.69)	0.87 (0.56–1.36)
Never married	0.98 (0.55–1.74)	0.79 (0.46–1.35)
Education		
Less than high school	0.16*** (0.08–0.32)	0.21*** (0.11–0.41)
High school graduate	0.38*** (0.23–0.59)	0.30*** (0.19–0.47)
Some college	0.89 (0.61–1.29)	0.67* (0.45–0.99)
College graduate or more	Ref	Ref
Household income		
<\$20,000	0.70 (0.34–1.44)	0.91 (0.46–1.81)
\$20,000 to \$34,999	0.79 (0.39–1.61)	0.98 (0.47–2.02)
\$35,000 to \$49,999	0.84 (0.49–1.43)	0.98 (0.56–1.72)
\$50,000 to \$74,999	1.15 (0.64–2.07)	1.24 (0.65–2.36)
\$75,000 to \$99,999	0.91 (0.56–1.49)	0.96 (0.55–1.66)
≥\$100,000	Ref	Ref
Race/ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic African American	0.53* (0.31–0.92)	0.48** (0.29–0.81)
Hispanic	0.63 (0.39–1.01)	0.62* (0.41–0.93)
Asian	0.17*** (0.09–0.32)	0.16*** (0.09–0.28)
English language proficiency		
Very well/well	Ref	Ref
Not very well/not at all	1.23 (0.60–2.52)	0.63 (0.30–1.32)
Regular provider status		
Yes	Ref	Ref
No	0.73 (0.54–1.01)	0.69 (0.48–0.98)
General health status		
Excellent/very good	Ref	Ref
Good	1.17 (0.78–1.74)	0.77 (0.52–1.14)
Fair/poor	1.19 (0.67–2.09)	0.66 (0.38–1.16)

HPV: Human papillomavirus

CI: Confidence interval

* $<.05$; ** $<.01$; *** $<.001$

cancer. Marital status was associated with HPV-associated cancer knowledge. In particular, adults that were divorced, separated, or widowed had increased odds of penile and oral cancer knowledge ($p < .05$). Differences across race/ethnicity were not found across cancer knowledge.

Multivariate analyses stratified by gender and race/ethnicity

Given the significance of gender in our models, we conducted additional logistic regression models examining the association between social media use on HPV awareness and knowledge

outcomes stratified by gender (Appendix). Among women, those that engaged in any social media had significantly increased odds of having heard of HPV compared to non-users, with those that engaged in three social behavior having the greatest odds (aOR: 6.84; 95%CI: 2.09–22.29). Similarly, for HPV vaccine awareness, women that engaged in any social media had significantly increased odds of having heard of HPV vaccination compared to non-users, with those that engaged in three social behavior having the greatest odds (aOR: 8.78; 95%CI: 2.98–25.89). Among men, the models did not yield major significant results for HPV and HPV vaccine awareness or cervical cancer knowledge. Race/ethnicity-stratified results did not demonstrate major significant results across HPV or HPV vaccine awareness.

Discussion

Using nationally representative data, this study examined the association between the level of social media use and HPV knowledge and awareness among adults with children under 18 years old in the household. We found that a majority of respondents were aware of HPV, HPV vaccine, and knowledgeable of HPV's linkage with cervical cancer, but less so about penile, anal, and oral cancer, in line with recent studies.^{31,32} Study findings indicated that social media users had significantly higher odds of being aware of HPV and HPV vaccination, compared to non-users. Increased social media use may facilitate increased direct or passive consumption of information online, corresponding with increased awareness. Social media use was not associated with knowledge that HPV causes certain cancers, warranting efforts to increase HPV cancer knowledge.

Results highlight important HPV-related awareness gaps between those that use social media and those who do not. Racial/ethnic minorities and men had significantly lower odds of HPV and HPV vaccine awareness. Men also had lower knowledge of HPV linkage with cervical cancer. Although the vaccine was initially introduced primarily for women, it has been over a decade since the recommendation for males, suggesting that promotion efforts among men need strengthening. Previous literature had pointed to communication inequalities, also known as the digital divide, which contributed to knowledge gaps among low socioeconomic, rural, underserved, and minority populations.³³ Our analysis demonstrated lower HPV and HPV vaccine awareness among African Americans, Asian Americans, and Hispanic adults, consistent with previous findings.³⁴

Social media may be indirectly perpetuating gender and racial disparities. Images on Twitter and Instagram reported an overrepresentation of women in HPV-related posts.¹² Men and racial minorities were less likely to be featured on Twitter images, despite having equal or more disease burden compared to women and white individuals.³⁵ In terms of reaching certain key demographics to disseminate vaccine and cancer prevention promotional messages, social media may be a cost-effective strategy to reach both targeted and broad groups of individuals.

Our findings, if confirmed with additional studies, can inform development of interventions using social media as a channel to reach vulnerable populations to spread accurate information about HPV to encourage vaccination. Han, Lee, & Demiris (2019) found that social media interventions targeting racial/ethnic minorities were fruitful in raising cancer awareness.³⁶ A randomized-controlled trial by Glanz et al. (2017) found that pregnant women who were assigned to a social media intervention were more likely to be up-to-date on infant immunizations than those who received usual routine care.³⁷ Social media components included a blog, forum, chat function, and ability to directly ask experts about vaccination to encourage engagement and reinforce the vaccine knowledge,³⁷ highlighting the benefits of multi-component interventions. Interventions that incorporate randomized controlled trials or longitudinal designs can assess the effectiveness of delivering messages on social media on health behaviors as well as the long-term impact of using social media on health behavior.

Given the proliferation of misinformation and its negative impact on vaccine attitudes,¹⁰ it is important for public health communication efforts to be proactive in delivering credible, well-timed information instead of reacting and attempting to correct misinformation, which has proved to be difficult.³⁸ Social media campaigns need to combat vaccine hesitancy and misinformation before it begins;³⁹ this is especially salient given the struggle against misinformation during the COVID-19 pandemic. Though yet to be developed, the anti-vaccine community has been propagating falsehoods and spreading doubts related to a potential COVID-19 vaccine using social media.⁴⁰ Though small in size, the vocal anti-vaccine community has employed strategic approaches online to undermine confidence in vaccines. For example, multiple anti-vaccination groups worked in tandem to leave thousands of negative comments when a pediatric practice posted a video promoting HPV vaccination on its Facebook page. Hoffman et al. (2019) found the anti-vaccination responses clustered in distinct subgroups (i.e. trust, alternatives, safety, and conspiracy).⁴¹ Anti-vaccine proponents employed varied arguments, necessitating targeted interventions in place of generic public health messages that encourage vaccination.

Additionally, the information presented by credible sources need to reflect the needs and preferences of its intended audiences. In other words, the message content needs to be aligned with the recipients, with consideration of health literacy, numeracy, language, and culture.^{42,43} Messages that are easy to understand incorporating faces and voices of the target audience are more likely to be effective than a one-size-fits-all approach to health communication.^{35,44} Lack of timely, relevant information may lead users to seek information from less credible sources, which may contribute to vaccine hesitancy. In addition to online channels, healthcare providers are critical in the multi-level efforts to spread correct HPV information. In addition to raising awareness, healthcare provider (HCP) recommendation is one of the most important factors in HPV vaccine uptake.⁴⁵ Patient-provider communication needs to be bolstered so that patients seek and trust provider counseling. As HCP recommendation has often been the primary reason for vaccination, providers need to be consistently

Table 5. Weighted, fully adjusted multivariable logistic regression of the association between social media use and HPV cancer knowledge, 2019–2017.

	Knowledgeable That HPV Causes Cervical Cancer (N = 1,863) aOR (95%CI)	Knowledgeable That HPV Causes Penile Cancer (N = 1,824) aOR (95%CI)	Knowledgeable That HPV Causes Anal Cancer (N = 1,824) aOR (95%CI)	Knowledgeable That HPV Causes Oral Cancer (N = 1,824) aOR (95%CI)
Social media use				
No social media use	Ref	Ref	Ref	Ref
Engaged in one social media behavior	0.97 (0.54–1.75)	0.83 (0.52–1.32)	0.82 (0.44–1.51)	1.12 (0.57–2.20)
Engaged in two social media behaviors	0.95 (0.53–1.69)	0.85 (0.50–1.45)	1.04 (0.53–2.05)	1.01 (0.49–2.10)
Engaged in three social media behaviors	1.73 (0.85–3.53)	1.20 (0.63–2.30)	1.24 (0.59–2.60)	1.33 (0.60–2.99)
Engaged in four social media behaviors	1.26 (0.45–3.54)	1.17 (0.58–2.39)	1.03 (0.45–2.36)	1.23 (0.47–3.19)
Covariates				
<i>Age</i>				
18–34	Ref			
35–49	1.42 (0.81–2.50)	1.09 (0.71–1.67)	1.00 (0.64–1.56)	0.99 (0.66–1.47)
50–65	0.94 (0.49–1.82)	1.05 (0.64–1.71)	1.22 (0.72–2.08)	1.16 (0.68–1.99)
>65	0.63 (0.25–1.60)	1.03 (0.37–2.83)	0.64 (0.20–2.02)	0.74 (0.27–2.03)
<i>Gender</i>				
Male	0.58* (0.38–0.88)	1.11 (0.76–1.62)	1.10 (0.75–1.62)	1.03 (0.71–1.49)
Female	Ref	Ref	Ref	Ref
<i>Marital status</i>				
Married/living as married	Ref	Ref	Ref	Ref
Divorced/separated/widowed	1.56 (0.85–2.85)	1.68* (1.00–2.83)	1.48 (0.91–2.43)	1.75* (1.04–2.94)
Single, never married	0.81 (0.43–1.52)	1.10 (0.67–1.82)	1.31 (0.72–2.36)	1.07 (0.57–2.01)
<i>Education</i>				
Less than high school	0.23** (0.09–0.60)	0.79 (0.30–2.05)	0.58 (0.18–1.83)	0.54 (0.19–1.54)
High school graduate	0.36*** (0.22–0.60)	0.98 (0.56–1.71)	0.66 (0.35–1.25)	0.45* (0.24–0.84)
Some college	0.65 (0.40–1.05)	1.37* (1.03–1.84)	1.01 (0.69–1.48)	0.76 (0.52–1.12)
College graduate or more	Ref	Ref	Ref	Ref
<i>Household income</i>				
<\$20,000	0.52 (0.22–1.23)	0.92 (0.49–1.74)	0.94 (0.44–2.00)	1.17 (0.55–2.51)
\$20,000 to \$34,999	1.03 (0.46–2.30)	0.87 (0.48–1.60)	1.22 (0.66–2.27)	1.00 (0.48–2.09)
\$35,000 to \$49,999	0.49 (0.22–1.09)	0.52* (0.31–0.86)	0.84 (0.44–1.58)	0.80 (0.44–1.46)
\$50,000 to \$74,999	0.68 (0.36–1.28)	1.08 (0.70–1.67)	1.31 (0.84–2.07)	1.00 (0.61–1.64)
\$75,000 to \$99,999	0.76 (0.39–1.47)	0.89 (0.54–1.45)	1.14 (0.70–1.89)	0.95 (0.56–1.60)
≥\$100,000	Ref	Ref	Ref	Ref
<i>Race/ethnicity</i>				
Non-Hispanic White	Ref	Ref	Ref	Ref
Non-Hispanic African American	0.69 (0.40–1.19)	0.87 (0.53–1.43)	0.69 (0.41–1.19)	0.62 (0.35–1.10)
Hispanic	1.14 (0.67–1.92)	1.22 (0.74–2.02)	1.12 (0.67–1.87)	1.20 (0.72–1.99)
Asian American	0.67 (0.24–1.86)	1.02 (0.46–2.27)	1.25 (0.58–2.72)	1.46 (0.71–3.01)
<i>English language proficiency</i>				
Very well/well	Ref	Ref	Ref	Ref
Not very well/not at all	0.89 (0.31–2.57)	1.27 (0.49–3.28)	1.47 (0.57–3.78)	1.63 (0.61–4.36)
<i>Regular provider status</i>				
Yes	Ref	Ref	Ref	Ref
No	0.75 (0.31–2.57)	0.76 (0.54–1.06)	0.73 (0.52–1.04)	0.91 (0.65–1.28)
<i>General health status</i>				
Excellent/very good	Ref	Ref	Ref	Ref
Good	0.59 (0.37–0.92)	0.85 (0.58–1.24)	0.96 (0.70–1.38)	0.89 (0.61–1.29)
Fair/poor	0.68 (0.40–1.15)	1.03 (0.60–1.06)	1.28 (0.71–2.31)	1.26 (0.70–2.29)

HPV: Human papillomavirus

CI: Confidence interval

* $<.05$; ** $<.01$; *** $<.001$

recommending vaccination for eligible patients. Further, culturally competent care centering around patient care needs to be emphasized in order to foster trust, understanding, and vaccine uptake. In concert with stating benefits of vaccine recommendation (e.g. cancer prevention), actionable next steps need to be provided (e.g. vaccination offer at the time of visit). Motivational interviewing, a patient-centered strategy

for behavior change, coupled with direct, easy to understand language underscoring HPV vaccination benefits have demonstrated to be effective recommendation techniques, particularly for vaccine hesitant patients.⁴⁶ Investing in provider communication strategies, including the use of translators, may alleviate the disparities for racial/ethnic minorities, who frequently cite lower satisfaction of care.^{47,48} Improved patient-provider

communication is critical so that patients receive recommendations from credible sources instead of seeking information online, increasing risk of exposure to false information.

To our knowledge, this is the first study that uses nationally representative data to explore the association of social media use with HPV and HPV awareness among adults with children in the household. Findings from this exploratory examination suggest that social media can potentially influence HPV-associated awareness and highlight low knowledge of non-cervical HPV cancers knowledge among users. As more people turn to social media for general and health-related purposes, users become consumers of a plethora of vaccine-related information, credible or not. Since knowledge is a critical piece in decision-making related to vaccination, it is crucial that users are exposed to correct information. The content and delivery of vaccine messages on social media can shape public knowledge and awareness of HPV, which may influence decision-making.^{10,49}

Lastly, our findings have implications for using social media as a channel for information dissemination. While the benefits of using this medium are numerous, there are associated challenges that need considering as well. First, while our study characterizes different types of social media engagement, further research is needed on why some users prefer certain platforms over others and for which purposes. Some platforms serve as a site of passive content consumption, while other promote active engagement via two-way communication such as social networking sites (e.g. Facebook). In a similar vein, further research is needed on what makes certain content more compelling (i.e. viral) than others and if engagement metrics (i.e. likes or shares) can be leveraged for disseminating vaccine promotional messages. Research has demonstrated the role of malicious actors, such as bots and trolls, which may interfere with public health efforts to reduce vaccine hesitancy,¹⁵ adding additional challenges to the constantly evolving nature of social media.

There are several limitations to our cross-sectional study, wherein causality cannot be assessed. First, we were limited in the variables available, which did not include vaccination intention or behavior. Second, since we combined social media behaviors into a composite variable, we were unable to discern which particular behaviors, which were not specifically related to HPV information seeking, may be contributing to HPV awareness. Thus, we were unable to ascertain the specific purpose of respondents' social media use. Furthermore, we acknowledge that individuals are exposed to health information from multiple sources aside from social media, directly or passively, which may influence their awareness and knowledge of HPV. Hence, findings of the association between increased social media use and increased HPV awareness must be interpreted with caution. Having robust data on factors that influence HPV-related information seeking would enrich study findings and allow for a better understanding of the role social media plays on vaccine decision-making among parents or caregivers. Bivariate analyses (not shown) revealed that

social media behaviors were not distinct from one another and thus, frequency and combination of behaviors may be more significant contributors to awareness than an individual behavior. In other words, using various forms of social media may present more opportunities to be exposed to HPV-related information. Further, our findings indicated an association, but did not account for the quality of information that users are exposed to on social media. Knowledge or awareness does not correspond to veracity of information that people are exposed to online. Future research can explore the accuracy of content and the role of misinformation on HPV awareness, vaccine intention, and behavior among parents and guardians of children.

Moreover, future studies can take into account HPV vaccine knowledge and decision-making among respondents who do not use social media (e.g. men, older adults). These adults may not be exposed to health promotional messages and may be subject to increased health disparities. In order to better understand the health-seeking behaviors of these individuals, qualitative studies can identify trusted and used information sources among this heterogeneous group. Questions investigating the preference of source and content of health messages may aid in the development of strategies to reach harder to reach populations. Further, identifying why these users do not use social media for health purposes and preferred communication channels can illuminate how to facilitate behavior adoption among social media non-users such as mobile applications (i.e. mHealth) or telemedicine.

Our study demonstrated that among adults with children in the household, social media users had increased odds of HPV-related awareness compared to non-users, highlighting knowledge gaps of this population. Public health practitioners and healthcare providers need to work in tandem with online efforts to connect individuals with credible information to promote healthy behavior adoption. Of critical importance, health promotion efforts need to be proactive in disseminating accurate information prior to misinformation exposure. Given the ubiquity and increased use of social media, it has potential to be an effective communication tool and platform to combat inequalities in HPV-associated knowledge and morbidities among vulnerable communities. Understanding how social media influences awareness of HPV and HPV vaccine among parents and caretakers of children could inform approaches to increase knowledge, which in turn could influence vaccine uptake, reducing risk for HPV infection and cancer for children and parents of eligible age.

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ORCID

Yuki Lama <http://orcid.org/0000-0003-2875-4093>
 Sandra Crouse Quinn <http://orcid.org/0000-0002-3258-4595>
 Xiaoli Nan <http://orcid.org/0000-0001-8139-0503>
 Raul Cruz-Cano <http://orcid.org/0000-0001-7715-1198>

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Appendix

Table A1. Logistic regressions estimating HPV, HPV vaccine awareness, and cervical cancer knowledge stratified by gender.

	Heard of HPV		Heard of HPV vaccine		Knowledgeable that HPV causes cervical cancer	
	Women	Men	Women	Men	Women	Men
	aOR 95% CI	aOR 95% CI	aOR 95% CI	aOR 95% CI	aOR 95% CI	aOR 95% CI
Engaged in one social media behaviors	2.58** (1.29–5.20)	1.80 (0.84–3.88)	3.05** (1.39–6.72)	1.69 (0.87–3.27)	0.86 (0.39–1.90)	0.95 (0.37–2.47)
Engaged in two social media behaviors	2.86** (1.44–5.69)	2.46* (1.07–5.66)	4.28*** (2.03–9.01)	2.08 (0.95–4.58)	0.96 (0.44–2.09)	0.85 (0.28–2.56)
Engaged in three social media behaviors	6.84** (2.09–22.29)	1.20 (0.34–4.31)	8.78** (2.98–25.89)	3.42 (0.92–12.77)	1.38 (0.54–3.51)	3.61 (0.52–25.03)
Engaged in four social media behaviors	4.22* (1.23–14.49)	1.52 (0.41–5.65)	7.06* (1.62–30.86)	1.85 (0.51–6.73)	1.51 (0.51–4.50)	0.53 (0.06–5.01)

HPV: Human papillomavirus

* $<.05$; ** $<.01$; *** $<.001$

Table A2. Logistic regressions estimating HPV and HPV vaccine awareness stratified by race/ethnicity.

	Heard of HPV ^a	Heard of HPV vaccine		
	Non-Hispanic Black	Non-Hispanic Black	Asian American	Hispanic
	aOR 95% CI	aOR 95% CI	aOR 95% CI	aOR 95% CI
Engaged in one social media behaviors	2.69 (0.97–7.44)	1.06 (0.33–3.37)	1.13 (0.16–8.06)	1.49 (0.50–4.45)
Engaged in two social media behaviors	2.62 (0.45–15.25)	0.77 (0.23–2.62)	9.70 (0.88–107.12)	1.33 (0.44–4.05)
Engaged in three social media behaviors	2.62 (0.51–13.50)	2.79 (0.51–15.24)	31.23* (1.09–894.73)	5.68** (1.73–18.62)
Engaged in four social media behaviors	5.32 (0.45–62.88)	13.44 (0.40–450.11)	10.25 (0.29–367.38)	1.26 (0.13–12.39)

^aNote: Due to lack of observations among Asian Americans for HPV awareness, odds ratios were not calculated.

HPV: Human papillomavirus

* $<.05$; ** $<.01$; *** $<.001$