



Disparities in HPV knowledge by race/ethnicity and socioeconomic position: Trusted sources for the dissemination of HPV information

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Abstract

Purpose To examine the differences in HPV and HPV vaccine awareness, knowledge, and beliefs by race/ethnicity and socioeconomic position (SEP) among a national sample of non-Hispanic whites (NH-Whites), non-Hispanic Blacks (NH-Blacks), and Hispanics in the United States. We also examine differences in trusted health information sources by race/ethnicity and SEP.

Methods Data were obtained from the Health Information National Trends Survey, Cycle 1, conducted from January to April 2017. Descriptive statistics, bivariate analyses, multivariate logistic regression, and listwise deletion were used to examine HPV and HPV vaccine awareness and knowledge-related items, and trust in health information sources among NH-Whites, NH-Blacks, and Hispanics 18–49 years old.

Results HPV vaccine awareness was moderate with no significant differences across racial/ethnic groups. NH-Whites had significantly higher knowledge that HPV causes cervical cancer than NH-Blacks and Hispanics ($p < 0.001$). High SEP NH-Blacks (OR = 0.42, 95% CI = [0.24–0.73], $p = 0.002$) and Hispanics (OR = 0.49, 95% CI = [0.31–0.79], $p = 0.003$) had lower odds of knowing HPV causes a sexually transmitted disease than their white counterparts. Low SEP NH-Blacks (OR = 11.03, 95% CI = [3.05–39.86], $p < 0.001$) had 11 times the odds of ever hearing about the HPV vaccine than low SEP NH-Whites. NH-Blacks had twice the odds of trusting health information from television (OR = 2.39, 95% CI = [1.52–3.78], $p < 0.001$), and almost six times the odds of trusting health information from religious organizations than low SEP NH-Whites (OR = 5.76, 95% CI = [2.02–16.44], $p < 0.001$).

Conclusion Tailored communication strategies may address the low HPV knowledge among NH-Blacks and Hispanics from high and low SEP.

Keywords HPV vaccination · Human papillomavirus · Cervical cancer · Race/ethnicity · Socioeconomic position · Cancer communication

Introduction

Human Papillomavirus (HPV) is the most common sexually transmitted infection in the United States (U.S.) and worldwide that can lead to multiple cancers and increased mortality [1]. Persistent infections with high-risk HPV can lead to cervical, vaginal and vulvar cancers in women, penile cancer in men, and oropharyngeal and anal cancers in both men and women [2]. An extensive body of literature documents the effects of race/ethnicity and socioeconomic position (SEP) on cervical cancer mortality and HPV infections [3–5]. Research suggests that women from higher SEP have a decreased risk and lower incidence of invasive cervical cancer than women from lower SEP [5]. Recent research shows that non-Hispanic Black women

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and men have the highest prevalence for any and high-risk genital and oral HPV infections than white women and men [6]. Further, Hispanic and non-Hispanic Black women have a higher cervical cancer incidence rate of 9.1 and 8.4 per 100,000 women compared to 7.0 per 100,000 women for non-Hispanic white women [7].

The HPV vaccine is a safe and effective public health strategy recommended to protect males and females from HPV infection [8]. The Advisory Committee on Immunization Practices (ACIP) routinely recommends HPV vaccination at age 11 or 12 years, and catch-up vaccination is recommended for all persons aged 13 to 26 years [9]. A two-dose vaccination series is recommended if started less than 15 years old. Otherwise, a three-dose series is recommended [9]. In October 2018, FDA approved an expansion of the age indication through age 45 years for 9vHPV. For adults aged 27 through 45 years, ACIP recommends shared clinical decision-making with a health care provider to determine if vaccination is beneficial [9]. However, despite the proven safety and efficacy of the HPV vaccine in reducing HPV vaccine type prevalence and genital infections [8], HPV vaccination rates among young adults are low. In 2018, only 21.5% of 18–26-year-old adults had received the recommended number of doses of the HPV vaccine [10]. Moreover, non-Hispanic white women (57.9%) are more likely to have ever received one or more doses of the HPV vaccine compared to Hispanic women (48.8%) and non-Hispanic Black women (44.7%) [10]. Among men, the percentage of 18–26-year-olds who ever received one or more doses of the HPV vaccine is low overall (range 24.7%–29.4%) [10]. As non-Hispanic Black and Hispanic women experience higher burdens of cervical cancer than non-Hispanic white women [11], and HPV-associated cancers are on the rise in men, more work to increase HPV vaccination rates among HPV vaccine-eligible adults is necessary [12, 13].

A consistently reported barrier to HPV vaccination uptake among adults is gaps in knowledge related to HPV infection and the HPV vaccine [14]. Gaps in HPV knowledge are often an underlying factor influencing HPV vaccination hesitancy and overall acceptance among Hispanic and non-Hispanic Black adults [15]. The health communication literature suggests that gaps in knowledge may also indicate communication inequalities among non-Hispanic Blacks and Hispanics compared to their non-Hispanic White counterparts, such that non-Hispanic Blacks and Hispanics have lower knowledge levels about HPV compared to non-Hispanic Whites [14]. The Structural Influence Model of Communication (SIM) [16] defines communication inequalities as differences among social classes in the generation, manipulation, and distribution of information at the group level and differences in access to and ability to take advantage of information at the individual level. Subsequently,

these communication inequalities may affect peoples' attention to, processing of, and use of health information [17].

Race/ethnicity and SEP are important indicators of HPV-associated cancer outcomes and knowledge levels [5, 18]. The purpose of this study is to examine differences in HPV and HPV vaccine awareness and knowledge by race and ethnicity, and SEP. This study also identifies trusted health information sources to determine potential communication channels for delivering HPV education to non-Hispanic White, non-Hispanic Black, and Hispanic adults. Study findings may inform future HPV dissemination efforts by identifying knowledge gaps within different racial and ethnic minority populations and SEP.

Methods

Data source

This project's data came from the 2017 Health Information National Trends Survey (HINTS 5 Cycle 1) by the National Cancer Institute [19]. HINTS is an initiative of the National Cancer Institute to collect national data about health communications, cancer knowledge and beliefs, and cancer-related behaviors. In the survey, U.S. residents aged 18 years to 65 and older were sampled from areas with high concentrations of minority populations (population proportion of Hispanics or non-Hispanic Blacks equaled or exceeded (34%), and from areas with a low concentration of minorities. Data was collected through mailed questionnaires from January 2017 to May 2017, with oversampling areas with a high concentration of minorities [20]. A full report of the HINTS 5 methodology is available elsewhere [19].

Outcome variables

HPV awareness and HPV knowledge

Participants first answered a question about whether they had ever heard of HPV. For those who had ever heard of HPV, the following three questions were administered: (1) Do you think HPV can cause cervical cancer, penile cancer, anal cancer, or oral cancer? (yes/no/not sure); (2) Do you think that HPV is a sexually transmitted disease (STD) (yes/no/not sure); (3) Do you think HPV requires medical treatment, or will it usually go away on its own without treatment? (requires medical treatment/will usually go away on its own).

HPV vaccine awareness and beliefs

All participants were asked, "Before today, have you ever heard of the cervical cancer or HPV shot (yes/no). All

participants were also asked, “In your opinion, how successful is the HPV vaccine in preventing cervical cancer.” Response options were on a scale of “not at all successful to very successful,” with the additional response option of ‘not sure.’ Responses were dichotomized into ‘pretty successful/very successful versus a little successful/not at all successful versus not sure.’

HPV vaccine communication with a healthcare provider

Participants were asked if anyone in their immediate family was between aged 9 and 27 years old. Those who responded yes were asked the following two questions: (1) In the last 12 months, had a doctor or health care professional ever talked with them or an immediate family member about the HPV shot or vaccine?; and (2) In the last 12 months, had a doctor or health care professional recommended that they or someone in their immediate family get an HPV shot or vaccine? Response options were yes, no, or not sure.

Trusted sources for health and medical information

Participants rated how much they would trust health or medical information from the following sources: a doctor, family or friends, newspaper or magazine, radio, internet, television, government health agencies, charitable organizations, religious organizations, and leaders. Responses were on a scale from ‘not at all to a lot.’ Trusted sources for health/medical information were dichotomized into ‘some/a lot’ versus ‘not at all/ a little.’

Predictor variables

Race and ethnicity

Participants were categorized as non-Hispanic White, non-Hispanic Black, or Hispanic.

Socioeconomic position

Socioeconomic position was measured based on those within our sample living at or below 100% of the federal poverty level. In 2017, the poverty threshold for a family of four with two children under age 18 was a household income of \$24,858 [21]. Given that income was a categorical variable, low SEP was defined as a participant with a household income less than \$35,000. High SEP was defined as participants with a household income higher than or equal to \$35,000.

Covariates

Several covariates were hypothesized to be associated with sociodemographic characteristics. They included gender, age, education, household income, employment, marital status, geographical area, having a regular healthcare provider, type of health coverage, sexual orientation, born in the U.S., and having children in the household.

Statistical analysis

Data were analyzed between March and April 2020 with Stata version 15 (StataCorp L.P., College Station TX). Descriptive statistics ($n/\%$), bivariate analyses (χ^2 test), multivariate logistic regression, and listwise deletion for missing data were used to examine HPV, HPV vaccine awareness and knowledge-related items, and trust in health and medical information sources among non-Hispanic White, non-Hispanic Black and Hispanic adults. Bivariate analyses were performed to compare these outcomes across the three racial/ethnic groups and within each group by SEP. For the multivariate logistic regression models, statistically significant outcomes ($p < 0.05$) from the bivariate analyses across racial/ethnic groups were regressed onto the categorical variable race/ethnicity while controlling for covariates. Survey weights were applied to each model to account for multiple adjustments in the sampling procedure to ensure that the sample was representative of all U.S. adults. As recommended by the HINTS analytical recommendations, a jackknife method was used to calculate standard errors of parameter estimates [22]. Given that age was a categorical variable, our analysis was restricted to those between the ages of 18 and 49 to include the extended HPV vaccination guideline for adults up to age 45 years old. The final sample used for analysis was $n = 918$.

Results

Table 1 summarizes the sample characteristics (weighted to the general U.S. adult population). Most respondents were non-Hispanic white, had some college education or higher, reported annual household income $< \$75,000$, had a regular provider and health insurance and did not have a child in the household. The sample was almost evenly split between males and females, and a majority was born in the U.S. and identified as heterosexual or straight.

Table 1 Weighted Demographic Characteristics $n=918$

Variables	<i>n</i>	Weighted%
Race		
Non-Hispanic white	543	64.4
Hispanic	203	21.4
Non-Hispanic black	144	11.0
Missing	28	3.2
Gender		
Females	580	51.7
Males	333	47.9
Missing	5	0.5
Age		
18–34	323	41.5
35–49	595	58.5
Education		
Less than HS/HS graduate	149	25.2
Some college	239	33.5
College graduate or higher	524	40.7
Missing	6	0.6
Household Income		
Less than \$20 k	127	15.2
\$20 k to <\$35 k	103	10.8
\$35 k to <\$50 k	101	14.7
\$50 k to <\$75 k	151	16.9
\$75 k or higher	391	35.2
Missing	45	7.0
Employment		
Employed	696	69.8
Homemaker	73	6.5
Unemployed	68	9.7
Student	39	8.8
Disabled	33	4.5
Retired	5	0.4
Missing	4	0.4
Marital Status		
Married/living as married	541	49.1
Divorced/widowed/separated	116	7.5
Single, never been married	252	42.8
Missing	9	0.7
Regular provider		
Yes	536	42.9
No	376	56.4
Missing	6	0.7
Healthcare coverage		
Private	660	62.3
Public	163	21.2
Other	27	3.0
Missing	68	12.9
Sexual orientation		
Heterosexual or straight	844	93.1
Homosexual, gay or lesbian, bisexual, something else	50	5.0

Table 1 (continued)

Variables	<i>n</i>	Weighted%
Missing	24	1.9
Born in USA		
Yes	789	86.4
No	126	13.2
Missing	3	0.4
Children in household		
Yes	502	47.2
No	394	50.8
Missing	22	1.2
Geographical area		
Urban	872	95.2
Rural	46	4.8

HPV and HPV vaccine outcomes

HPV awareness

Table 2 reports the bivariate analysis of HPV awareness by race/ ethnicity and SEP. Across racial groups, there were no significant differences in HPV awareness. HPV awareness was moderate, ranging from approximately 72.5% to 80%. There were significant differences within each racial group by SEP. Non-Hispanic Whites and Hispanics from high SEP were significantly more likely to be aware of HPV than their low SEP counterparts.

HPV knowledge

Overall, the knowledge that HPV causes cervical cancer was generally high. However, non-Hispanic Whites had significantly higher knowledge that HPV causes cervical cancer compared to non-Hispanic Blacks and Hispanics ($p < 0.001$) (Table 2). Among non-Hispanic Whites, those from high SEP were significantly more likely to know that HPV causes cervical cancer than non-Hispanic Whites from low SEP. Knowledge of other cancers caused by HPV was low across all racial and ethnic groups and SEP, with at least 50% of participants responding 'not sure' to whether HPV causes penile, anal or oral cancers. Non-Hispanic Blacks were more likely to know that HPV causes penile cancer compared to non-Hispanic whites and Hispanics. Also, Hispanics from high SEP were more likely to respond "not sure" that HPV causes anal cancer than Hispanics from lower SEP. Non-Hispanic whites were significantly more likely to know HPV causes an STD ($p < 0.001$). Hispanics from high SEP were also more likely to know that HPV can cause a STD than Hispanics from lower SEP.

Table 2 Weighted Unadjusted Population Estimates for HPV Awareness, Knowledge and Beliefs, by Race/Ethnicity and Socioeconomic Position (SEP)

Variables	Non-Hispanic white			Non-Hispanic black			Hispanic			Weighted <i>p</i> value
	High SEP	Low SEP	Total n (%weighted)	High SEP	Low SEP	Total n (%weighted)	High SEP	Low SEP	Total n (%weighted)	
Ever heard of HPV (<i>n</i> = 873)			*						*	0.28
Yes	390 (86.2)	58 (61.6)	448 (80.0)	56 (71.0)	52 (74.5)	108 (72.5)	99 (69.8)	53 (84.9)	152 (74.3)	
No	44 (13.8)	27 (38.4)	71 (20.0)	14 (29.0)	21 (25.5)	35 (27.5)	30 (30.2)	12 (15.1)	42 (25.7)	
HPV cause cervical cancer (<i>n</i> = 713)			*							<0.001
Yes	357 (92.6)	51 (82.7)	408 (90.6)	46 (80.6)	37 (67.4)	83 (74.9)	80 (74.2)	35 (67.4)	115 (72.0)	
No	3 (0.3)	2 (6.7)	5 (1.6)	0 (0.0)	2 (6.1)	2 (2.6)	1 (5.8)	3 (10.0)	4 (7.1)	
Not sure	27 (7.1)	5 (10.6)	32 (7.8)	9 (19.4)	12 (26.6)	21 (22.5)	17 (20.0)	14 (22.5)	31 (20.8)	
^a HPV cause penile cancer (<i>n</i> = 702)										0.01
Yes	128 (30.8)	22 (34.5)	150 (31.5)	20 (43.5)	12 (24.6)	32 (35.9)	32 (27.9)	12 (22.8)	44 (26.3)	
No	72 (21.0)	9 (15.9)	81 (20.1)	11 (13.9)	7 (12.5)	18 (13.3)	17 (9.9)	12 (20.3)	29 (13.1)	
Not sure	186 (48.2)	25 (49.6)	211 (48.5)	23 (42.6)	31 (63.0)	54 (50.8)	48 (62.2)	24 (57.0)	72 (60.6)	
^a HPV cause anal cancer (<i>n</i> = 700)									*	0.02
Yes	125 (33.7)	17 (29.8)	142 (33.0)	18 (31.5)	10 (17.2)	28 (25.9)	20 (23.3)	11 (19.0)	31 (21.9)	
No	72 (19.1)	12 (18.4)	84 (19.0)	11 (15.3)	7 (12.2)	18 (14.1)	16 (10.1)	14 (26.7)	30 (15.2)	
Not sure	188 (47.3)	27 (51.8)	215 (48.1)	25 (53.2)	32 (70.6)	57 (60.0)	60 (66.7)	24 (54.3)	84 (62.8)	
^a HPV cause oral cancer (<i>n</i> = 701)										0.14
Yes	134 (29.5)	22 (36.5)	156 (30.8)	14 (24.9)	12 (20.9)	26 (23.3)	29 (28.4)	11 (19.1)	40 (25.6)	
No	76 (21.5)	9 (14.1)	85 (20.1)	15 (17.9)	7 (11.9)	22 (15.5)	15 (15.8)	13 (31.3)	28 (20.5)	
Not sure	176 (49.1)	26 (49.4)	202 (49.1)	25 (57.2)	31 (67.2)	56 (61.2)	52 (55.8)	23 (49.6)	75 (53.9)	
^a HPV can cause an STD (<i>n</i> = 714)			*						*	<0.001
Yes	314 (80.3)	40 (68.8)	354 (78.1)	32 (62.8)	29 (47.9)	61 (56.3)	72 (69.8)	35 (64.6)	107 (68.0)	
No	36 (9.7)	8 (16.6)	44 (11.0)	13 (21.0)	11 (32.5)	24 (25.9)	10 (8.9)	10 (23.4)	20 (13.8)	
Not sure	39 (10.0)	9 (14.6)	48 (10.9)	10 (16.2)	10 (19.6)	20 (17.7)	16 (21.3)	8 (11.9)	24 (18.2)	
^a HPV requires medical treatment (<i>n</i> = 706)										0.67
Requires medical treatment	342 (91.8)	51 (91.9)	393 (91.8)	47 (87.3)	45 (91.3)	92 (89.0)	87 (92.1)	48 (90.5)	135 (91.5)	
Will go away on its own	43 (8.2)	5 (8.1)	48 (8.2)	7 (12.7)	6 (8.7)	13 (11.0)	9 (7.9)	4 (9.5)	13 (8.5)	
Ever heard of HPV shot (<i>n</i> = 872)			*							<0.001
Yes	371 (81.6)	54 (55.0)	425 (74.9)	54 (66.0)	49 (70.2)	103 (67.8)	86 (61.9)	38 (48.1)	124 (57.8)	
No	62 (18.4)	31 (45.0)	93 (25.1)	16 (34.0)	24 (29.8)	40 (32.2)	43 (38.1)	27 (51.9)	70 (42.2)	
HPV shot prevents cervical cancer (<i>n</i> = 870)									*	0.15
Pretty successful/very successful	171 (34.2)	24 (27.0)	195 (32.4)	16 (26.5)	21 (33.3)	37 (29.4)	39 (35.1)	15 (20.6)	54 (30.8)	
A little successful/Not at all successful	34 (7.2)	6 (11.6)	40 (8.3)	6 (8.1)	4 (6.2)	10 (7.3)	3 (1.3)	6 (8.5)	9 (3.4)	
Not sure	227 (58.6)	54 (61.4)	281 (59.3)	48 (65.5)	48 (60.5)	96 (63.4)	87 (63.6)	44 (70.9)	131 (65.7)	

Table 2 (continued)

Variables	Non-Hispanic white			Non-Hispanic black			Hispanic			Weighted <i>p</i> value
	High SEP	Low SEP	Total n (%weighted)	High SEP	Low SEP	Total n (%weighted)	High SEP	Low SEP	Total n (%weighted)	
Family between 9 and 27 yo (<i>n</i> = 873)										
Yes	212 (54.6)	43 (48.6)	255 (53.1)	47 (71.4)	45 (68.5)	92 (70.1)	80 (69.0)	51 (85.5)	131 (73.9)	* < 0.001
No	222 (45.4)	42 (51.4)	264 (46.9)	23 (28.6)	28 (31.5)	51 (29.9)	49 (31.0)	14 (14.5)	63 (26.1)	
^b HCP discuss HPV vaccination in the last 12 months (<i>n</i> = 484)										
Yes	82 (32.8)	11 (29.0)	93 (31.9)	20 (40.7)	11 (22.9)	31 (33.6)	28 (33.2)	18 (26.4)	46 (30.9)	0.01
No	108 (53.2)	25 (59.6)	133 (54.7)	19 (29.2)	25 (58.4)	44 (40.9)	44 (58.7)	23 (59.9)	67 (59.1)	
Not sure	20 (14.0)	6 (11.4)	26 (13.4)	8 (30.0)	7 (18.7)	15 (25.5)	7 (8.1)	8 (13.7)	15 (10.0)	
^b HCP recommend HPV shot (<i>n</i> = 485)										
Yes	64 (25.9)	12 (29.4)	76 (26.7)	15 (34.1)	10 (19.8)	25 (28.0)	25 (30.0)	16 (21.6)	41 (27.1)	0.36
No	120 (59.3)	26 (62.4)	146 (60.0)	24 (44.2)	25 (59.4)	49 (50.7)	45 (61.1)	24 (56.6)	69 (59.6)	
Not sure	27 (14.8)	5 (8.2)	32 (13.2)	7 (21.7)	8 (20.8)	15 (21.3)	9 (8.9)	9 (21.8)	18 (13.3)	

Listwise deletion used for missing data

Weighted *p* value comparing low SEP vs. high SEP within each racial ethnic group^aquestion asked only to participants who responded yes to ever hearing about HPV^bquestion asked only to participants who responded yes to having family member between 9 and 27 years old* = *p* ≤ 0.05

HPV vaccine awareness and beliefs

HPV vaccine awareness was significantly higher among non-Hispanic Whites compared to non-Hispanic Blacks and Hispanics ($p < 0.001$) and was significantly higher among non-Hispanic Whites from high SEP compared to non-Hispanic Whites from low SEP (Table 2). Regardless of race and ethnicity, most participants were not sure if HPV vaccination prevented cervical cancer (59.3%–65.7%). Among those who reported having a family member between the ages of 9 and 27, receiving a healthcare provider HPV vaccine recommendation was low across all racial groups. Significant differences in healthcare providers discussing HPV vaccination were also observed ($p = 0.01$). Non-Hispanic Blacks from high SEP more likely to have a discussion than Non-Hispanic Blacks from low SEP.

Table 3 reports HPV variables that were statistically significant in multivariate logistic regression analysis. Hispanics (OR = 0.29, 95% CI = [0.16–0.52, $p < 0.001$]) had lower odds of knowing that HPV causes cervical cancer compared to non-Hispanic Whites. High SEP Hispanics (OR = 0.20, 95% CI = [0.09–0.42, $p < 0.0001$]) also had lower odds of knowing HPV causes cervical cancer than high SEP non-Hispanic Whites. High SEP non-Hispanic Blacks also had lower odds of knowing HPV causes cervical cancer compared to high SEP non-Hispanic Whites

(OR = 0.31, 95% CI = [0.11–0.88, $p = 0.03$]). Non-Hispanic Blacks (OR = 0.42, 95% CI = [0.24–0.73, $p = 0.002$]) and Hispanics (OR = 0.49, 95% CI = [0.31–0.79, $p = 0.003$]) had lower odds of knowing HPV causes a STD. High SEP non-Hispanic Blacks (OR = 0.34, 95% CI = [0.17–0.70, $p = 0.003$]) and Hispanics (OR = 0.54, 95% CI = [0.31–0.95, $p = 0.03$]), and low SEP non-Hispanic Blacks (OR = 0.30, 95% CI = [0.09–0.95, $p = 0.04$]) and Hispanics (OR = 0.15, 95% CI = [0.04–0.54, $p = 0.003$]) had lower odds of knowing HPV was a STD compared to non-Hispanic Whites from both high and low SEP. Hispanics (OR = 0.40, 95% CI = [0.25–0.62, $p < 0.001$]) had lower odds of being aware of the HPV vaccine compared to non-Hispanic Whites. Non-Hispanic Blacks (OR = 0.36, 95% CI = 0.18–0.73, $p = 0.005$) and Hispanics (OR = 0.30, 95% CI = 0.17–0.53, $p < 0.001$) from high SEP had lower odds of ever hearing about the HPV vaccine compared to non-Hispanic Whites from high SEP. However, non-Hispanic Blacks (OR = 11.03, 95% CI = [3.05–39.86, $p < 0.001$]) from lower SEP had 11 times the odds of ever hearing about the HPV vaccine compared to non-Hispanic Whites from low SEP. This difference in odds ratios between non-Hispanic Blacks and non-Hispanic Whites from high and low SEP was statistically significant ($p = 0.01$).

Table 3 Weighted, Fully Adjusted Multivariate Logistic Regression Models Predicting HPV Awareness, Knowledge and Beliefs, by Race/Ethnicity and Socioeconomic Position

	Non-Hispanic white	Non-Hispanic black		Hispanic	
		OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
HPV causes cervical cancer (<i>n</i> = 624)	Reference category				
Overall		0.53 (0.26–1.08)	0.08	0.29 (0.16–0.52)	< .0001
High SEP		0.31 (0.11–0.88)	0.03	0.20 (0.09–0.42)	< .0001
Low SEP		2.40 (0.61–9.46)	0.21	0.40 (0.10–1.62)	0.20
Interaction			0.51		0.62
HPV can causes an STD (<i>n</i> = 624)					
Overall		0.42 (0.24–0.73)	0.002	0.49 (0.31–0.79)	0.003
High SEP		0.34 (0.17–0.70)	0.003	0.54 (0.31–0.95)	0.03
Low SEP		0.30 (0.09–0.95)	0.04	0.15 (0.04–0.54)	0.003
Interaction			0.61		0.93
Ever heard of HPV shot (<i>n</i> = 759)					
Overall		0.79 (0.46–1.38)	0.41	0.40 (0.25–0.62)	< .0001
High SEP		0.36 (0.18–0.73)	0.005	0.30 (0.17–0.53)	< .0001
Low SEP		11.03 (3.05–39.86)	0.0003	0.75 (0.24–2.37)	0.62
Interaction			0.01		0.76

Reference category is non-Hispanic whites

Logistic regression models controlled for the following demographic covariates (gender, age, education, household income, employment, marital status, geographical area, having a regular healthcare provider, type of health coverage, sexual orientation, born in the U.S., and having children in the household)

Listwise deletion used for missing data

Table 4 Weighted Multivariate Analysis of Trust in Health/Medical Information from Varied Sources

	Non-Hispanic white	Non-Hispanic black		Hispanic	
		OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Trust radio (<i>n</i> = 759)	Reference category				
Overall		1.03 (0.60–1.77)	0.92	1.10 (0.70–1.71)	0.69
High SEP		0.90 (0.46–1.76)	0.76	0.85 (0.50–1.46)	0.55
Low SEP		0.60 (0.15–2.35)	0.47	2.69 (0.88–8.25)	0.08
Interaction			0.97		0.25
Trust television (<i>n</i> = 759)					
Overall		2.39 (1.52–3.78)	0.0002	1.80 (1.22–2.67)	0.003
High SEP		1.45 (0.81–2.61)	0.21	1.38 (0.86–2.23)	0.18
Low SEP		15.55 (4.89–49.50)	<.0001	5.15 (1.75–15.18)	0.003
Interaction			0.01		0.34
Trust charities (<i>n</i> = 759)					
Overall		0.52 (0.33–0.83)	0.01	1.18 (0.80–1.73)	0.41
High SEP		0.44 (0.25–0.79)	0.01	0.91 (0.57–1.46)	0.70
Low SEP		0.61 (0.21–1.81)	0.37	2.52 (0.96–6.66)	0.06
Interaction			0.16		0.14
Trust religious organizations (<i>n</i> = 759)					
Overall		1.47 (0.90–2.38)	0.12	1.08 (0.70–1.65)	0.73
High SEP		1.07 (0.58–1.98)	0.83	0.69 (0.41–1.17)	0.17
Low SEP		5.76 (2.02–16.44)	0.001	4.37 (1.54–12.39)	0.01
Interaction			0.01		0.01

Reference category is non-Hispanic whites

Logistic regression models controlled for the following demographic covariates (gender, age, education, household income, employment, marital status, geographical area, having a regular healthcare provider, type of health coverage, sexual orientation, born in the U.S., and having children in the household)

Listwise deletion used for missing data

Trust sources for health/medical information

Trusted sources of information were examined to identify potential avenues for interventions (Table 4). In multivariate logistic regression (Table 4), non-Hispanic Blacks had more than twice the odds (OR = 2.39, 95% CI = [1.52–3.78, $p < 0.001$]) and Hispanics had 1.8 times the odds (OR = 1.80, 95% CI = 1.22–2.67, $p = 0.003$) of trusting health/medical information from the television compared to non-Hispanic Whites. Within the low SEP group, non-Hispanic Blacks had almost 16 times the odds of trusting health/medical information from the television compared to non-Hispanic Whites (OR = 15.55, 95% CI = [4.89–49.50, $p < 0.001$]). This difference in odd ratios between non-Hispanic Blacks and non-Hispanic Whites from high and low SEP was statistically significant ($p = 0.01$). Likewise, Hispanics within the low SEP group had 5 times the odds of trusting health/medical information from television than non-Hispanics Whites within the low SEP group (OR = 5.15, 95% CI = [1.75–15.18, $p = 0.003$]). Non-Hispanic Blacks had significantly lower odds of trusting health information from charities compared to non-Hispanic whites (OR = 0.52, 95%

CI = [0.33–0.83, $p = 0.01$]). Within the high SEP groups, Non-Hispanic Blacks had lower odds of trusting health information from charities compared to non-Hispanic Whites (OR = 0.44, 95% CI = [0.25–0.79, $p = 0.01$]). Although not significant, Non-Hispanic Blacks had higher odds of trusting religious organizations (OR = 1.47, 95% CI = [0.90–2.38, $p = 0.12$]) compared to non-Hispanic Whites. Being in the low SEP group significantly increased those odds by almost 4-folds (OR = 5.76, 95% CI = [2.02–16.44, $p = 0.001$]). Lastly, Hispanics in the low SEP group had increased odds in trusting religious organizations than non-Hispanic Whites with low SEP (OR = 4.37, 95% CI = [1.54–12.39, $p = 0.01$]). There were no other significant differences among racial/ethnic groups for other trusted information sources.

Discussion

The purpose of this study was to examine differences in HPV and HPV vaccine awareness, knowledge, and beliefs by race and ethnicity, and SEP. We also describe communication preferences for health/medical information among

non-Hispanic Black, non-Hispanic White, and Hispanic adults aged 18–49. This study shows that across racial and ethnic groups, HPV knowledge gaps were present and varied by SEP. We also identified differences in HPV vaccination knowledge and trust in information sources among non-Hispanic Blacks and Hispanics compared to non-Hispanic Whites based on SEP.

Our study found racial and ethnic, and SEP differences in cervical cancer knowledge. Non-Hispanic Whites were statistically more likely to have higher cervical cancer knowledge compared to non-Hispanic Blacks and Hispanics. Lower knowledge of cervical cancer was also found among high SEP non-Hispanic Blacks and Hispanics compared to high SEP non-Hispanic Whites. Our findings are consistent with previous studies examining HPV knowledge and beliefs among racial and ethnically diverse adults in the U.S. [14, 23]. These findings are interesting given that those from higher SEPs usually have greater access to and engagement with health information than those from lower SEP [24, 25]. This trend is particularly evident for cervical cancer, where SEP, race, and region are indicators for cervical cancer outcomes. Black and Hispanic women and women from low SEP experience greater barriers to accessing and engaging with health information [25]. They also experience disproportionately higher cervical cancer incidence and mortality rates due to inequitable access and underutilization of health services for cervical cancer screening and early diagnosis [24, 26–28]. Our finding that despite being from a higher SEP, non-Hispanic Blacks and Hispanics still experience lower knowledge of cervical cancer than high SEP non-Hispanic Whites shows that cervical cancer information may not be disseminated in channels that are utilized by or accessible to high SEP non-Hispanic Blacks and Hispanics. Greater focus may be needed to identify effective strategies for communicating the link between HPV and cervical cancer and cervical cancer risk to non-Hispanic Black and Hispanic women from both low and high SEP. Considering that cervical cancer is one of the few preventable cancers through HPV vaccination and early detection of precursor lesions, interventions should make this linkage explicit to capitalize on these preventive opportunities.

Our study also found much uncertainty surrounding the role of HPV in causing oral, anal, and penile cancers across racial and ethnic groups. This uncertainty and lack of knowledge was also found in a recent publication by Osazuwa-Peters [29]. Oropharyngeal cancer has surpassed cervical cancer as the most common HPV-associated cancer [30]. The incidence of late-stage head and neck cancers increased in male patients, with Black patients experiencing the worst outcomes [31, 32]. Similarly, the rate of anal cancer has also increased in both men and women. This increase in oral and anal cancer rates among men and women is related

to increases in high-risk sexual behaviors associated with exposure to HPV among men and women, such as condomless sex, anal sex, multiple sexual partners [33, 34]. Recent data indicates that the prevalence of anal sex among heterosexuals has increased, coinciding with an increase in the incidence rates of anal cancers in women over the last several decades [35] [36, 37]. Our findings of high rates of uncertainty about HPV causing oral, anal, and penile cancers underscores the need to address uncertainty and lack of knowledge for other HPV-associated cancers among heterosexuals and sexual and gender minorities.

Significant differences in knowing that HPV causes a STD were observed among non-Hispanic Blacks and Hispanics from high and low SEP compared to their non-Hispanic White counterparts. Risk factors for HPV infection include having multiple sexual partners, condomless sex, and promiscuous sexual behaviors [38]. Young adults between the ages of 18 and 24 are at the highest risk of exposure to HPV infection due to increased engagement in these high-risk sexual behaviors [39], as evident by 18–24 year-olds acquiring half of all the 20 million new STIs each year [40, 41]. Educational interventions that emphasize the sexually transmitted nature of HPV and HPV-associated cancer risks for non-Hispanic Blacks and Hispanics may further HPV cancer prevention efforts.

This study found that high SEP Hispanics and non-Hispanic Blacks were less likely to have heard of the HPV vaccine than non-Hispanic Whites. On the other hand, low SEP non-Hispanic Blacks had 11 times the odds of hearing about the HPV vaccine compared to low SEP non-Hispanic Whites. These differences could result from the federal government's funding through the Vaccine for Children Program, which increased access to HPV vaccination among low SEP groups and increased opportunities to receive an HPV vaccination recommendation from a healthcare provider. The literature documents that Hispanics and non-Hispanic Blacks are more likely to accept the HPV vaccine when recommended by a healthcare provider compared to non-Hispanic Whites. Missed healthcare providers' opportunities to recommend HPV vaccination to high SEP Hispanics and non-Hispanic Blacks within the 'catch-up' may contribute to low awareness of HPV vaccination [42, 43]. Studies that examine how to strengthen healthcare providers' HPV vaccination recommendations among vaccine-eligible adults may be needed to encourage adherence to the HPV vaccination recommended guidelines.

Finally, non-Hispanic Blacks and Hispanics had higher for several information sources than non-Hispanic Whites, such as television and religious organizations. Trust in television was almost 16 times and five times higher among low SEP non-Hispanic Blacks and Hispanics compared to low SEP non-Hispanic Whites. Trust in religious organizations

was nearly six times higher and four times higher among low SEP non-Hispanic Blacks and Hispanics than low SEP non-Hispanic whites. These findings are consistent with a recent analysis of trusted health information sources among racial and ethnic minorities over 11 years [44]. Although healthcare providers play an essential role in promoting HPV vaccination, incorporating other communal modes to disseminate accurate HPV information to the non-Hispanic Black and Hispanic community is necessary for accessing these populations at risk for HPV infection and HPV-related cancers [45–48].

Limitations

The findings in this study should be interpreted with some considerations. First, this descriptive study examined knowledge levels across racial and ethnic groups and SEP using cross-sectional data and did not draw any causal inferences. Secondly, the HINTS survey relies on self-reported data, which is vulnerable to bias. However, the sample included in this survey were diverse racially and ethnically, and socioeconomically, giving insight into the knowledge and beliefs about HPV and HPV vaccination for this vaccine-eligible population.

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Declarations

Conflict of interest The authors declare they have no conflict of interest.

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