



## Human papillomavirus awareness among foreign- and US-born Hispanics, United States, 2017–2018

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### ABSTRACT

**Introduction:** Human papillomavirus (HPV) and HPV vaccine knowledge and awareness are known to be lower among Hispanics compared to non-Hispanic whites. However, Hispanics in the US are a non-homogenous population, with significant differences by nativity, particularly between the US-and foreign-born individuals. We examined HPV and HPV vaccine awareness among foreign-born Hispanics, US-born Hispanics, and US-born non-Hispanic whites.

**Methods:** We analyzed data from the Health Information National Trends Survey (HINTS) 5, cycles 1 (2017) and 2 (2018), the most recent HINTS datasets including nativity information. We used descriptive statistics and multivariable regression to compare awareness of HPV and the HPV vaccine among ethnicity/nativity subgroups. **Results:** Over 50% of foreign-born Hispanics had not heard of HPV, compared to 32% of US-born Hispanics ( $P < 0.01$ ) and 33% of non-Hispanic whites ( $p < 0.01$ ). Lack of HPV vaccine awareness among foreign-born Hispanics was not significantly different from US-born Hispanics (52% vs. 44%,  $p = 0.12$ ), but was significantly lower compared to non-Hispanic whites (52% vs. 32%,  $p < 0.01$ ). In multivariable analyses, non-Hispanic whites had over twice the odds of having heard of HPV than foreign-born Hispanics ( $p < 0.05$ ), while US-born Hispanics had 75% higher odds ( $p < 0.05$ ). Regarding HPV awareness, non-Hispanic whites had 95% higher odds of having heard of the HPV vaccine than foreign-born Hispanics ( $p < 0.05$ ), while differences between US and foreign-born Hispanics were not significant.

**Conclusion:** There are significant nativity-related differences in HPV and HPV vaccine awareness and knowledge among US-born Hispanics. Over 50% of foreign-born Hispanic adults are unaware of HPV and the HPV vaccine.

### 1. Introduction

Each year in the US, over 34,000 new human papillomavirus (HPV) infection-associated cancer cases are diagnosed, including cervical, anal, oropharyngeal, vaginal, vulvar, and penile cancers (Deshmukh et al., 2019). While the overall cancer incidence and mortality has decreased in the US over the last several decades, the incidence and mortality of two HPV-associated cancers— anal and oropharyngeal cancer—is rising rapidly ( $>3\%/year$ ) (Berman and Schiller, 2017). The burden of cervical cancer also remains high, particularly among racial/ethnic minority women (CDC, 2017). The Advisory Committee on Immunization

Practices (ACIP) first recommended the HPV vaccine in 2006 (Meites et al., 2019). This vaccine prevents HPV infections occurring at oral and anogenital sites, HPV-induced pre-cancers, as well as anogenital warts (CDC, 2019). It is currently recommended as a routine vaccine for males and females ages 11–12 years, with catch-up vaccination through age 26. Shared decision-making between patients and providers is recommended for adults, ages 27–45 years (Meites et al., 2019). Despite its effectiveness and recommendation for over ten years as a routine adolescent vaccine, the uptake of the HPV vaccine in the US remains sub-optimal (Walker et al., 2019).

Hispanics are the largest growing racial/ethnic minority in the US

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(Flores, 2020). They are a population with a disproportionate burden of certain HPV-associated cancers. Hispanic women have a significantly higher incidence of cervical cancer compared to non-Hispanic white women (8.9 vs. 7.3 per 100,000), and higher cervical cancer mortality (2.6 vs. 2.1 per 100,000) (CDC, 2017). Overall, the annual number of cervical cancer cases diagnosed in the US has not changed in recent years (2001–2017), while the number of new diagnoses among Hispanic women continues to rise (Deshmukh et al., 2020). Among men, the incidence of penile cancer is significantly higher among Hispanics than non-Hispanic whites (1.3 vs. 0.8 per 100,000) (CDC, 2019). Research has consistently documented lower rates of participation in cancer screening among Hispanic adults, including lower usage of Pap tests for cervical cancer screening among Hispanic women (ACS 2018). Regarding the HPV vaccine, Hispanic adults ages 18–26 years (both overall and women in particular) are less likely than their non-Hispanic white counterparts to have received one or more doses of the HPV vaccine (Boersma and Black, 2020).

According to health promotion theories, awareness and knowledge of HPV and the HPV vaccine contribute to the adoption and maintenance of HPV prevention behaviors (Janz and Becker, 1984), including vaccination and screening. HPV and HPV vaccine awareness and knowledge are generally lower in the Hispanic population compared to non-Hispanic whites (Otaney and Torr, 2017; Suk et al., 2019). Estimates from the nationally-representative Health Information National Trends Survey (HINTS) indicate an 8–9% absolute difference in the proportion of Hispanic females and males who have heard of HPV compared to their non-Hispanic white counterparts (McBride and Singh, 2018). Even wider absolute differences (16% and 19% among females and males, respectively) were reported regarding awareness of the HPV vaccine.

Despite the standard categorization of Hispanics as a single group, the Hispanic population is non-homogenous. Significant heterogeneity exists in terms of the nativity, particularly between the US and foreign-born Hispanics. The total foreign-born population in the US (approximately 60.7 million individuals) currently represents 13.7% of the overall US population; among the foreign-born, 33% identify themselves as Hispanic (Flores, 2020; Radford and Noe-Bustamante, 2020; U.S. Census Bureau QuickFacts: United States, 2020). Significant nativity-related differences have been reported regarding HPV risk behaviors and cervical cancer screening and disease burden (Montealegre et al., 2013a, 2013b; Tsui et al., 2007). Likewise, nativity differences are likely to exist related to knowledge of HPV and the HPV vaccine (Holman et al., 2014; Luque et al., 2010; Kobetz et al., 2010; Fernández et al., 2010; Morales-Campos and Vanderpool, 2017). Herein, we utilize data from the nationally-representative Health Information National Trends Survey (HINTS) to examine HPV and HPV vaccine awareness and knowledge among foreign-born Hispanics, US-born Hispanics, and US-born non-Hispanic whites.

## 2. Methods

### 2.1. Data source

We analyzed data from the Health Information National Trends Survey (HINTS) 5, cycles 1 (2017) and 2 (2018). HINTS is a nationally representative survey of non-institutionalized US adults aged 18 years and older. The survey is conducted biennially by the National Cancer Institute to collect and monitor data on health-related behaviors, knowledge, and attitudes in the US adult population (NCI, 2019). HINTS-5, cycles 1 and 2 are the most recent cycles that include nativity information for participants (i.e., place of birth and number of years in the US). Cycle 1 was conducted between January–May 2017 (response rate = 32.4%) and cycle 2 was conducted between January–May 2018 (response rate = 32.9%). A detailed description of the survey methodology and the questionnaire are available elsewhere (Finney Rutten et al., 2012). Briefly, the psychometrically-validated HINTS survey

questionnaires are administered by trained interviewers to a random digit dial sample of US telephone exchanges. Minorities are over-sampled. The publicly available survey data are weighted to account for the sampling procedure and non-response (NCI, 2019). The HINTS-5 survey was granted exempted status by the Internal Review Board (IRB) of the NCI's Office of Human Subjects Research and by the IRB of the organization that administers the survey, Westat. The current analysis was exempted from review by the IRB of Baylor College of Medicine.

### 2.2. Ethnicity and country of birth

Data on ethnicity and country of birth are available in the HINTS demographic data file. Race and Hispanic ethnicity (Hispanic vs. non-Hispanic) were assessed according to the Office of Management and Budget standards (OMB, 2020). Among those identifying as Hispanic, the Hispanic origin was categorized as Mexican, Puerto Rican, Cuban, or Other Hispanic. Nativity was based on the HINTS 5 question, "Were you born in the United States?" Those who responded "Yes," were identified as US-born; those who replied "No" were identified as foreign-born. The study's final analytic sample included non-US born Hispanics, US-born Hispanics, and US-born non-Hispanic Whites. Participants of other races/ethnicities were excluded.

### 2.3. Sociodemographic variables

Age, gender, educational status, annual household income, and sexual orientation were also identified from the demographic file. Respondents born outside of the US were asked, "In what year did you come to live in the United States?" The number of years living in the US was calculated as of survey participation year. English fluency was assessed with the question, "How well do you speak English?" Responses were dichotomized as "Well/Very Well" and "Not well/Not at all." Participants were asked, "Including yourself, is anyone in your immediate family between the ages of 9 and 27 years old?" Those who answered "Yes" were considered to have a family member (including themselves) who was age-eligible for the HPV vaccine.

### 2.4. HPV and HPV vaccine awareness

Awareness of HPV and the HPV vaccine were respectively assessed using the questions, "Have you heard of HPV?" and "Have you ever heard of the cervical cancer vaccine or HPV shot?" Responses to these questions were "Yes" or "No." Participants who responded that they had heard of HPV were asked a series of questions regarding the causal link between HPV and specific HPV-associated cancers, specifically, "Do you think HPV can cause cervical/oral/ anal/penile cancer?" Responses were "Yes," "No," or "Not sure."

### 2.5. HPV-vaccine eligibility and recommendation by doctor

Participants who had a family member (including themselves) who was age-eligible for the HPV vaccine (i.e., age 9–27 years) were asked, "In the last 12 months, has a doctor or health care professional recommended that you or someone in your immediate family get an HPV shot or vaccine?" ("Yes," "No," and "I don't know"). Those who answered "Yes" were considered to have received a provider recommendation for the HPV vaccine.

### 2.6. Statistical analysis

Weighted proportions and chi-square tests were used to summarize the data on HPV and HPV vaccine awareness, and HPV vaccine recommendation by a provider across ethnicity/nativity subgroups. We used the Rao-Scott chi-square test, which adjusts for the complex survey design and weighting, to compare differences across groups.

Multivariable logistic regression models were used to examine the association between Hispanic ethnicity/nativity and two outcomes—heard of HPV and the HPV vaccine. Foreign-born Hispanics were specified as the referent group. The models were simultaneously adjusted for sociodemographic factors, including sex, education, age, income, and having family between 9 and 27 years, based on differences in baseline characteristics and prior literature. English language proficiency was not included as a covariate in the model as a test for collinearity indicated that it was highly correlated with Hispanic ethnicity/nativity in the dataset ( $p < 0.001$ ).

Additionally, we considered that its inclusion might over-control for a variable that is commonly considered endogenous (Elwert and Winship, 2014) to the Hispanic foreign-born population. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) are reported. Data analyses were conducted using SAS 9.4 software (SAS Institute Cary, NC). We followed the analytical guidelines published by HINTS (2020) for combining the two HINTS cycles and recalculating survey weights. Statistical significance was assessed at  $p < 0.05$ .

### 3. Results

Of the 4,523 respondents included in the analyses, 80.7% were non-Hispanic white, and 19.3% were Hispanic. Among Hispanics, 61.9% were US-born, and 38.1% were foreign-born. Table 1 describes participant sociodemographic characteristics by Hispanic ethnicity and nativity status. Age, educational attainment, household income, the proportion of vaccine-eligible family members, and English proficiency were significantly different across subgroups.

Awareness of HPV and the HPV vaccine by subgroups are reported in Fig. 1. A higher proportion of foreign-born Hispanics (51.4%) had reportedly never heard of HPV compared to US-born Hispanics (32.4%;  $p < 0.001$ ) and non-Hispanic whites (32.6%,  $p < 0.001$ ). A significantly higher proportion of foreign-born Hispanics (52.3%) had not heard of the HPV vaccine compared to non-Hispanic whites (32.0%,  $p < 0.001$ ). The difference in HPV vaccine awareness among foreign- and US-born Hispanics (44.3%) was not statistically significant ( $p = 0.125$ ) among those who had heard of HPV. Over 75% of participants across the three subgroups identified that HPV can cause cervical cancer. However, there was generally low knowledge of the causal link between HPV and HPV-associated cancers. Across the three subgroups,  $\leq 36\%$  of participants identified that HPV can cause penile or anal cancer, with no statistically significant differences between subgroups. A significantly higher proportion of foreign- versus US-born Hispanics knew that HPV could cause oral cancer (39.0% versus 23.6%,  $p = 0.030$ ). Among those who reported having an immediate family member in their household (including themselves) who were age-eligible for the HPV vaccine, just over 20% in all three groups reported having received a health care provider's recommendation for the HPV vaccine. Receipt of a provider recommendation was not significantly different across subgroups.

In the multivariable analyses (Table 2), foreign-born Hispanics had significantly lower odds of having heard of HPV compared to US-born Hispanics and non-Hispanic whites. Non-Hispanic whites had over twice the odds of having heard of HPV compared to foreign-born Hispanics [AOR = 2.30 (95% CI 1.47–3.58)], while US-born Hispanics had 75% higher odds. Other factors significantly associated with higher odds of having heard of HPV were being female, having some college education or higher, and having an income of \$75,000 +. Older age (65 + years) was significantly associated with lower odds of having heard of HPV. Regarding HPV awareness, there were significant differences between foreign-born Hispanics and non-Hispanic whites, but no significant differences between foreign- and US-born Hispanics. Compared to foreign-born Hispanics, non-Hispanic whites had 95% higher odds of having heard of the HPV vaccine [AOR = 1.95 (95% CI 1.19–3.21)]. Other factors significantly associated with higher odds having heard of the HPV vaccine were being female, having some college education or higher, having an income between \$35,000–\$49,000 or \$75,000+, and

**Table 1**  
Demographic characteristics of survey respondents by Hispanic ethnicity and nativity, Health Information National Trends Survey (HINTS)-5, n = 4,523.

	Foreign-born Hispanic (n = 332)	US-born Hispanic (n = 540)	US-born non-Hispanic white (n = 3651)	X <sup>2</sup> p-value, foreign- vs. US-born Hispanic	X <sup>2</sup> p-value, foreign-born Hispanic vs. non-Hispanic white
<b>Age, years</b>				<b>&lt;0.001</b>	<b>&lt;0.001</b>
18–34	41 (18.73)	117 (36.22)	402 (21.64)		
35–49	87 (38.30)	157 (34.48)	626 (25.25)		
50–64	118 (32.91)	141 (20.22)	1225 (31.21)		
65–74	57 (7.64)	74 (5.17)	841 (12.96)		
75+	24 (2.42)	44 (3.91)	519 (8.94)		
<b>Family ages 9–27 years</b>				0.724	<b>&lt;0.001</b>
Yes	185 (68.75)	283 (67.17)	1186 (45.37)		
No	147 (31.25)	257 (32.83)	2457 (54.63)		
<b>Gender</b>				0.630	0.502
Male	147 (52.01)	208 (49.10)	1547 (49.30)		
Female	181 (47.99)	330 (50.90)	2063 (50.70)		
<b>Education</b>				<b>&lt;0.001</b>	<b>&lt;0.001</b>
Less than HS	94 (31.21)	52 (7.76)	129 (5.34)		
HS graduate or equivalent	69 (28.83)	118 (26.90)	641 (20.73)		
Some college	66 (16.72)	182 (34.48)	1099 (41.66)		
College graduate or post graduate	99 (23.24)	185 (30.87)	1765 (32.27)		
<b>Household income</b>				<b>0.002</b>	<b>&lt;0.001</b>
< \$20,000	84 (19.34)	110 (17.45)	419 (13.74)		
\$20,000–\$34,999	62 (17.66)	68 (11.57)	421 (11.33)		
\$35,000–\$49,999	52 (27.47)	58 (12.51)	403 (12.96)		
\$50,000–\$74,999	42 (13.51)	90 (21.94)	655 (19.14)		
\$75,000+	69 (22.02)	163 (36.53)	1433 (42.82)		
<b>Years in the US</b>				—	—
0–5	15 (3.78)	—	—		
6–10	9 (3.65)	—	—		
10+	281 (92.57)	—	—		
<b>Speak English</b>				<b>&lt;0.001</b>	<b>&lt;0.001</b>
Well or Very Well	244 (75.81)	518 (97.99)	3593 (99.65)		
Not well or Not at all	88 (24.19)	15 (2.01)	6 (0.35)		
<b>Hispanic Origin</b>				<b>0.035</b>	—
Mexican	137 (49.11)	267 (48.78)	—		
Puerto Rican	29 (5.16)	63 (11.26)	—		
Cuban	29 (6.21)	18 (2.96)	—		
Other Hispanic	137 (39.52)	192 (36.99)	—		
<b>Race</b>				<b>0.024</b>	—

(continued on next page)

Table 1 (continued)

	Foreign-born Hispanic (n = 332)	US-born Hispanic (n = 540)	US-born non-Hispanic white (n = 3651)	χ <sup>2</sup> p-value, foreign-born vs. US-born Hispanic	χ <sup>2</sup> p-value, foreign-born Hispanic vs. non-Hispanic white
White	201 (76.78)	332 (79.39)	3651 (100.00)		
Black	10 (5.59)	22 (2.06)	—		
American Indian	12 (5.74)	38 (8.98)	—		
Asian Pacific Islander	6 (1.71)	12 (3.28)	—		
Sexual Orientation				0.150	0.284
Heterosexual, straight	299 (97.65)	487 (93.65)	3447 (94.81)		
Homosexual, gay, lesbian	4 (1.17)	15 (3.31)	90 (2.54)		
Bisexual	3 (0.80)	7 (1.86)	51 (1.72)		
Other	3 (0.39)	11 (1.18)	19 (0.93)		

Note: Adjusted p-values are based on the Rao-Scott Chi-Square test.  
 Note: Boldface indicates significance  $p < 0.05$ .

having a family member (including themselves) age 9–27 years. Individuals in the top age bracket had significantly lower odds of having heard of the HPV vaccine.

4. Discussion

In this analysis of nationally representative HINTS data, we found significant differences in HPV awareness and knowledge between foreign- and US-born Hispanics, as well as significant differences in both HPV and HPV vaccine awareness between foreign-born Hispanics and

non-Hispanic whites. In regard to HPV awareness, over half of foreign-born Hispanics had not heard of HPV, compared to a third or less of US-born Hispanics and non-Hispanic whites. Similarly, over half of foreign-born Hispanics had not heard of the HPV vaccine, compared to about a third of non-Hispanic whites.

The foreign-born Hispanic population in the US is generally younger, less educated, and lower-income than the general US population (Flores, 2020), a demographic profile mirrored in the HINTS sample. However, our data suggest that the lower levels of HPV and HPV vaccine awareness among foreign-born Hispanics are independent of these socio-demographic differences. After controlling for age, education, household income, and having a family member (or being themselves) of HPV vaccine-eligible age, foreign-born Hispanics had about half the odds of having heard of HPV compared to non-Hispanic whites and significantly lower odds compared to US-born Hispanics. The odds of having heard of the HPV vaccine were also lower among foreign-born Hispanics compared to non-Hispanic whites, but not compared to US-born Hispanics. This may reflect lower health literacy among the foreign-born population (Calvo, 2016), as well as language barriers (Becerra et al., 2017) that may make public health messaging about the HPV vaccine less accessible (Lee et al., 2017). Furthermore, healthcare access is significantly lower among the foreign-born population (Avila and Bramlett, 2012; Montealegre and Selwyn, 2014), which may preclude or reduce the opportunities for health education by a healthcare provider.

Overall, the majority (over three-quarters) of individuals who had heard of HPV identified that HPV could cause cervical cancer. However, a markedly smaller proportion ( $\leq 39\%$ ) was aware of the association between HPV and other HPV-associated cancers. The low levels of knowledge regarding penile, anal, and oral cancer among US adults have recently been reported elsewhere (Suk et al., 2019), suggesting that HPV prevention campaigns have focused heavily on cervical cancer prevention in women, but less so on preventing other HPV-associated cancers in women and men. With the dramatically increasing incidence rates of HPV-associated oropharyngeal cancer (which increased by over 2% per

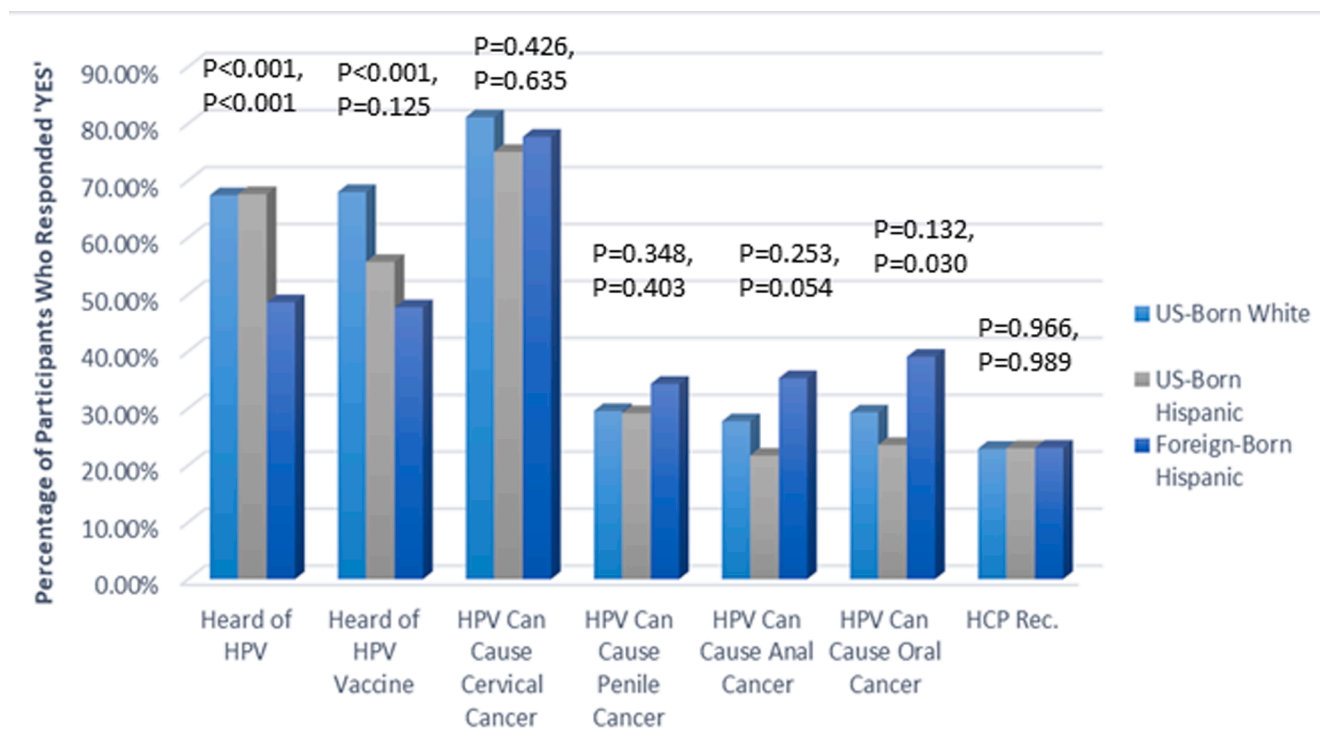


Fig. 1. Weighted, unadjusted estimates of HPV and HPV vaccine awareness and knowledge among survey respondents, by Hispanic ethnicity and nativity, Health Information National Trends Survey (HINTS)-5, n = 4,523.

**Table 2**

Weighted logistic regression models describing the multivariable association between Hispanic ethnicity/nativity and awareness of HPV (Model 1) and the HPV vaccine (Model 2), Health Information National Trends Survey (HINTS)-5, n = 4,523.

	Model 1 Heard of HPV (AOR, 95% CI)	Model 2 Heard of HPV Vaccine (AOR, 95% CI)
<b>Ethnicity/Nativity</b>		
Foreign-born-Hispanic	1.00	1.00
US-born Hispanic	<b>1.75 (1.01 – 3.04)</b>	0.90 (0.51 – 1.57)
non-Hispanic white	<b>2.30 (1.47 – 3.58)</b>	<b>1.95 (1.19 – 3.21)</b>
<b>Age, years</b>		
18–34	1.00	1.00
35–49	1.25 (0.74 – 2.10)	1.18 (0.74 – 1.89)
50–64	0.64 (0.38 – 1.06)	0.80 (0.48 – 1.32)
65–74	<b>0.40 (0.24 – 0.66)</b>	0.66 (0.40 – 1.10)
75+	<b>0.20 (0.11 – 0.35)</b>	<b>0.27 (0.15 – 0.48)</b>
<b>Gender</b>		
Male	1.00	1.00
Female	<b>3.18 (2.51 – 4.02)</b>	<b>4.53 (3.48 – 5.88)</b>
<b>Education</b>		
Less than HS	1.00	1.00
HS graduate or equivalent	1.39 (0.73 – 2.64)	1.61 (0.82 – 3.14)
Some college	<b>2.58 (1.33 – 5.02)</b>	<b>3.77 (2.04 – 6.96)</b>
College graduate or post graduate	<b>5.05 (2.66 – 9.58)</b>	<b>5.24 (2.83 – 9.69)</b>
<b>Household Income</b>		
< \$20,000	1.00	1.00
\$20,000–\$34,999	1.08 (0.69 – 1.68)	1.07 (0.65 – 1.76)
\$35,000–\$49,999	1.48 (0.93 – 2.36)	<b>1.89 (1.16 – 3.09)</b>
\$50,000–\$74,999	1.34 (0.80 – 2.24)	1.66 (0.94 – 2.93)
\$75,000+	<b>1.58 (1.03 – 2.42)</b>	<b>2.45 (1.55 – 3.87)</b>
<b>Family member age 9–27 years</b>		
No	1.00	1.00
Yes	1.18 (0.86 – 1.63)	<b>1.48 (1.07 – 2.04)</b>

Note: Table values represent adjusted odds ratios (AOR) with 95% confidence intervals (CI); models are adjusted for all variables in the table.

Note: Boldface indicates significance  $p < 0.05$ .

year between 2007 and 2016) (Ellington et al., 2020) and anal cancer (which increased by nearly three percent per year between 2001 and 2015) (Deshmukh et al., 2019) there may be a need to expand messaging about HPV and the HPV in relation to other HPV-associated cancers.

Interestingly, in our study, foreign-born Hispanics had a higher knowledge of the causal link between HPV and oral cancer compared to their US-born counterparts (39% vs. 24%). A possible explanation is that foreign-born Hispanics are more exposed to HPV information through healthcare providers and television (Mueller et al., 2012) as opposed to seeking information online that often tends to be inaccurate or incomplete (Massey et al., 2017). Foreign-born Hispanics often report minimal confidence in obtaining relevant information and moderate to low trust in online media as a health information source (Mueller et al., 2012; Massey et al., 2017). This may reflect digital disparities, including lower ownership of digital devices, access to broadband internet, and digital literacy, limiting digital technologies' utilization and functionality among immigrant populations (Massey et al., 2017).

Our finding of lower HPV and HPV vaccine awareness among Hispanic subgroups versus non-Hispanic whites supports previously reported findings in the literature (Ford, 2011; Reimer et al., 2013; Adjei Boakyee et al., 2017). In a recent HINTS survey, Hispanics as a whole had a 27% and 53% lower odds of having heard of HPV and the HPV vaccine, respectively, compared to non-Hispanic whites (Otanee and Torr, 2017). The differences in HPV and HPV vaccine awareness are particularly concerning because of a large proportion of foreign- and US-born Hispanics (about two thirds in our sample) who are themselves age-eligible or who have a family member who is age-eligible for the HPV vaccine. Presumably, these individuals should be targeted for HPV vaccine messaging. However, only about 23% of individuals across the three groups who were themselves or who had a family member who was age-eligible for the HPV vaccine received an HPV-vaccine recommendation

from a health care professional. This potentially suggests a missed opportunity to capitalize on the role of healthcare providers in disseminating information about the HPV vaccine (Vorsters et al., 2019). Research consistently demonstrates that receiving a strong provider recommendation increases HPV vaccine uptake (Ylitalo et al., 2013; Bahena et al., 2019).

Some limitations should be considered when interpreting the findings of this study. A large proportion of individuals in our sample are over the age of 45 years. As they are outside the age group for which the HPV vaccine is licensed and recommended, they are unlikely to have had a conversation with their provider about the HPV vaccine for themselves. This likely contributes to the overall low levels of HPV vaccine awareness in the studied populations. Another significant limitation of this study is that the HINTS survey only asks for knowledge of HPV and the HPV vaccine but does not ask for actual HPV vaccination status. Thus we were unable to assess the relationship between knowledge/awareness and behavior. The sociodemographic characteristics of foreign-born Hispanic participants in the HINTS survey may not be entirely consistent with those of the general foreign-born Hispanic population in the US. One such sociodemographic characteristic may be immigration status. While the HINTS survey does not specify exclusion criteria based on citizenship or immigrant status, it is possible that foreign-born Hispanic participants with certain immigration status (e.g., undocumented, pending asylum, or temporary protected status) may have been differentially more reluctant to participate in the survey. Additionally, while previous studies have shown an association between acculturation and cancer prevention behavior (Andreeva et al., 2009), we were unable to adjust for this as acculturation information is not collected in HINTS. Finally, survey data is subject to respondent bias and non-response bias. Our study's strengths include using a nationally representative sample and two cycles of HINTS-5, which provided a larger sample size to ensure the improved robustness of our findings.

In summary, there are significant differences in HPV and HPV vaccine awareness and knowledge between foreign- and US-born Hispanics, as well as between foreign-born Hispanics and non-Hispanic whites. These findings underscore a growing awareness that disparities affecting specific subgroups (i.e., foreign-born Hispanics) might be masked when individuals are categorized into broad racial/ethnic categories (Holman et al., 2014; Luque et al., 2010; Kobetz et al., 2010; Fernández et al., 2010; Morales-Campos and Vanderpool, 2017). These findings suggest a need to implement strategic public health awareness campaigns targeting Hispanic nativity subgroups to increase HPV and HPV vaccine awareness. The general suboptimal knowledge of HPV and the HPV vaccine within the broader sample indicates an urgent need to enhance HPV vaccine promotion efforts in the broader US adult population.

#### CRedit authorship contribution statement

**Betsy Escobar:** Conceptualization, Methodology, Writing - original draft. **Trisha L. Amboree:** Formal analysis, Methodology, Writing - original draft. **Kalyani Sonawane:** Methodology, Writing - review & editing. **Ashish A. Deshmukh:** Methodology, Writing - review & editing. **Lindy U. McGee:** Writing - review & editing. **Ana M. Rodriguez:** Writing - review & editing. **Maria L. Jibaja-Weiss:** Writing - review & editing. **Jane R. Montealegre:** Conceptualization, Methodology, Writing - original draft, Supervision, Funding acquisition.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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