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Race, Nativity, and Sex Disparities in Human Papillomavirus Vaccination among Young Adults in the United States

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Abstract

Introduction: Research has demonstrated that the human papillomavirus (HPV) vaccine is a safe and effective way to decrease HPV-related cancers; however, the vaccination rate in the U.S. is suboptimal. The current study examined racial and ethnic disparities in HPV vaccination among a nationally representative sample, including Native Hawaiian and Pacific Islanders (NHPI). This study also investigated the associations between nativity and vaccination, and sex-differences between race/ethnicity and vaccination and nativity and vaccination.

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Conflict of Interest: The authors have no conflicts of interest to declare.

Ethical Standards Disclosure: This study was ruled exempt as non-human subjects research by the University of Arkansas for Medical Sciences Institutional Review Board (IRB#206591).

Materials and Methods: A cross-sectional study was conducted with a sample of adults aged 18–26 years drawn from the 2014 NHPI National Health Interview Survey (n=2,590) and the general 2014 National Health Interview Survey (n=36,697). Log-binomial models were fitted to examine differences in vaccination.

Results: There was a statistically significant racial/ethnic difference in HPV vaccination (p=0.003). More women than men were vaccinated (41.8% vs. 10.1%) (p<0.001). There was a significant difference in HPV vaccination based on nativity: 27.4% of adults aged 18 to 26 years who were born in the US or a US territory received the HPV vaccine compared to 14.3 among those not born in the US or a US territory (p<0.001). The association of HPV vaccination with nativity and race/ethnicity differed by sex showed several nuanced differences.

Discussion: Overall, the prevalence of HPV vaccination was low. The study's findings demonstrate the need for public health strategies to increase vaccination rates among all populations, with the critical need to identify strategies that are effective for men, racial/ethnic minorities, and immigrant women born outside the US.

Keywords

Human papillomavirus; vaccination; racial and ethnic disparities; nativity; National Health Interview Survey

INTRODUCTION

Human papillomavirus (HPV) is responsible for 70% of cervical cancer and can cause vulvar, vaginal, penile, anal, and oropharyngeal cancer (Grulich et al. 2010; Rahman, Islam, and Berenson 2015; Van Hilten 2016). Approximately 35,000 individuals are diagnosed with HPV-associated cancer every year ("Reasons to Get Vaccinated Against HPV" 2020). Minority women have higher rates of HPV-related cervical cancer. Hispanic women have the highest incidence of HPV-related cancer; nine per 100,000 Hispanic women were diagnosed, compared to seven per 100,000 non-Hispanic women. Black women have the second highest number at approximately eight per 100,000 women ("Reasons to Get Vaccinated Against HPV" 2020; "HPV-Associated Cervical Cancer Rates by Race and Ethnicity" 2019).

HPV vaccines have proven to be safe and effective at reducing cervical cancer ("HPV Vaccine Information For Young Women" 2016; Grulich et al. 2010). Although research has demonstrated that the HPV vaccine decreases HPV-related cancers, the number of people receiving the HPV vaccination is suboptimal (Gelman et al. 2013; "Reasons to Get Vaccinated Against HPV" 2020). Only 53.7% of girls and 48.7% of boys aged 13–17 years have completed the required doses of HPV vaccines (Walker et al. 2019). Approximately 27% of men and 53.6% of women between the ages of 18–26 are vaccinated (Boersma and Black 2020). There are disparities in vaccination rates by race and ethnicity. For women between the ages of 19–26 years, Hispanics, Asians, and Blacks, have lower vaccination rates compared to whites (Boersma and Black 2020; Williams et al. 2017; "Vaccination Coverage among Adults in the United States" 2017). Some studies suggest vaccination disparities among US residents based on nativity (Healy et al. 2018; Williams et al. 2016; Lu et al. 2014).

Although prior studies have documented disparities in vaccination rates (Healy et al. 2018; Williams et al. 2016; Lu et al. 2014; "HPV Vaccine Information For Young Women" 2016; Grulich et al. 2010; Gelman et al. 2013; Walker et al. 2019; Boersma and Black 2020; Williams et al. 2017; "Reasons to Get Vaccinated Against HPV" 2020; "Vaccination Coverage among Adults in the United States" 2017), gaps in the literature remain. There have been no studies using nationally representative data that have included disaggregated information on Asian Americans and Native Hawaiian Pacific Islanders living in the US, which has constrained our understanding of the differences in the two racial groups (Srinivasan and Guillermo 2000; McElfish et al. 2017). Furthermore, there has been a limited number of studies examining racial/ethnic difference in HPV vaccination rates by sex, and these studies focus primarily on women (Bond et al. 2016; AM et al. 2012; A et al. 2013; N et al. 2014).

This study helps fill the gap in current literature with three aims. The first aim was to examine racial/ethnic disparities in HPV vaccination among a national representative sample in the US that included specific information about Native Hawaiian and Pacific Islanders (NHPI). The second aim was to examine associations between nativity status and HPV vaccination. The third aim was to investigate sex-difference in the association between race/ethnicity and HPV vaccination, and nativity status and HPV vaccination.

MATERIALS AND METHODS

Data Sources

Each year, the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention (CDC) fields the National Health Interview Survey (NHIS) to gather information about the health of US adults. In the general NHIS, it is not possible to identify NHPI because the small number of respondents would pose a confidentiality issue (National Center for Health Statistics 2015). Therefore, the NCHS fielded the first and only NHIS focused exclusively on NHPI (National Center for Health Statistics 2014, 2017). This present cross-sectional study used data from the 2014 NHPI-NHIS and the 2014 general NHIS, through which 2,590 NHPI adults were surveyed for the NHPI-NHIS and 36,697 adults were surveyed in the general NHIS. A detailed description of both surveys can be found elsewhere (National Center for Health Statistics 2015, 2016, 2017).

The NHPI-NHIS and NHIS used the same questionnaire but different sampling methodologies. Simply combining these two surveys into a single dataset may lead to biased estimates of standard errors. Therefore, Kaminska and Lynn's (2017) method was used to combine and compare surveys with distinct sampling designs (Kaminska and Lynn 2017). First, a stratum indicator that reflects the sampling strata from each survey was created. Stratum identifications were verified to remain unique after combining the two datasets. Because both surveys used a multi-stage design, a primary sampling unit (PSU) indicator was created to reflect multi-stage design with a unique value for each PSU. The uniqueness of the PSUs was verified after combining both datasets. Sampling weights and variance estimation variables were taken into account; and, confirmation that the point estimates had not changed after combining datasets was established. For all variables, misspecification effect —which is the ratio of the true variance of a sample statistic under

the complex sample design to the estimated variance when ignoring all or part of the sample design (Kaminska and Lynn 2017)— was not found. Specifications indicated by the NCHS regarding the use of sampling weights and the steps delineated by Kaminska and Lynn (2017) were followed to combine the datasets and analyze the data in an unbiased way (Kaminska and Lynn 2017; National Center for Health Statistics 2017, 2015).

Study Population

At the time of the 2014 survey, the Federal Drug Administration (FDA) approved the HPV vaccines for those aged 10 to 25 years. Thus, only adults between the ages of 18 to 26 years who answered the survey question on HPV vaccination were included in the sample for the present analysis. From the general NHIS, the sample included 4,602 adults aged 18 to 26 years: non-Hispanic White (n=2,589), Hispanic (n=966), non-Hispanic Black/African-American (n=656), non-Hispanic Asian (n=329) (hereafter referred to as Whites, Hispanics, Blacks, and Asians). American Indians/Alaska Natives and individuals of multiple races or with no primary race selected were categorized as "Other" (n=62). From the NHPI-NHIS, 279 NHPIs between the ages of 18 to 26 years who identified as NHPI alone or in combination with other races were included in the analysis.

Measures

HPV vaccination was a dichotomous variable determined by respondents' answer to the survey question: "*Have you ever received an HPV shot or vaccine? HPV stands for human papillomavirus. The vaccines are sometimes called CERVARIX™ or GARDASIL™*".

Race/ethnicity was defined by self-selected survey categories: Whites (reference group), Hispanics, Blacks, Asians, Other, and NHPIs." Nativity was determined by self-reported place of birth: (1) Born in one of the 50 US states or the District of Columbia; (2) Born in a US territory; (3) Not born in the US or a US territory. A continuous measure of age, which ranged from 18 to 26 years, was used. Responses of "Refused", "Not ascertained", or "Don't know" were coded as missing.

Statistical Analyses

Stata/SE 16(StataCorp.. 2015) *svy* procedures were used to estimate parameters and adjust for the NHIS complex stratified-multistage-area-probability sampling design. The Rao-Scott chi-square (χ^2) test of independence, which accounts for sampling design, was used to determine statistically significant racial/ethnic differences in HPV vaccination.(Rao and Scott 1984) Mean age differences were assessed with an independent t-test. Associations between race/ethnicity and HPV vaccination were examined by conducting log-binomial regressions. Prevalence Ratio (PR) estimated the magnitude of associations, and 95% confidence intervals (CI) reported uncertainty around the estimates. Log-binomial regression was chosen because the prevalence of HPV vaccination was common (25.8%), and odds-ratios estimated from logistic regression would not be similar to PR.(Zhang and Yu 1998).

Three separate regression models were fitted: Model 1 included race/ethnicity as the sole independent variable and HPV vaccination as the dependent variable. Model 2 included race/ethnicity along with nativity status, sex, and age variables. Model 2 allows us to

determine the extent to which the influence of race/ethnicity on HPV vaccination is attenuated when the influence of the other potential factors are considered. Model 3 included the same variables as model 2, but stratified by sex rather than incorporating sex as an independent variable. Statistical significance was determined at α=.05.

Research Ethics Review

The NHPI-NHIS and general NHIS contain de-identified public data. Therefore, this research was exempted by the UAMS Institutional Review Board (IRB# 206591).

RESULTS

Descriptive Analysis

A quarter (25.8%) of adults aged 18 to 26 years received the HPV vaccine at least once. There was a statistically significant racial/ethnic difference in HPV vaccination; 15.4% of Asians, 21.9% of Hispanics, 24.7% of Blacks, 24.9% of NHPIs, 28.3% of Whites, and 33.0% of adults of other races were vaccinated against HPV(p=0.003) (Table 1).

More women than men were vaccinated (41.8% vs. 10.1%) (p<0.001) (Table 1). Among women aged 18 to 26 years, racial/ethnic differences were found; 25.9% of Asians, 30.9% of Hispanics, 38.1% of Blacks, 39.3% of NHPIs, 47.7% of Whites, and 54.9% of women of other races were vaccinated against HPV (p<0.001) (Table 2). There were no racial/ethnic differences in HPV vaccination among men overall (p=0.162).

There was a significant difference in HPV vaccination based on nativity: 27.4% of adults aged 18 to 26 years who were born in the US or a US territory received the HPV vaccine compared to 14.3% among those not born in the US or a US territory (p<0.001) (Table 1).

Regression Analysis

Model 1 (race/ethnicity as the sole predictor) showed that relative to Whites, Hispanics and Asians were less likely to be vaccinated against HPV (PR=0.77; 95% CI=0.64, 0.94 and PR=0.54, 95% CI=0.40, 0.74). No significant differences were found for Blacks, NHPIs, and the Other race group compared to Whites in this non-adjusted model.

Model 2 (race/ethnicity, nativity status, sex and age as predictors) revealed that the differences found in Model 1 remained; Hispanics and Asians were less likely than Whites to be vaccinated (PR=0.80; 95% CI=0.66, 0.97 and PR=0.67, 95% CI=0.49, 0.92) when the other variables are held constant. No significant associations were found for Blacks, NHPIs, and the Other race group in this adjusted model.

Model 2 also indicates those not born in the US or a US territory were significantly less likely to be vaccinated against HPV than those born in the US or a US territory (PR=0.67, 95% CI=0.50, 0.90). There was a significant negative association between age and the likelihood of being vaccinated (PR=0.93, 95% CI=0.90, 0.95). Women were significantly more likely to be vaccinated than men (PR=4.08, CI=3.34, 4.98).

Model 3 (race/ethnicity, nativity status, and age, stratified by sex) demonstrated that Hispanic (PR=0.70, 95% CI=0.55, 0.88), Asian (PR=0.67, 95% CI=0.47, 0.95), and Black (PR=0.80, 95% CI=0.65, 0.98) women were less likely to be vaccinated than White women. NHPI women and those of other races, were as likely as White women in receiving HPV vaccination. Hispanic men were more likely to be vaccinated against HPV than White men (PR=1.55, 95% CI=1.05, 2.30). Apart from the Hispanic ethnicity, associations between race and HPV vaccinations were not found among men.

Model 3 indicated women not born in the US or a US territory were less likely to be vaccinated against HPV than those born in the US or a US territory (PR=0.67, 95% CI=0.47, 0.95). However, not being born in the US or a US territory was not associated with receiving the HPV vaccine among men.

An inverse association between age and HPV vaccination was observed among women (PR=0.95, 95% CI=0.92, 0.98) and men (PR=0.79, 95% CI=0.73, 0.86) (Table 3).

DISCUSSION

This study revealed that the prevalence of HPV vaccine is low in Americans aged 18 to 26 years. Only a quarter of the sample reported that they had received the HPV vaccine. Women were four times as likely as men to be vaccinated. This is consistent with prior literature, which has shown higher HPV vaccination rates among women (Walker et al. 2019; Boersma and Black 2020).

The analysis showed significant disparities by race and ethnicity for women. Asian, Black and Hispanic women were less likely than White women to be vaccinated in both adjusted and unadjusted models. Overall, this finding is consistent with most prior literature (Boersma and Black 2020; Williams et al. 2017; “Vaccination Coverage among Adults in the United States” 2017). However, this study adds significantly to the literature as it is the first to include analysis of NHPI in a nationally representative sample, and the analysis shows there were no significant differences for NHPI women relative to White women in either the adjusted or unadjusted models. The findings that there were not significant disparities between NHPIs and Whites is encouraging, but they should be considered in light of the overall suboptimal coverage of HPV vaccinations.

Several nuanced differences were found in the models that examined race/ethnicity and nativity by sex and demonstrate the importance of stratification by sex, which has not been conducted in prior HPV literature. Surprisingly, Hispanic men were more likely to report receiving the HPV vaccination than White men in adjusted models, while there were no significant racial/ethnic differences detected between men of any other racial/ethnic group and White men. This finding adds significantly to the literature as one of the first studies to examine differences in HPV vaccination by race/ethnicity for men.

There was a significant difference in HPV vaccination based on nativity overall and for women, but not for men. This finding is consistent with prior literature that has shown differences based on nativity (Healy et al. 2018; Williams et al. 2016; Lu et al. 2014). The current study extends the literature through the analyses by sex and nativity.

Limitations

The findings presented in this article need to be interpreted in light of certain limitations. First, as is typical with large national surveys, the response rate was 58.9% for NHIS and 64.8% % of the general NHIS (Parsons et al. 2014; 2014 NHPI-NHIS, survey description Document 2014; 2014 NHIS, survey description document 2015). Nonresponse bias may have impacted the results if participants and non-participants differed in their vaccination status. Second, the analyses were based on self-report of vaccination and were not validated by medical records. Self-report of vaccination might be subject to recall bias. Other factors associated with behavior, community, religion, culture, vaccine safety concerns, and State statutes/regulations were not included as they were not available in the surveys. Thus, it is possible that the magnitude and significance of associations found in this article could vary had these social determinants and other proximal and distal determinants been included in the adjusted models.

Conclusions

Despite the limitations, this study has points of strength that make it unique and contributes to the literature on HPV vaccinations. First, a population-based sample is used in order to generalize the results to the American population aged 18 to 26 years. Second, to our knowledge, this is the first study to include disaggregated information on HPV vaccination among Asian Americans and NHPI living in the US. Third, race/ethnicity and nativity by sex are examined, which has not been examined in prior HPV literature. Overall, the findings of the current study demonstrate the need for public health strategies to increase HPV vaccination rates among all populations, with the critical need to find strategies that are effective for men, racial/ethnic minorities, and women born outside the US.

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Table 1.

Estimated differences in the proportion of adults aged 18–26 years who received HPV vaccination and those who did not, 2014 (Weighted % and 95% Confidence Interval)

	Have you ever received an HPV shot or vaccination?		
	No	**Yes**	
	74.2 (71.9,76.3)	**25.8 (23.7,28.1)**	
Race/Ethnicity			Rao-Scott Σ^2 F(3.75,1219.00)=4.22; p=0.003
White (n=2,589)	71.7 (68.3,74.8)	28.3 (25.2,31.7)	
NHPI (n=279)	75.1 (63.3,84.0)	24.9 (16.0,36.7)	
Hispanic (n=966)	78.1 (74.5,81.3)	21.9 (18.7,25.5)	
Black (n=656)	75.3 (70.1,79.9)	24.7 (20.1,29.9)	
Asian (n=329)	84.6 (79.8,88.4)	15.4 (11.6,20.2)	
Other (n=62)	67.0 (46.2,82.8)	33.0 (17.2,53.8)	
Nativity			Rao-Scott Σ^2 F(1.97,639.79)=13.17; p<0.001
Born in U.S. (n=4,184)	72.6 (70.1,75.0)	27.4 (25.0,29.9)	
Born in U.S. territory (n=34)	72.3 (44.0,89.7)	27.7 (10.3,56.0)	
Not born in U.S. or U.S. territory (n=661)	85.7 (81.5,89.1)	14.3 (10.9,18.5)	
Sex			Rao-Scott Σ^2 F(1,325)=247.49; p<0.001
Males (n=2,394)	89.9 (88.0,91.6)	10.1 (8.4,12.0)	
Females (n=2,486)	58.2 (54.7,61.7)	41.8 (38.3,45.3)	
Age			Difference=0.8 (0.1); t-value=5.95; p<0.001
18–26 years (n=4,880)	22.2 (0.6)	21.4 (0.12)	

Data sources: NCHS, National Health Interview Survey, 2014. NCHS, Native Hawaiian and Pacific Islander National Health Interview Survey, 2014.

Note: HPV=human papillomavirus; NHPI=Native Hawaiian and Pacific Islander.

Table 2.

Estimated differences in the proportion of men and women aged 18–26 years who received HPV vaccination and those who did not, 2014

	Have you ever received an HPV shot or vaccination?			
	Women		**Men**	
	No	**Yes**	**No**	**Yes**
	58.2 (54.7,61.7)	**41.8 (38.3,45.3)**	**89.9 (88.0,91.6)**	**10.1 (8.4,12.0)**
Race/Ethnicity				
White	52.3 (47.2,57.3)	47.7 (42.7,52.8)	91.2 (88.7,93.1)	8.8 (6.9,11.3)
NHPI	60.7 (45.7,74.0)	39.3 (26.0,54.3)	89.2 (77.9,95.1)	10.8 (4.9,22.1)
Hispanic	69.1 (63.0,74.7)	30.9 (25.3,37.0)	86.4 (81.6,90.1)	13.6 (9.9,18.4)
Black	61.9 (55.0,68.3)	38.1 (31.7,45.0)	89.0 (80.9,93.9)	11.0 (6.1,19.1)
Asian	74.1 (64.7,81.6)	25.9 (18.4,35.3)	94.8 (90.2,97.3)	5.2 (2.7,9.8)
Other	45.1 (20.0,72.9)	54.9 (27.1,80.0)	83.2 (51.2,95.9)	16.8 (4.1,48.8)
	Rao-Scott X^2 F(3.89, 1230.55)=8.25; p<0.001		Rao-Scott X^2 F(3.35, 1051.89)=1.68; p=0.162	

Data sources: NCHS, National Health Interview Survey, 2014. NCHS, Native Hawaiian and Pacific Islander National Health Interview Survey, 2014.

Note: HPV=human papillomavirus; NHPI=Native Hawaiian and Pacific Islander.

Table 3.

Associations between race/ethnicity, nativity, and HPV vaccination: prevalence ratios and 95% confidence intervals

	Model 1	*p*	Model 2	*p*	Model 3 (Women)	*p*	Model 3 (Men)	*p*
Race/Ethnicity [a]								
NHPI	0.88 (0.57,1.36)	0.563	0.83 (0.55,1.24)	0.361	0.83 (0.56,1.21)	0.326	0.82 (0.30,2.19)	0.686
Hispanic	0.77 (0.64,0.94)	**0.009**	0.8 (0.66,0.97)	**0.024**	0.7 (0.55,0.88)	**0.002**	1.55 (1.05,2.30)	**0.029**
Black	0.87 (0.69,1.10)	0.246	0.84 (0.69,1.03)	0.102	0.8 (0.65,0.98)	**0.034**	1.24 (0.67,2.29)	0.487
Asian	0.54 (0.40,0.74)	<**0.001**	0.67 (0.49,0.92)	**0.014**	0.67 (0.47,0.95)	**0.025**	0.68 (0.32,1.45)	0.318
Other	1.16 (0.65,2.10)	0.612	1.14 (0.71,1.81)	0.59	1.09 (0.63,1.87)	0.759	1.67 (0.45,6.23)	0.441
Nativity [b]								
Born in U.S./U.S. territory	---	---	1.36 (0.64,2.86)	0.421	1 (0.29,3.51)	0.997	1.93 (0.62,5.99)	0.253
Not born in U.S./U.S. territory	---	---	0.67 (0.50,0.90)	**0.007**	0.67 (0.47,0.95)	**0.025**	0.69 (0.36,1.31)	0.258
Sex [c]								
Female	---	---	4.08 (3.34,4.98)	<**0.001**	---	---	---	---
Age (18–26 years)	---	---	0.93 (0.90,0.95)	<**0.001**	0.95 (0.92,0.98)	<**0.001**	0.79 (0.73,0.86)	<**0.001**

Data sources: NCHS, National Health Interview Survey, 2014. NCHS, Native Hawaiian and Pacific Islander National Health Interview Survey, 2014.

Note: HPV=human papillomavirus; NHPI=Native Hawaiian and Pacific Islander.

[a] White is the reference group for race/ethnicity.

[b] Born in U.S./U.S. territory is the reference group for nativity.

[c] Males are the reference group for sex.

Statistically significant p-values are bolded.

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