Differences in human papillomavirus (HPV) vaccine uptake by nativity status among men aged 18–34 years

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ABSTRACT

Annually, about 16,500 HPV-associated cancers occur in the US among men. Data regarding HPV vaccine uptake among men based on nativity status (i.e., US-versus foreign-born) is limited, yet potentially important for informing interventions. We assessed differences in HPV vaccine uptake by nativity status among men aged 18–34 years in the US. The 2014–2017 National Health Interview Survey was examined for men, aged 18–34 years (n = 14,056). HPV vaccine initiation was defined as receipt of at least one dose of the vaccine and completion as receipt of three doses. Weighted, multivariable binary logistic regression models were used to assess the association between nativity status and HPV vaccine uptake, adjusting for demographic, socioeconomic, and healthcare factors. Analyses were performed in July 2018. Overall, 17% of men self-identified as foreign-born, 9.9% of men had initiated the HPV vaccine, and 3.3% had completed the HPV vaccine. Among foreign-born men, Asians had the highest HPV vaccination rates whereas those from Indian subcontinental region had the lowest rates. After accounting for demographic, socioeconomic, and healthcare factors, compared to US-born men, foreign-born men were 46% (adjusted odds ratio = 0.54; 95% CI = 0.39–0.72) less likely to initiate the HPV vaccine but there was no difference between the two groups in terms of vaccine completion. We found that HPV vaccine uptake among men was very low overall, and foreign-born men had lower initiation compared to US-born men. Public health interventions which improve HPV vaccination need to be developed for all men, irrespective of nativity status.

1. Introduction

Currently, an estimated 79 million individuals in the United States (US) are infected with at least one type of human papillomavirus (HPV), and an estimated 14 million new infections occur each year (Viens et al., 2016). There are at least 150 types of HPV, some of which are oncogenic or high-risk for causing cancer (Viens et al., 2016). Oncogenic HPV subtypes are thought to be responsible for more than 90% of anal, 70% of oropharynx, and 60% of penile cancers (National Vaccine Advisory Committee, 2016; World Health Organization, 2016). HPV infection is not only associated with primary cancers but are also attributable to second primary cancers (Adjei Boakye et al., 2018a, 2018b, 2019). More than 40% of all HPV-related cancers in the US occur in men (Viens et al., 2016). There will be an estimated 35,130 oral, 8,300 anal and 2,080 penile cancer incident cases among men in 2019 in the US (Siegel et al., 2019). Approximately 16,500 HPV-associated cancers (including anal, penile, and oropharyngeal cancers) occur among men in the US annually (Centers for Disease Control and Prevention, 2018a). HPV-associated oral cancers are more common in men, and account for the largest burden of HPV-associated cancers in the US, with an estimated 10,700 cancers occurring annually (Centers for Disease Control and Prevention, 2018a).

The foreign-born are the fastest growing population in the US. Since 1970, the foreign-born population has increased tremendously from 9.6

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million to 40 million in 2010, with most foreign-born individuals immigrating to the US from Latin America and Asia (India and China) (United States Census Bureau). There is a huge burden of HPV infection among foreign-born in the US. For example, Bhattacharyya et al. recently reported the rate of any HPV infection to be 39%, high risk infection to be 22%, and vaccine preventable infection to be 12% among foreign-born men in the US (Bhattacharyya et al., 2019). HPV-associated anal cancers in males are higher in Asia (India and China) than in the US, while HPV-associated penile cancers are higher in Latin America and Asia (India and China) than in the US (de Martel et al., 2017).

A factor associated with HPV and HPV-related diseases among the foreign-born is acculturation, defined as the process by which individuals adopt the attitudes, values, customs, beliefs, and behaviors of another culture (LaFromboise et al., 1993). Acculturation may affect health behaviors; the underlying assumption is that beliefs or norms concerning particular behaviors change with greater acculturation. Although there is no single measurement of acculturation in research, those that have been used include nativity or generational status, length of residence in the US, and language use. In this study, we focused on nativity status and number of years in the US. Foreign-born men may be at higher risk for HPV-associated cancers given known barriers to accessing health care and preventive services such as vaccination in their country of origin and when they immigrate to the US (Derose et al., 2009). There is a paucity of studies that have focused on men; the earliest studies included only women (Coffie et al., 2018), more recent studies seem to compare men and women (Perez et al., 2018), but studies focusing on men are rare.

The Advisory Committee on Immunization Practices (ACIP) recommends routine HPV vaccination for adolescents between 11 and 12 years of age (Markowitz et al., 2014). Catch-up vaccination is recommended for females aged 13–26 years and males aged 13–21 years, with vaccination up to 26 years for immune-compromised men or men who have sex with men (Markowitz et al., 2014). The most recent national coverage estimates indicated that 56% of 13–17-year-old males (Walker et al., 2017) and 14% of 19–26-year-old males (Adjei Boakye et al., 2018c) had initiated the HPV vaccine; and 35% of 13–17-year-old males (Walker et al., 2017) and 4% of 19–26-year-old males (Adjei Boakye et al., 2018c) had completed the HPV vaccine series. It is reasonable to expect that vaccination rates are even lower among foreign-born men as a previous study found that vaccination coverage for various routinely recommended adult vaccines in the US were lower among foreign-born individuals compared with US-born individuals (Lu et al., 2014).

With the increasing incidence rates of HPV-associated cancers as well as the rising numbers of foreign-born individuals in the US, it is important to understand patterns of HPV vaccine uptake among foreign-born individuals. Coffie et al found lower HPV vaccine initiation among foreign-born women compared with US-born women (Coffie et al., 2018) but did not examine initiation among men or HPV vaccine completion. In addition, a few studies have focused on adolescent males or men who have sex with men, but did not focus on foreign-born populations (Landis et al., 2018; Oliver et al., 2017). Little is known about the uptake of HPV vaccination among foreign-born men, differences in subgroups, and the characteristics that influence HPV vaccine uptake. We aimed to fill this gap in the literature by assessing differences in HPV vaccine initiation and completion among US-born and foreign-born men aged 18–34 years living in the US who immigrated from different regions of the world. Understanding HPV vaccine uptake based on nativity status may help identify groups for whom additional or targeted efforts are needed to achieve national goals for HPV vaccination.

2. Materials and methods
2.1. Data source

Data were obtained from the National Health Interview Survey (NHIS) (National Center for Health Statistics, 2018) from 2014 to 2017. NHIS is a nationally representative annual health survey, conducted by the National Center for Health Statistics (NCHS) under the Centers for Disease Control and Prevention (CDC). NHIS covers a broad range of health topics and includes the civilian non-institutionalized population residing in the US. The data were collected through a personal household interview conducted by the US Census Bureau. One civilian adult per family is randomly selected for a detailed interview that includes health status, health behavior and utilization of health care. Details of survey development, design, and methodology have been published elsewhere (Parsons et al., 2014). The NHIS was approved by the research ethics review board of the NCHS. The study was deemed exempt by the Southern Illinois University School of Medicine Institutional Review Board.

A total unweighted sample of 15,350 men 18–34 years of age were included because men who were between the ages of 18 and 34 years at the time of the survey (2014–2017) would have been eligible to have received the HPV vaccine, based on the year of licensure for males in the US. For example, a man aged 25 years in 2016 was 18 years of age in 2009, when the vaccine was recommended for boys and young men. We excluded men who did not respond to questions regarding their country of birth (n = 7) or HPV vaccination (n = 1287) resulting in a final sample of 14,056 men for analysis.

2.2. Measures

The outcome variables were HPV vaccine initiation and completion. HPV vaccine initiation was assessed with the question “Ever received HPV shot/vaccine?” Participant responses were dichotomized (yes or no). Participants who responded yes were subsequently asked how many doses of the HPV vaccine they had received. Participants with three or more vaccine doses were categorized ‘yes’ for completion and those with less than three doses were categorized as ‘no’.

The main independent variable was nativity status (US-born or foreign-born). Participants were asked where they were born, and those who were not born in the US or US territory were categorized as foreign-born. Men who were born in the US were categorized as US-born.

Sociodemographic characteristics and access to health care variables potentially related to HPV initiation and completion were selected based on previous literature (Adjei Boakye et al., 2017a, 2018c; Perez et al., 2018). They include: age at time of interview, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), marital status (married or not married), education (less than high school, high school graduate, some college, or college graduate), insurance status (yes or no), whether or not they have a usual place of getting healthcare, health care utilization (number of health care visits in the past 12 months [none, 1–5 or ≥6]), general health (excellent, very good, good or poor/fair), and location of residence based on Census region.

Foreign-born men were asked their country of origin, and their responses were categorized into geographic regions: Mexico/Central America/Caribbean Island, South America, Europe (including Russia), Africa, Indian Subcontinent, Asia, Southeast Asia, and Other (Middle East, unknown). Foreign-born men were also asked how long they had been in the US and categorized as: < 10 years, and ≥10 years based on cutoffs from previous literature (Lu et al., 2014).

2.3. Statistical analysis

All analyses were performed in SAS 9.4 (SAS Institute Inc., Cary, NC) using survey-specific procedures, which incorporate survey sampling weights and stratum to account for the complex sampling design used in the NHIS (National Center for Health Statistics, 2018) and to provide representative estimates of the U.S. population. Descriptive statistics were used to analyze participants’ characteristics. We compared sample characteristics by nativity status using Chi-squared tests for categorical variables and independent samples t-tests for continuous
variables. Among foreign-born men, prevalence of HPV vaccination initiation and completion were investigated by region of birth, length of residence in the US and US citizenship status. Multivariable binary logistic regression was used to examine the association between nativity status and HPV vaccine initiation and completion. Two models (initiation and completion pair) were constructed; the first model controlled for sociodemographic variables, general health and geographic region. The second model added healthcare access variables (health insurance, usual source of care, and number of doctor visits). Next, separate multivariable logistic regression models were evaluated for US-born and foreign-born men to investigate the associations between patient characteristics and HPV vaccination initiation and completion. Finally, to account for the effect of acculturation among foreign-born men, three models (initiation and completion pair) were developed for foreign-born men only. The first model controlled for U.S. citizenship status, the second model controlled for length of U.S. residency, and the third model controlled for both variables. Since the catch-up vaccination is up to 26 years, we conducted a sensitivity analyses by limiting the data to only those that were aged 18–26. We then rerun all the analyses above for this subpopulation. Statistical tests were two-tailed, and the significance level was set at \( P < 0.05 \).

3. Results

Table 1 summarizes demographic, socioeconomic and access to health care characteristics of US men ages 18–34, overall and by nativity status. A total of 14,056 men, with an average age of 27 years (SD = 5 years), were included in the study, of which 2,396 (17.0%) identified as foreign-born. Among the foreign-born men, 34.4% were US citizens, and approximately half (49.2%) were from Mexico/Central America/Caribbean Island.

The overall HPV initiation and completion rates were 9.9% and 3.3%, respectively (Table 1). When stratified by nativity status, HPV vaccine initiation was higher among US-born than foreign-born men (11.0% vs 4.5%); HPV vaccine completion was slightly higher among US-born men than among foreign-born men (3.7% vs 1.7%, Table 1). Among foreign-born men, both HPV vaccine initiation and completion rates were higher among those who obtained US citizenship (Table 2). Similarly, HPV vaccine uptake were higher for men who had been in the US for ≥10 years (Table 2). Foreign-born men from south-east Asia had the highest vaccine initiation while those from Europe had the highest completion rates and those from the Indian Subcontinent had the lowest rates for both initiation and completion (Table 2).

Disparities in HPV vaccination initiation and completion by nativity status assessed with two models are presented in Table 3. Model 1 adjusted for sociodemographic variables, general health and geographic region. Compared with US-born men, foreign-born men had lower odds of HPV vaccine initiation (OR = 0.48, 95% CI = 0.36, 0.65). The odds of initiation decreased slightly in Model 2 when healthcare access variables were added (OR = 0.54, 95% CI = 0.39, 0.72). However, in both Model 1 and Model 2, there were no significant differences between US-born and foreign-born men in terms of vaccine completion. As the number of healthcare visits increased, the likelihood of initiating and completing the HPV vaccination also increased.

In the adjusted analyses stratified by nativity status, among US-born men, the odds of initiating the HPV vaccine increased if they had visited the healthcare provider’s office 1–5 times (OR = 2.10, 95% CI = 1.68, 2.62) or ≥6 times (OR = 3.39, 95% CI = 2.49, 4.62) as opposed to no health care visits (Table 4). Similarly, the odds of completing the 3-dose series increased if US-born men had visited the healthcare provider’s office 1–5 times (OR = 2.18, 95% CI = 1.50, 3.17) or ≥6 times (OR = 4.18, 95% CI = 2.58, 6.77) as opposed to no visit to the healthcare provider. Among foreign-born men, the likelihood of initiating (OR = 1.86, 95% CI = 1.06, 3.26) and completing (OR = 4.06, 95% CI = 2.90, 5.67) HPV vaccine increased if they had visited the healthcare provider’s office 1–5 times (OR = 2.10, 95% CI = 1.68, 2.62) or ≥6 times (OR = 3.39, 95% CI = 2.49, 4.62) as opposed to no visit to the healthcare provider.

Table 1

| Characteristics of adult men aged 18–34 in the US overall and stratified by nativity status, NHIS (2014–2017). |
|----------------------------------------------------------|----------------------------------------------------------|
| n (w%) | US Born Men | Foreign Born Men | p-value |
|---------------------------------|----------------|------------------|---------|
| Total n = 14056 | | | | |
| US Born Men n = 11,660 (83.0%) | | | | |
| Foreign Born Men n = 2396 (17.0%) | | | | |
| HPV vaccine initiation: | | | | |
| Yes | 1325 (9.9) | 1206 (11.0) | 119 (4.5) | < 0.0001 |
| HPV vaccine completion: | | | | |
| Yes | 443 (3.3) | 410 (3.7) | 33 (1.7) | 0.0011 |
| Age (Mean ± SD) | 26.5 ± 4.8 | 26.3 ± 4.8 | 27.6 ± 4.5 | < 0.0001 |
| Race/ethnicity | | | | |
| Non-Hispanic White | 8584 (57.9) | 8198 (66.5) | 386 (15.8) | < 0.0001 |
| Non-Hispanic Black | 1523 (13.4) | 1319 (13.9) | 204 (11.2) | | |
| Hispanic | 2679 (21.8) | 1578 (15.7) | 1101 (51.4) | | |
| Hispanic - Non-Hispanic | 1269 (6.9) | 564 (5.9) | 705 (31.6) | | |
| Other | | | | | |
| Marital status | | | | |
| Married | 5282 (41.0) | 4202 (39.1) | 1080 (50.5) | < 0.0001 |
| Not Married | 8759 (59.0) | 7445 (60.9) | 1314 (49.5) | | |
| Educational attainment | | | | |
| College graduate or higher | 4006 (25.2) | 3179 (24.5) | 827 (29.1) | < 0.0001 |
| Some college or associate degree | 4959 (35.1) | 4398 (37.2) | 561 (24.7) | | |
| High School diploma | 3566 (27.2) | 3054 (27.9) | 512 (23.8) | | |
| Less than high school degree | 1493 (12.4) | 1011 (10.4) | 482 (22.4) | | |
| Uninsured: Yes | 2606 (18.8) | 1779 (15.0) | 827 (37.2) | < 0.0001 |
| Has usual place of care: Yes | 9559 (70.0) | 8185 (72.4) | 1374 (58.4) | < 0.0001 |
| Number of healthcare office visits in past year | | | | |
| None | 5002 (35.3) | 3875 (32.8) | 1127 (47.2) | < 0.0001 |
| 1–5 | 7684 (55.7) | 6532 (57.3) | 1152 (48.0) | | |
| ≥6 | 1353 (9.0) | 1240 (9.9) | 113 (4.8) | | |
| General health status | | | 0.1200 | |
| Excellent | 5658 (42.3) | 4643 (42.2) | 1015 (42.7) | | |
| Very Good | 5045 (33.6) | 4238 (34.0) | 807 (31.7) | | |
| Good | 2685 (19.3) | 2197 (18.9) | 488 (21.4) | | |
| Poor/Fair | 661 (4.8) | 576 (4.9) | 85 (4.1) | | |
| Geographic Region | | | | |
| West | 4040 (25.1) | 3245 (24.3) | 795 (28.9) | < 0.0001 |
| Northeast | 1953 (13.5) | 1582 (14.8) | 371 (18.8) | | |
| Midwest | 3343 (23.4) | 2943 (25.2) | 400 (14.8) | | |
| South | 4719 (35.6) | 3889 (35.6) | 830 (37.5) | | |

n = frequency, w% = weighted percentage, *p-value based on chi-square tests or independent samples t-test where appropriate; frequency or % may not add up due to missing or rounding. NHIS = National Health Interview Survey; HPV = Human Papillomavirus; US = United States; SD = Standard Deviation.
Factors associated with HPV vaccination uptake overall, NHIS (2014–2017).

| Nativity status | HPV vaccine initiation | HPV vaccine completion |
|-----------------|------------------------|------------------------|
| US born         | Ref 0.48 (0.36, 0.65)  | Ref 0.65 (0.38, 1.12)   |
| Foreign born    | Ref 0.54 (0.39, 0.72)  | Ref 0.78 (0.45, 1.34)   |
| Uninsured       |                        |                        |
| Yes             | –                      | –                      |
| No              | –                      | –                      |
| Has usual place of care | | |
| Yes             | –                      | –                      |
| No              | –                      | –                      |
| Number of healthcare office visits in past year | | |
| None            | –                      | –                      |
| 1–5             | –                      | –                      |
| ≥6              | –                      | –                      |

Models adjusted for age, race/ethnicity, marital status, education, general health, and geographic region.

NHIS = National Health Interview Survey; HPV = Human Papillomavirus; US = United States.
which has been shown to have poor healthcare access (Arredondo, 2014; Centers for Disease Control and Prevention, 2017). Second is lack of health insurance. In our study, we found that 75% of US-born men had health insurance while only 63% for foreign-born had health insurance. Although men who were insured were no more or less likely to initiate the HPV vaccine after adjusting for covariates in our study, Cofie et al found that insured women had a higher likelihood of initiating HPV vaccine (Cofie et al., 2018). Previous studies have also shown that individuals with insurance are usually more likely to receive preventive services such as vaccinations than uninsured individuals (Anandappa et al., 2018; Laz et al., 2013; Lu et al., 2014). Third, HPV vaccines were initially targeted toward women and the prevention of cervical cancer resulting from persistent infection with oncogenic HPV subtypes (Pisciotta, 2012). As a result, men in the US are less aware of HPV, the existence of a vaccine to protect against HPV, and the association between HPV and cancers relevant to men (Adjei Boakye et al., 2017b; Osazuwa-Peters et al., 2017).

To increase HPV vaccine coverage among immigrant men, public health programs aimed at providing education and instruction regarding preventive services such as vaccinations and improving health coverage among immigrant men can be beneficial (Anandappa et al., 2018; Laz et al., 2013; Lu et al., 2014). Third, HPV vaccines were initially targeted toward women and the prevention of cervical cancer resulting from persistent infection with oncogenic HPV subtypes (Pisciotta, 2012). As a result, men in the US are less aware of HPV, the existence of a vaccine to protect against HPV, and the association between HPV and cancers relevant to men (Adjei Boakye et al., 2017b; Osazuwa-Peters et al., 2017).
needed for particular subgroups of men such as immigrants and men who have sex with men.

We found disparities in HPV vaccination rates among foreign-born men regarding region of birth, number of years in the US, and US citizenship status. In the adjusted model accounting for citizenship status and number of years in the US, the difference was not statistically significant. Immigrants from Indian subcontinent had the lowest vaccination rates, potentially reflecting low knowledge about the benefits of HPV vaccination and cost (Vohra et al., 2013); as Indians are third largest group of immigrants in the US (United States Census Bureau), further efforts to identify modifiable factors underlying low rates of HPV vaccination in this subgroup are warranted. Immigrants may not prioritize preventive care such as non-required vaccinations since they may face other, more immediate challenges upon arrival, such as securing employment or establishing residence. Foreign-born men who reported US citizenship or had been in the US for ≥10 years had higher rates of HPV vaccine initiation and completion. This may reflect the fact that foreign-born men who had been in the US for a longer period of time and/or become US citizens are more acculturated, they might have gone through school/college in the US and been exposed to more age-appropriate messaging, and wellness visits. It is also likely that they have the necessary resources to overcome barriers that may impede accessing health care, which include linguistic, cultural, and knowledge-related barriers. To decrease these disparities, interventions are needed that are culturally and linguistically sensitive and that prepare healthcare providers to effectively present and recommend HPV vaccination to foreign-born men.

4.1. Limitations

Study findings should be interpreted in the context of its limitations. This analysis was limited by self-reported data for HPV vaccination which could lead to recall bias. There is also a potential time lag between receipt of vaccination and the time the interview was conducted. Patients who received the HPV vaccination when they were adolescents might not recall since their parents/guardians might have overseen their healthcare needs at that moment. We did conduct a sensitivity analyses by limiting our data to only 18–26 years since some of these might have receive the vaccine as adults and the results were similar to main analyses. Future studies should focus on the association between nativity status and HPV vaccine uptake among adolescent males. Second, nativity status did not take in account acculturation. However, we used citizenship status and number of years in the US as surrogates to account for acculturation in the analyses. Third, since this was a cross-sectional study, no causal inference could be made about the findings. Moreover, as with many observational studies, there is always risk of unmeasured confounders altering the associations of interest. For example, NHIS does not collect information on factors such as provider recommendation and therefore we could not investigate if foreign-born men were less likely to have received a strong provider vaccine recommendation. We also did not have any information on the availability of the HPV vaccine in the country of origin of foreign-born men. Furthermore, there could be temporal issues with some of the variables. For example, insurance status is reported as insurance status of respondent at the time of interview and not insurance at the time of vaccination. Finally, the small number of foreign-born men who had completed the vaccination might have contributed to the non-statistically significant findings. Also, the small sample size for country of origin did prevent us from performing adjusted analyses with that variable.

5. Conclusion

This study found that HPV vaccination rate was very low among all men. We also found disparities among foreign-born men by US citizenship status, number of years in US, and country of origin that require further investigation. In this study, after adjusting for demographic, socioeconomic, and healthcare factors, foreign-born men had lower odds of having initiated the HPV vaccination compared with US-born men. If these disparities remain unaddressed, they could have long-term implications for disparities in HPV-associated cancers among US immigrant adults. There is a need for targeted outreach to foreign-born men to further understand the findings reported here and identify mechanisms through which interventions may improve HPV vaccination coverage in this population.

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Declaration of Competing Interest

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

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Appendix A. Supplementary data

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