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Racial disparities in human papillomavirus vaccination: Does access matter?

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Abstract

Purpose—To examine the association between race/ethnicity and HPV vaccine initiation and to determine how access to healthcare influences this relationship.

Methods—We used nationally representative data from the National Survey of Family Growth to assess HPV vaccine initiation in 2,168 females aged 15–24. A series of regression analyses were performed to determine the independent effect of race/ethnicity on HPV vaccine initiation after controlling for socio-demographic variables and healthcare access measures. Age-stratified regression analyses were also performed to assess whether the relationship between race/ethnicity and HPV vaccine initiation differed between females aged 15–18 and 19–24.

Results—There were significant racial/ethnic disparities in HPV vaccination with US-born Hispanics, foreign-born Hispanics, and African-Americans less likely to have initiated vaccination than whites ($p<0.001$). Adjusting for socio-demographic characteristics attenuated the disparity for both US-born and foreign-born Hispanics (adjusted odds ratio (AOR): 0.76; 95% confidence interval (CI): 0.50–1.16 and AOR: 0.67; 95% CI: 0.37–1.19) but not for African-Americans (AOR: 0.47; 95% CI: 0.33–0.66). Adding healthcare access measures further attenuated the disparity for US-born and foreign-born Hispanics (AOR: 0.85; 95% CI: 0.54–1.34 and AOR: 0.84;

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95% CI: 0.45–1.55). African-Americans, however, remained less likely than whites to have initiated vaccination (AOR: 0.49; 95% CI: 0.36–0.68). These racial/ethnic trends were similar for females aged 15–18 and 19–24.

Conclusions—Lower rates of HPV vaccination among African-American females do not appear to be explained by differential access to healthcare. More research is necessary to elucidate factors contributing to HPV vaccination in this population.

Keywords

race/ethnicity; HPV; NSFG; disparities; vaccination

Introduction

Squamous cell cervical cancer risk begins with human papillomavirus (HPV) infection. Two strains (HPV 16 and 18) are responsible for 70% of all cervical cancer (1). In the US, the availability of two HPV vaccines active against these HPV subtypes (Gardasil, approved in 2006 and Cervarix, approved in 2009) provides an opportunity for primary prevention of HPV infection. Given the important role of HPV vaccination in preventing cervical cancer, as well as other cancers and genital warts, the Centers for Disease Control and Prevention (CDC) recommends that all girls and boys aged 11–12 receive the three dose vaccination series, with catch-up recommended through age 26 for girls and age 21 for boys (2). Because even one dose may provide significant HPV protection (3), initiation of the HPV vaccine series is a highly important public health goal.

Despite the safety and efficacy of HPV vaccination (4), national rates of vaccination remain suboptimal, with only 53% of adolescent girls (aged 13–17) (5) and 21% of young adult females (aged 19–26) (6) reporting vaccine initiation. Given that cervical cancer is more common and associated with higher mortality in African-American and Hispanic women than in white women (7, 8), it is especially important to understand barriers to HPV vaccination for these populations. Previous multivariable analyses have had mixed conclusions regarding racial and ethnic differences in HPV vaccination among females. For adolescents (below the age of 18 or 19), nationally representative studies have shown lower, equivalent, and higher rates of HPV vaccine initiation among females in minority racial/ethnic groups compared to white females (9–13). A recent meta-analysis including 14 local and nationally representative studies between 2007 and 2010 showed that black adolescent females were, on average, less likely to have initiated HPV vaccination compared to their white counterparts, while data for Hispanic females was too heterogeneous to pool (14). Studies using national data to assess vaccine initiation in young adults (over the age of 17 or 18) have mostly found equivalent vaccination rates for African-American, Hispanic, and white females in multivariable analyses (15–19). To our knowledge, there have been no multivariable studies using national data after 2008 to assess the relationship between race/ethnicity and HPV vaccine initiation in both adolescents and young adults.

Racial variation in HPV vaccination, like many health disparities, is likely multifactorial. Decreased access to healthcare and poorer quality of care have been documented for many racial/ethnic minorities (20). Among adolescents and young adults, African-Americans and

Hispanics are less likely to have continuous insurance coverage or to have had a doctor visit in the past year compared to age-matched whites (21). Hispanics adolescents and young adults are also less likely to have a usual place to go to when they are sick than their white or African-American counterparts (21). Given that the HPV vaccine must be administered by a healthcare professional, decreased access to health services may contribute to the under-vaccination of minority females. Additionally, vaccination is estimated to cost $390 without insurance (2), although these costs may be mitigated by Vaccines for Children, a federal program which offers vaccination to uninsured or underinsured children under the age of 19, and pharmaceutical company-sponsored assistance programs. Many studies have identified an association between utilization of healthcare resources and HPV vaccination (9, 11, 12, 15, 16, 18, 22–24), whether limited access to healthcare explains racial/ethnic disparities in HPV vaccination has not been thoroughly explored.

Because HPV vaccination has been shown to decrease the prevalence of oncogenic HPV strains and cervical neoplasia (4), it is important to identify disparities in vaccination. Moreover, an analysis of the role of healthcare access in explaining disparities in HPV vaccination may clarify whether making the vaccine more accessible is likely to increase vaccine uptake in vulnerable populations. Therefore, we used nationally representative data to examine the independent effect of race/ethnicity on HPV vaccine initiation in adolescent girls and young women and to determine whether access to healthcare influences this relationship.

Methods

Data source

This study used data from the 2006–2010 National Survey of Family Growth (NSFG (25), a national cross-sectional survey. The NSFG is designed and administered by the National Center for Health Statistics, an agency of the US Department of Health and Human Services, to provide national estimates of factors affecting reproductive health. Interviewing for the 2006–2010 NSFG occurred between June 2006 and June 2010, and the full dataset was released to the public in October 2011. One of the key independent variables used for these analyses (whether the respondent has a usual source of healthcare) was added to the survey in July 2008, thus we used only data collected between July 2008 and June 2010 for this study. Each year of interviewing in the NSFG can be considered a nationally representative sample, and results from multiple years can be combined for more reliable population estimates.

Study sample

The NSFG uses a national probability sample designed to represent men and women aged 15 to 44 living in households in all 50 States and the District of Columbia. Teenage, African-American, Hispanic, and female participants were over-sampled, and the NSFG provides sampling weights to adjust for the different sampling and response rates within the survey sample. Self-reported HPV vaccination status was only assessed for female participants under the age of 25, thus this cohort comprised our study population.

Study outcome

The primary outcome of interest was whether the participant had ever received the HPV vaccine. Participants were first asked whether they had heard of "the cervical cancer vaccine, HPV shot, or Gardasil." As this question was added to the NSFG survey in 2007, soon after the national release of Gardasil but before the release of Cervarix, only Gardasil is listed by name. If a participant said that she had heard of the HPV vaccine, she was subsequently asked about her HPV vaccination status. If a participant had received at least one of the three HPV vaccine shots, she was considered to have received the vaccine. The NSFG does not assess how many doses of the HPV vaccine respondents have received. If a participant indicated that she had not received any HPV vaccination, or if she had not heard of the HPV vaccine, she was considered not to have been vaccinated in this study.

Independent variables

The primary independent variable of interest was self-reported race/ethnicity. Participants were asked whether they were Hispanic, Latino, or of Spanish origin. Those who answered affirmatively were classified as "Hispanic." Participants were subsequently categorized as non-Hispanic white, non-Hispanic black, or non-Hispanic other based on a follow-up question about their racial background. Participants categorized as non-Hispanic other (n=135) were removed from our analysis as this group was too small and too heterogeneous to generate meaningful conclusions. Participants were also asked whether they were born in the United States. Given the large number of Hispanic females born outside of the US, we divided Hispanics into US-born and foreign-born.

Socio-demographic factors including age, religion, parent education level, household income, place of residence (urban, suburban or rural), and number of lifetime male sexual partners were examined as potential confounders. Participant education was initially considered as a covariate but ultimately excluded because of its high correlation with age in this young sample. We included two healthcare access variables that could influence vaccination status: insurance status and whether the participant had a usual place for receiving healthcare.

Statistical analysis

We compared socio-demographic and access variables by race/ethnicity using chi-squared tests for all categorical variables. We then assessed the bivariate associations between each covariate and our primary outcome, HPV vaccine initiation, and calculated unadjusted odds ratios (OR) for each pair.

To understand the role of healthcare access as a confounder for the association between race/ethnicity and HPV vaccine initiation, we conducted a series of regression analyses. We first examined the unadjusted relationship between race/ethnicity and HPV vaccination (Model 1). In Model 2, we adjusted for socio-demographic variables that were associated with HPV vaccination at the $p<0.10$ level in bivariate analyses, with the exception that we decided *a priori* to force household income into the model. In Model 3, we adjusted for all of the socio-demographic variables included in Model 2 and added our two healthcare

access variables into the model. A change of at least 10% between Models 2 and 3 was considered a confounding effect by healthcare access (26).

Given that existing national studies have restricted their analyses to either adolescents or young adults, we also conducted age-stratified analyses to enable comparison to existing published data. We performed the same series of regression analyses described above for each age group (15–18 and 19–24), using the same covariates that were used in the main analyses.

Statistics for this analysis were performed using Stata 11 SE software (StataCorp, College Station, TX), using appropriate adjustment for the NSFG's complex sample design. All percentages shown have been weighted to reflect national estimates, however, actual sample sizes are also provided to give the reader an indication of the reliability of the estimates. This study was approved by the University of Pittsburgh Institutional Review Board.

Results

Our study sample included 2,168 females aged 15–24. Table 1 shows the socio-demographic characteristics of the study sample by race/ethnicity. Briefly, 63.6% were white, 13.8% were US-born Hispanic, 5.3% were foreign-born Hispanic, and 17.2% were African-American. The four groups differed significantly in all socio-demographic and healthcare access variables. For example, US-born and foreign-born Hispanics were more likely to be uninsured than whites (25.9%, 41.1%, and 16.3%, respectively). African-Americans were more likely to have public insurance than whites (44.4% and 17.2%, respectively). Both US-born and foreign-born Hispanics and African-Americans were less likely than whites to have a usual source of healthcare (76.1%, 71.1%. 79.6%, and 84.7%, respectively).

Results from the bivariate and unadjusted analyses are shown in Table 2. Overall, only 28.4% of participants had received at least 1 dose of an HPV vaccine. US-born and foreign-born Hispanics and African-Americans were significantly less likely than whites to have been vaccinated (unadjusted odds ratio (OR): 0.65; 95% confidence interval (CI): 0.44–0.95, OR: 0.39; 95% CI 0.23–0.68, and OR: 0.45; 95% CI: 0.33–0.62, respectively). Females who were aged 15–18, had at least one parent with a HS diploma or some college education, had public or private insurance, or had a usual source of healthcare had higher rates of vaccine initiation in unadjusted analyses.

Results from the multivariable regression analyses are shown in Table 3. After adjusting for socio-demographic variables (age, parent education level, and household income) in Model 2, the odds of HPV vaccine initiation among both US-born and foreign-born Hispanics increased and became non-significant compared to whites (adjusted odds ratio (AOR): 0.76; 95% confidence interval (CI): 0.50–1.16 and AOR: 0.67; 95% CI: 0.37–1.19, respectively). Adding the two healthcare access variables (insurance and has a usual source of healthcare) in Model 3 further increased the odds of vaccination for US-born and foreign-born Hispanics (AOR: 0.85; 95% CI: 0.54–1.34 and AOR: 0.84; 95% CI: 0.45–1.55, respectively). African-Americans, however, remained significantly less likely to have reported vaccination than whites after adjusting for socio-demographic factors in Model 2

(AOR: 0.47; 95% CI: 0.33–0.66). The addition of healthcare access variables in Model 3 did not substantially alter this disparity (AOR: 0.49; 95% CI: 0.36–0.68). In the final adjusted analysis (Model 3), females who were aged 15–18, had at least one parent with some college education, had public or private insurance, and had a usual source of healthcare had a higher likelihood of HPV vaccine initiation.

Table 4 shows the results from the age-stratified analyses. Because of comparable trends among US-born and foreign-born Hispanics in the full sample, we combined these groups in the stratified analyses to improve the reliability of our estimates. Among the 872 adolescent girls aged 15–18, Hispanics and African-Americans were significantly less likely to have initiated HPV vaccination in unadjusted analysis compared to whites (OR: 0.48; 95% CI: 0.31–0.72 and OR: 0.41; 95% CI: 0.27–0.62, respectively). Adjusting for socio-demographic variables (parent education level and household income) substantially increased the odds of vaccination for Hispanics, becoming statistically non-significant in comparison with white adolescents (AOR: 0.64; 95% CI: 0.38–1.09). Adding the two healthcare access variables into the model further increased the odds of vaccination for Hispanics (AOR: 0.73; 95% CI: 0.42–1.27). Conversely, African-Americans remained less likely to have initiated vaccination after adjusting for socio-demographic covariates (AOR: 0.44; 95% CI: 0.28–0.68). The addition of healthcare access variables also did not substantially affect the odds of vaccine initiation for African-American adolescents (AOR: 0.47; 95% CI: 0.29–0.75).

For the 1,296 young women aged 19–24, Hispanics were less likely to have initiated vaccination, but this did not reach statistical significance (OR: 0.62; 95% CI: 0.35–1.08). Adjusting for socio-demographic variables increased the odds of vaccination for Hispanics (AOR: 0.88; 95% CI: 0.48–1.63); the odds were further increased with the addition of healthcare access variables into the model (AOR: 1.03; 95% CI: 0.54–2.00). Conversely, African-Americans were significantly less likely to have reported HPV vaccination compared to whites across all three models with no attenuation in the disparity even after adjusting for socio-demographic variables and healthcare access variables (OR 0.46; 95% CI: 0.27–0.78 in Model 1; AOR 0.47; 95% CI: 0.27–0.82 in Model 2; and AOR: 0.51; 95% CI: 0.29–0.88 in Model 3).

Discussion

In this nationally representative sample of adolescent girls and young women interviewed between 2008 and 2010, African-Americans were significantly less likely than whites to have initiated HPV vaccination, even after taking into account socio-demographic and healthcare access covariates. This disparity persisted among both younger (aged 15–18) and older (aged 19–24) African-Americans. Disparities in HPV vaccination for Hispanics, on the other hand, were fully attenuated after adjusting for socio-demographic and healthcare access variables.

Our results among adolescents aged 13–17 are consistent with a recent meta-analysis showing that black female adolescents are less likely to have initiated HPV vaccination compared to their white counterparts (14). However, several studies have shown equal or higher vaccine initiation among adolescents from racial/ethnic minority groups (5, 9–12, 22,

27). One explanation for the inconsistency with other studies is that patterns of HPV vaccination may be changing over time. Of note, the 2010 NIS-Teen demonstrated increased HPV vaccine initiation in Hispanic girls and comparable rates of vaccine initiation among African-American and white girls ages 13–17 (56.2%, 48.9%, and 45.8%, respectively) (27). Then, the 2011 NIS-Teen showed increased HPV vaccine initiation in both Hispanic and African-American girls compared to white girls (65%, 56%, and 47.5%, respectively) (5). These findings suggest that patterns of HPV vaccination are rapidly changing in adolescent girls, with greater increases in vaccine initiation among Hispanics and African-Americans compared to whites. These changes may reflect changes in provider and patient familiarity with the HPV vaccine as well as federal vaccine programs offering vaccine assistance and outreach to children over time. The NIS-Teen's different racial/ethnic patterns of HPV vaccine initiation, as well as the higher rates of HPV vaccine initiation overall compared to our findings, may also reflect different methods of obtaining vaccination status in the NIS-Teen compared to the NSFG. In particular, whereas the NSFG relies solely on self-report, the NIS-Teen confirms parental report of vaccination status with provider immunization records. A recent study demonstrated that parents of Hispanic and African-American adolescents were less likely than parents of white adolescents to correctly identify that their daughters had received HPV vaccination (28); likewise it is possible that the Hispanic and African-American adolescents in our study were underreporting HPV vaccination. While the NIS-Teen's vaccination data is slightly more recent and perhaps less subject to recall error, using the NSFG for our analyses allowed us to capture and examine personal participant information such as sexual activity and usual source of healthcare.

For young women aged 19–24, our results are consistent with several local studies showing decreased HPV vaccine initiation in African-American young adults compared to their white counterparts (29, 30). However, a recent analysis of the 2010 National Health Interview Survey (NHIS) found that lower rates of vaccine initiation among Hispanic and African-American females compared to whites aged 19–26 (18.1%, 18.8%, and 24.9%, respectively) were not statistically significant (16). Our different results may reflect methodological differences between the NHIS and NSFG including the slightly smaller sample size (n=1,892) and wider age range (ages 18–26) in the NHIS.

Interestingly, we found that disparities in HPV vaccine initiation among Hispanics, but not African-Americans, were attenuated after adjusting for healthcare access variables. Given that Hispanics were the least likely racial/ethnic group to have insurance or a usual source of healthcare, our findings suggest that improving these healthcare access parameters could lead to increased vaccination rates in this population. On the other hand, our findings in African-Americans suggest that there are other unmeasured patient- or provider-level factors contributing to under-vaccination and that alternate strategies will need to be identified to increase HPV vaccination. Although the data are limited, negative attitudes towards the HPV vaccine appear to be barriers to HPV vaccination among African-American females (31, 32). Conversely, provider recommendation for HPV vaccination has emerged as an important enabling factor for increasing HPV vaccination among African-American females (33, 34). While there is a positive association between receiving a recommendation and HPV vaccine receipt among white, Hispanic and African-American females, the relationship is strongest for African-Americans (35). Unfortunately, African-Americans are less likely to

receive an HPV vaccine recommendation from a provider compared to whites (10, 35). These findings indicate that improving access to healthcare may be insufficient in increasing HPV vaccination among African-Americans; perhaps, addressing negative attitudes and beliefs and increasing provider recommendation for HPV vaccination will be fruitful in increasing HPV vaccination rates in this population.

Our study had several important limitations. First, socio-demographic characteristics and healthcare access variables were assessed at the time of interview, rather than at the time of vaccination, and may have changed over time. Similarly, date of vaccination is not documented by the NSFG so we cannot discern whether our findings reflect current or previous vaccine uptake patterns. Because the NSFG does not mention Cervarix when assessing HPV vaccination status, it is possible that some participants who received this vaccine were not aware of its indication or familiar that it is a product similar to Gardasil. The NSFG also does not confirm vaccination status with immunization records which could lead to misclassification bias. Finally, the NSFG only assesses vaccine initiation and not completion, which appears to differ by race (11). However, given that even one HPV vaccine dose effectively reduces HPV acquisition (3), racial/ethnic disparities in HPV vaccine initiation are a significant public health problem.

Conclusions

In summary, after controlling for socio-demographic factors and markers of access to healthcare, African-American females aged 15–24 were significantly less likely to have initiated HPV vaccination compared to white females. Observed disparities in HPV vaccine initiation among both US-born and foreign-born Hispanics, on the other hand, were largely explained by socio-demographic and healthcare access variables. Research is needed to further elucidate the reasons for under-vaccination among African-American adolescents and young women and identify ways in which providers and healthcare systems may improve HPV vaccine uptake for this vulnerable population.

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Abbreviations/Acronyms

CDC	Centers for Disease Control and Prevention
HPV	Human papillomavirus
NHIS	National Health Interview Survey
NIS-Teen	National Immunization Survey - Teen
NSFG	National Survey of Family Growth

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Implications and Contribution

African-American females are less likely to have initiated HPV vaccination compared to whites; this cannot simply be explained by differential access to healthcare.

Table 1

Socio-Demographic and Healthcare Access Characteristics by Race/Ethnicity (n=2,168)

Variable	White (n=1,110) (%)	Hispanic (US-born) (n=405) (%)	Hispanic (Foreign-born) (n=149) (%)	AA (n=504) (%)	p value
Total population	63.6	13.8	5.3	17.2	
Age (years)					0.001
15–18	35.2	46.8	26.9	40.3	
19–24	64.8	53.2	73.1	59.7	
Religion					<0.001
Protestant	47.3	21.7	14.8	78.1	
Catholic	20.1	58.8	75.1	5.4	
Other religion	7.7	3.9	2.0	3.3	
None	24.9	15.6	8.1	13.2	
Parent education level[a]					<0.001
Less than HS	2.4	25.7	54.3	7.4	
HS diploma	20.9	27.5	21.2	29.9	
At least some college	76.7	46.8	24.5	62.7	
Household income (% of poverty level)[b]					<0.001
<100	22.7	38.2	49.2	43.8	
100–199	24.4	29.3	29.2	24.5	
200+	52.9	32.5	21.6	31.7	
Place of residence[c]					<0.001
Urban	24.0	37.2	41.3	58.3	
Suburban	53.9	56.4	49.0	37.6	
Rural	22.1	6.4	9.7	4.1	
Lifetime male sexual partners					<0.001
None	34.1	36.4	30.3	31.7	

Variable	White (n=1,110) (%)	Hispanic (US-born) (n=405) (%)	Hispanic (Foreign-born) (n=149) (%)	AA (n=504) (%)	p value
One to three	34.0	47.1	51.0	27.4	
More than three	31.9	16.5	18.7	40.9	
Insurance status					<0.001
No insurance[d]	16.3	25.9	41.1	17.5	
Public insurance	17.2	37.2	35.4	44.4	
Private insurance	66.5	36.9	23.5	38.1	
Has a usual source of healthcare	84.7	76.1	71.1	79.6	0.002

Weighted to reflect the US female household population.

AA=African-American; HS = high school

[a]Participants who had no mother or father were considered to have a mother or father with less than HS education, respectively. Participants who did not know their mother or father's education were considered to have a mother or father with at least some college education, respectively.

[b]Poverty threshold based on 2008–2010 level defined by the US Census Bureau, which takes into account total household income and number.

[c]In the NSFG, place of residence is divided into three groups consistent with US Office of Management and Budget definitions: Metropolitan Statistical Area (MSA)- central city, MSA-other, and non-MSA. These roughly correspond to urban, suburban, and rural settings.

[d]Participants with only single service plans were considered to have no insurance.

Table 2

Unadjusted Odds of HPV Vaccine Initiation (n=2,168)

	HPV vaccine initiation (%)	Unadjusted OR	p value
Total Sample	28.4		
Race/ethnicity			<0.001
White	33.1	Reference	-
Hispanic, US-born	24.2	0.65 (0.44–0.95)	0.028
Hispanic, foreign- born	16.2	0.39 (0.23–0.68)	0.001
African-American	18.2	0.45 (0.33–0.62)	<0.001
Age (years)			0.001
15–18	34.7	Reference	-
19–24	24.6	0.62 (0.46–0.82)	0.001
Religion			0.200
Protestant	27.0	Reference	-
Catholic	31.0	1.22 (0.90–1.65)	0.197
Other religion	21.1	0.72 (0.45–1.17)	0.181
None	30.4	1.18 (0.85–1.65)	0.319
Parent education level[a]			<0.001
Less than HS	12.0	Reference	-
HS diploma	24.3	2.35 (1.40–3.94)	0.002
At least some college	32.0	3.45 (1.98–6.00)	<0.001
Household income (% of poverty level)[b]			0.150
<100	24.8	Reference	-
100–199	29.0	1.24 (0.92–1.67)	0.152
200+	30.5	1.33 (0.98–1.81)	0.070
Place of residence[c]			0.426
Urban	26.4	Reference	-
Suburban	28.0	1.08 (0.82–1.43)	0.569
Rural	33.5	1.40 (0.75–2.65)	0.286
Lifetime male sexual partners			0.532
None	28.2	Reference	-
One to three	30.4	1.11 (0.82–1.50)	0.491
More than three	26.3	0.91 (0.61–1.36)	0.633
Insurance status			<0.001
No insurance[d]	10.2	Reference	-
Public insurance	26.1	3.12 (1.98–4.90)	<0.001
Private insurance	35.7	4.91 (3.03–7.95)	<0.001

	HPV vaccine initiation (%)	Unadjusted OR	p value
Has a usual source of healthcare			<0.001
No	12.1	Reference	-
Yes	32.0	3.43 (2.08–5.65)	<0.001

Weighted to reflect the US female household population.

HPV= human papillomavirus; HS = high school; OR = odds ratio

[a]Participants who had no mother or father were considered to have a mother or father with less than HS education, respectively. Participants who did not know their mother or father's education were considered to have a mother or father with at least some college education, respectively.

[b]Poverty threshold based on 2008–2010 level defined by the US Census Bureau, which takes into account total household income and number.

[c]In the NSFG, place of residence is divided into three groups consistent with US Office of Management and Budget definitions: Metropolitan Statistical Area (MSA)- central city, MSA-other, and non-MSA. These roughly correspond to urban, suburban, and rural settings.

[d]Participants with only single service plans were considered to have no insurance.

Table 3

Adjusted Odds of HPV Vaccine Initiation (n=2,168)

	Model 1[a]		Model 2[b]		Model 3[c]	
	OR	**p value**	**OR**	**p value**	**OR**	**p value**
Race/ethnicity						
White	Reference	-	Reference	-	Reference	-
Hispanic, US-born	0.65 (0.44–0.95)	0.028	0.76 (0.50–1.16)	0.195	0.85 (0.54–1.34)	0.484
Hispanic, foreign-born	0.39 (0.23–0.68)	0.001	0.67 (0.37–1.19)	0.166	0.84 (0.45–1.55)	0.569
African-American	0.45 (0.33–0.62)	<0.001	0.47 (0.33–0.66)	<0.001	0.49 (0.36–0.68)	<0.001
Age (years)						
15–18			Reference	-	Reference	
19–24			0.59 (0.44–0.79)	0.001	0.71 (0.53–0.95)	0.023
Parent education level[d]						
Less than HS			Reference	-	Reference	-
HS diploma			2.05 (1.11–3.77)	0.022	1.83 (0.98–3.41)	0.056
At least some college			2.85 (1.43–5.70)	0.004	2.34 (1.16–4.70)	0.018
Household Income (% of poverty level)[e]						
<100			Reference	-	Reference	-
100–199			1.11 (0.82–1.51)	0.477	1.09 (0.80–1.49)	0.575
200+			1.06 (0.75–1.50)	0.719	0.89 (0.62–1.28)	0.519
Insurance status						
No insurance[f]					Reference	-
Public insurance					2.71 (1.70–4.33)	<0.001
Private insurance					3.36 (2.10–5.36)	<0.001
Has a usual source of healthcare						
No					Reference	-
Yes					2.45 (1.49–4.02)	0.001

Weighted to reflect the US female household population.

HPV= human papillomavirus; HS = high school; OR = odds ratio

[a] Unadjusted odds ratios by race/ethnicity, replicated from Table 2

[b] Model includes race/ethnicity, age, parent education level, household income

[c] Model includes race/ethnicity, age, parent education level, household income, insurance status, usual source of healthcare

[d] Participants who had no mother or father were considered to have a mother or father with less than HS education, respectively. Participants who did not know their mother or father's education were considered to have a mother or father with at least some college education, respectively.

[e] Poverty threshold based on 2008–2010 level defined by the US Census Bureau, which takes into account total household income and number.

[f] Participants with only single service plans were considered to have no insurance.

Table 4

Adjusted Odds of HPV Vaccine Initiation, Stratified by Age (n=2,168)

	Model 1[a]		Model 2[b]		Model 3[c]	
	OR	**p value**	**OR**	**p value**	**OR**	**p value**
Ages 15–18 (n=872)						
White	Reference	-	Reference	-	Reference	-
Hispanic	0.48 (0.31–0.72)	0.001	0.64 (0.38–1.09)	.100	0.73 (0.42–1.27)	0.262
African-American	0.41 (0.27–0.62)	<0.001	0.44 (0.28–0.68)	.001	0.47 (0.29–0.75)	0.002
Ages 19–24 (n=1,296)						
White	Reference	-	Reference	-	Reference	-
Hispanic	0.62 (0.35–1.08)	0.088	0.88 (0.48–1.63)	0.678	1.03 (0.54–2.00)	0.920
African-American	0.46 (0.27–0.78)	0.005	0.47 (0.27–0.82)	0.009	0.51 (0.29–0.88)	0.016

Weighted to reflect the US female household population.

HPV= human papillomavirus; OR = odds ratio

[a] Unadjusted odds ratios by race/ethnicity

[b] Model includes race/ethnicity, parent education level, household income

[c] Model includes race/ethnicity, parent education level, household income, insurance status, usual source of healthcare