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Major Article

Characteristics associated with human papillomavirus vaccination initiation and completion among young adults

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Key Words:
HPV vaccination
Prevalence

Background: Human papillomavirus (HPV) vaccination has been recommended for young adults aged 18-26 years.

Methods: Data from the 2016 and 2017 National Health Interview Survey were pooled.

Results: The prevalence of HPV vaccination initiation (≥1 dose) was 32.54% in 2016 and 37.92% in 2017, and the prevalence of HPV vaccination completion (≥3 doses) was 17.05% in 2016 and 19.38% in 2017 among young adults aged 18-26 years. Being female sex (odds ratio: 4.74) was the leading indicator for receiving the HPV vaccine, followed by receipt of other recommended vaccines (pneumococcal, hepatitis B, and hepatitis A), begin born in the United States, being gay/lesbian, having a greater number of physician visits, being younger, not being married, living in the Northeast, ever having had a pap smear, higher education, being not Hispanic ethnicity, and having more physical activity. Meanwhile, being female sex (odds ratio: 7.23) was the leading indicator for completing the HPV vaccination, followed by receipt of other recommended vaccines (pneumococcal, hepatitis B, and hepatitis A), having a greater number of physician visits, being younger, being born in the United States, being gay/lesbian, living in the Northeast, and current drinking.

Conclusions: HPV vaccination coverage remains low among young adults, and HPV vaccine coverage was associated with a number of characteristics.

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States.[1] Based on data from 2011-2015, approximately 42,700 new cases of HPV-associated cancers occurred in the United States each year, including approximately 24,400 among women, and approximately 18,300 among men.[2] Cervical cancer (49%) is the most common HPV-associated cancer among women, and oropharyngeal cancers (81%) are the most common among men.[2] To reduce the health burden of HPV, the Advisory Committee on Immunization Practices recommends routine HPV vaccination for girls and boys aged 11-12 years, and for female sex through age 26 and male sex through age 21 who did not receive the HPV vaccine when they were younger, as well as male sex aged 22-26 years at high risk.[3] During the past 10 years since the HPV vaccine was first introduced in the United States in 2006, substantial progress has been made and advances in research have led to policy and program changes; however, HPV vaccination coverage remains lower than for other vaccines recommended.[4] Factors associated with HPV vaccination include sex, ethnicity, socioeconomic status, and health care use.[5,6] However, the previous findings mainly focused on adolescents,[5,6] and studies exploring HPV vaccination disparities among young adults are limited.[7,8] National HPV vaccination coverage among young US adults in the years of 2016 and 2017 are not published, and characteristics associated with HPV vaccination coverage among young US adults are unclear. Exploring characteristics associated with HPV vaccination prevalence among adults is also important because prevalence of any and high-risk genital HPV for adults aged 18-59 was 45.2% and 25.1% in men and 39.9% and 20.4% in women,[9] respectively. The National Health Interview Survey (NHIS) is the principal source of information on the health of the civilian noninstitutionalized population of the United States, and data from the 2017 NHIS were released recently. Timely measurement of characteristics associated with HPV vaccination coverage is critical for public health interventions to improve HPV vaccination. Therefore, the objective of this study was to assess characteristics associated with HPV vaccination initiation (≥1 dose) and completion (≥3 doses) among young adults

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aged 18-26 years by demographic, socioeconomic, health care, and health behavioral characteristics.

METHODS

The main objective of the NHIS is to monitor the health of the United States population through the collection and analysis of data on a broad range of health topics. The NHIS is a cross-sectional household interview survey, and the target population is the civilian noninstitutionalized population residing in the United States at the time of the interview. The sample design follows a multistage area probability design. In this analysis, we first merged the data from the Family File, Person File, and Sample Adult File in the 2016 and 2017 NHIS, respectively, and then combined the merged data from the 2016-2017 NHIS (the years fall within the same sample design period with the same public use design variables). The conditional response rates for the Family section were 98.9% in 2016 and 98.9% in 2017, and 80.9% in 2016 and 80.7% in 2017 for the Sample Adult section. Questions related to adult HPV immunizations included if they have ever received the HPV vaccine and number of HPV shots received. The NHIS was approved by the Research Ethics Review Board of the National Center for Health Statistics.

Since October 2016, adolescents aged 11-14 years need only 2 vaccine doses at least 6 months apart, and 3 doses remain recommended for persons who initiate the vaccination series at ages 15-26 years.[10] However, because this analysis is only restricted to young adults (18-26 years), vaccination completion was defined as receiving 3 or more vaccine doses. According to the previously related studies,[5,6] a number of factors including demographic characteristics, socioeconomic status, health behaviors, and health care characteristics were considered in this analysis. There are 7 demographic characteristics (sex, age, region, race, Hispanic ethnicity, nativity disparity, and sexual orientation), 7 socioeconomic characteristics (marital status, class of worker, number of years on the job, education, computer usage, health insurance coverage, and ratio of family income to the poverty threshold), 3 health behavior characteristics (smoking, drinking, light/moderate physical activity), and 6 health care characteristics (pneumonia vaccine, hepatitis A vaccine, hepatitis B vaccine, pap smear in the past 12 months, having a usual place for sick care, and number of physician visits in the past 12 months).

Because data collected in the NHIS were obtained through a complex, multistage sample design that involves stratification, clustering, and oversampling of specific population subgroups, weighted data were used to produce national estimates and 95% confidence intervals (CIs). The sampling weights for pooled data from 2016-2017 were adjusted by dividing each sample weight in the pooled dataset by 2. Characteristics with 3 or more categories were treated as indicator (dummy) variables in the logistic analysis, and public use variance estimation variables were used for the logistic regression, including stratum for variance estimation, primary sampling unit for variance estimation, and weight. Characteristics were then included in the multivariate model if the P values were <.10 in individual univariate logistic models.[11] To explore the issue of collinearity, pairwise correlation coefficients between the variables were calculated. The results showed that the pairwise correlation coefficients ranged from −0.26 to 0.24. Stata 12.0 (Stata Corp, College Station, TX) was used, and $P \leq .05$ was considered statistically significant.

RESULTS

After excluding respondents who answered “Don’t know” or refused or not ascertained (N = 683, 9.57%), a total of 6,452 young adults (male: 3,026; female: 3,426) aged 18-26 years were included in this analysis. The weighted number of young adults was 68,915,925 (male: 34,333,914; female: 34,582,011). The weighted prevalence of HPV vaccination initiation was 32.54% (95% CI, 30.33-34.75%) in 2016 and 37.92% (35.46-40.38%) in 2017, and the weighted prevalence of HPV vaccination completion was 17.05% (15.45-18.66%) in 2016 and 19.38% (17.30-21.46%) in 2017. The basic characteristics HPV vaccination initiation group and completion group versus corresponding control group are shown in Table 1. Detailed results from univariate analysis and multivariate analysis are shown in Table 2.

Demographic characteristics

In the multivariate analysis, female sex (odds ratio with 95% CI, 4.74 [3.94-5.72]), subjects born in the United States (2.16 [1.59-2.94]), gay/lesbian (1.98 [1.38-2.85]), and subjects not of Hispanic ethnicity (1.28 [1.01-1.63]) had a significantly higher likelihood of initiating HPV vaccination, whereas subjects from the South (0.69 [0.52-0.91]) and young adults aged 21-26 years (0.58 [0.47-0.73]) had a lower likelihood of initiating HPV vaccination. In the analysis with HPV vaccination completion, female sex (7.23 [5.58-9.36]), subjects born in the United States (1.73 [1.13-2.66]), and gay/lesbian (1.70 [1.10-2.64]) had a significantly higher likelihood of completing HPV vaccination, whereas subjects from the South (0.60 [0.43-0.84]) and Midwest (0.64 [0.45-0.91]) and young adults aged 21-26 years (0.54 [0.40-0.74]) had a lower likelihood of completing HPV vaccination.

Socioeconomic characteristics

In the multivariate analysis, the results showed that subjects receiving a higher level of education (associate degree or higher: 1.28 [1.01-1.63]) had a higher likelihood of initiating HPV vaccination, whereas being not married (0.63 [0.51-0.77]) was associated with lower likelihood of initiating HPV vaccination. However, none of these socioeconomic characteristics were found associated with prevalence of completing HPV vaccination.

Health behavior characteristics

In the multivariate analysis, the results showed that subjects who engaged in more physical activity (1.26 [1.01-1.59]) had a higher likelihood of initiating HPV vaccination, and current drinkers (1.54 [1.14-2.08]) had a higher likelihood of HPV vaccination completion.

Health care characteristics

In the multivariate analysis, compared with those having no physician visit in the past 12 months, a higher likelihood of initiating HPV vaccination was found for young adults having 2-3 physician visits (1.69 [1.28-2.23]) and ≥4 physician visits (1.96 [1.49-2.58]) in the past 12 months. In addition, young women taking pap smear in the past 12 months (1.37 [1.06-1.78]) also showed a higher likelihood of initiating HPV vaccination. However, only physician visit in the past 12 months (≥4 visits: 2.19 [1.54-3.12], 2-3 visits: 1.90 [1.31-2.75]) was found associated with likelihood of completing HPV vaccination. In addition, subjects ever receiving pneumococcal vaccine (1.45 [1.11-1.91]), hepatitis B vaccine (2.35 [1.93-2.87]), and hepatitis A vaccine (2.02 [1.63-2.50]) had a higher likelihood of initiating HPV vaccination, and subjects ever receiving pneumococcal vaccine (1.50 [1.06-2.13]), hepatitis B vaccine (2.36 [1.86-2.99]), and hepatitis A vaccine (2.14 [1.64-2.80]) had a higher likelihood of HPV vaccination completion.

DISCUSSION

The prevalence of HPV vaccination initiation and completion remains low among US young adults aged 18-26 years. Prevalence of HPV vaccination initiation were associated with a number of

Table 1
Basic characteristics of human papillomavirus vaccination initiation group (≥1 dose) and completion group (≥3 doses) versus control group (0 doses) in the 2016-2017 National Health Interview Survey

	Initiation	Completion	Control	Initiation versus Control	Completion versus Control
Characteristics	N	N	N	*P*	*P*
Sex				<.01	<.01
Male	3,026	2,625	2,396		
Female	3,426	2,684	1,669		
Born in the United States				<.01	.02
No	705	618	540		
Yes	5,745	4,689	3,524		
Age (y)				<.01	.09
18-20	2,043	1,569	1,137		
21-26	4,409	3,740	2,928		
Region				<.01	.06
Northeast	975	780	524		
Midwest	1,256	1,285	986		
South	2,240	1,877	1,510		
West	1,675	1,367	1,045		
Race				.50	.36
Black	864	671	549		
White	5,013	4,141	3,121		
Asian	420	360	287		
Hispanic ethnicity				.02	.08
Yes	1,086	912	755		
No	5,366	4,397	3,310		
Sexual orientation				<.01	.05
Not gay (male) lesbian (female)	5,907	4,905	3,794		
Gay (male) lesbian (female)/bisexual	367	262	166		
Marital status				.06	.76
Never married	4,815	3,883	2,957		
Married/living with partner	1,513	1,313	1,015		
Class of worker					
Employee of private company	5,033	4,139	3,188	.05	.13
Government employee	669	537	371		
Years on the job				.01	.36
<1	2,769	2,189	1,616		
1-2	1,807	1,520	1,165		
≥3	1,159	989	792		
Computer use				<.01	<.01
Not every day	1,618	1,351	1,141		
Every day	4,811	3,938	2,911		
Education				<.01	<.01
High school or below	2,191	1,860	1,556		
Some college, no degree	2,430	1,901	1,415		
Associate degree or higher	1,820	1,538	1,084		
Health insurance				<.01	.03
None	807	699	609		
Private	4,298	3,528	2,615		
Public	1,278	1,031	804		
Ratio of family income to the poverty threshold				.06	.69
<1	2,137	1,671	1,238		
1-2	1,264	1,047	831		
2-4	1,501	1,271	977		
≥4	1,102	950	714		
Alcohol drinking				.23	.17
Abstainer	1,801	1,466	1,185		
Former	273	227	185		
Current	4,331	3,576	2,663		
Smoking				.10	.44
Never	5,124	4,184	3,167		
Current	890	761	621		
Former	434	360	273		
Light/moderate activity (times per week)				<.01	.03
Never	1,909	1,631	1,351		
1-4	2,250	1,855	1,360		
≥5	2,075	1,647	1,215		
Pneumococcal vaccine					
Never	5,331	4,450	3,456	<.01	.13
Ever	731	555	388		
Hepatitis B vaccine					
Never	3,079	2,740	2,395	<.01	<.01
Ever	2,874	2,172	1,369		

(*continued*)

Table 1 (*Continued*)

Characteristics	Initiation N	Completion N	Control N	Initiation versus Control *P*	Completion versus Control *P*
Hepatitis A vaccine					
Never	3,705	3,223	2,699	<.01	<.01
Ever	1,795	1,339	824		
Number of physician visits in the past 12 months				<.01	<.01
0	1,504	1,334	1,197		
1	1,433	1,187	981		
2-3	1,676	1,344	972		
≥4	1,828	1,434	907		
Having a usual place for sick care				<.01	<.01
No	1,545	1,310	1,119		
Yes	4,906	3,998	2,945		
Pap smear in the past 12 months				.02	.01
No	2,028	1,484	983		
Yes	1,591	1,186	673		

characteristics including sex, nativity, age, region, Hispanic ethnicity, sexual orientation, marital status, education, physical activity engagement, receipt of other recommended vaccines, number of physician visits, and pap smear. Meanwhile, sex, nativity, age, region, sexual orientation, drinking, receipt of other recommended vaccines, and number of physician visits were found associated with prevalence of HPV vaccination completion.

In the United States, HPV vaccination has been recommended for female sex since 2006 and male sex since 2011.[3] HPV vaccination is recommended for girls and boys aged 11-12 years, and for female sex through age 26 and male sex through age 21 who did not receive the HPV vaccine when they were younger. HPV vaccination may be given to male sex aged 22-26 years, and is recommended for men who have sex with men.[3] The HPV vaccination coverage has been increasing overall, although it remains below the national targets for both male sex and female sex of 80% coverage for 13- to 15-year-olds.[12] Previous studies on barriers to HPV vaccine uptake are mainly restricted to adolescents, and sex, ethnicity, socioeconomic status, and health care use may contribute to the disparities in the prevalence of HPV vaccination.[5,6] In addition, not needing the vaccine was the major reason among young women who were not interested in receiving the HPV vaccine.[13] Recently, Thompson et al[14] found that identifying social determinants of health leverage points is critical to promoting HPV vaccination initiation among young adults, and studies exploring the HPV vaccination initiation and completion disparities among young adults are limited.[7,8]

Data from the 2010 NHIS showed that among women aged 18-26 years, not currently being married, having a regular physician, seeing a physician or obstetrician/gynecologist in the past year, influenza vaccination in the past year, and receipt of other recommended vaccines were associated with receipt of at least 1 dose of the HPV vaccine,[13] and characteristics associated with receipt of 3 HPV vaccine doses are similar to those of women who initiated HPV vaccination.[13] Among men aged 18-26 years, although effects for income, employment, place of usual care, and time since last seen by a health care provider on HPV vaccination initiation were not significant, men who did not use the Internet to look up health information were at lower odds to be vaccinated for HPV, while controlling for other variables (0.65 [0.54, 0.79]).[14] However, education (highest level of education completed, English language), and health and health care (health literacy) factors were significantly associated with HPV vaccination initiation among women aged 18-26 years,[14] and women who did not look up health information in the last year on the Internet were at lower odds to be vaccinated [0.66 (0.49, 0.90)].[14] Using 2015 NHIS data, the authors found that although there was no statistically significant difference in the odds of HPV vaccination initiation or completion by race/ethnicity among women aged 18-22 years, Latina and Asian women had significantly lower adjusted odds of initiating HPV vaccination compared to white women.[7] Further, relative to white women, black, Latina, and Asian women had significantly lower adjusted odds of completing HPV vaccination.[7] In addition, the 2011-2015 NHIS showed that compared with those born in the United Stsates, foreign-born men and women had lower prevalence of HPV vaccine initiation and completion.[8]

To our knowledge, this is the first study to assess the disparities in the prevalence of HPV vaccination initiation and completion based on the 2017 NHIS data. We observed pronounced HPV vaccination initiation disparities between young women and young men, and the findings were consistent with those among adolescents,[15] probably in part because special efforts have been recommended to vaccinate female sex since 2006, whereas male sex have been recommended since 2011.[3] The disparity by age group could also be attributed to the fact that vaccination would be most effective when given before exposure to HPV through sexual contact. Receipt of other recommended vaccines (pneumococcal, hepatitis B, and hepatitis A) also contributed much to the disparities in HPV vaccine uptake, and the shared factors influencing completion of multidose vaccine schedules in adolescents may partially explain these findings.[5] The observed vaccination disparity by nativity status remains unaddressed compared to the analysis on the 2011-2015 NHIS,[8] and the disparity was not explained by demographic, socioeconomic, health care, and behavioral differences in this analysis, suggesting unmeasured cultural/social variables may account for the disparity and should be explored further. The disparities by region, race, and ethnicity were attenuated after adjustment for other characteristics selected in this analysis, and research to identify the drivers of these HPV vaccination disparities are still warranted. Gay/lesbian showed a higher prevalence of HPV vaccination coverage, and the result is consistent with the fact that the guidelines recommend catch-up vaccination for boys aged 13-21 years, as well as vaccination of men aged 22-26 years who have sex with men.[3] The higher HPV vaccination prevalence among persons with higher education and daily computer usage may be explained by knowing more about HPV and the HPV vaccine. In addition, education was also found associated with receipt of other recommend vaccines, like influenza vaccine.[16,17] It is reasonable that persons having more physician visits showed higher HPV vaccination prevalence because almost all vaccinations are delivered by primary care providers in clinic-based settings in the United States. In addition, doctor recommendation also had a pivotal importance in acceptance of other recommended vaccines, like influenza vaccine and pneumococcal vaccine.[18,19]

Table 2
Characteristics associated with the prevalence of HPV vaccination initiation and completion among young adults in the 2016-2017 NHIS.

	Initiation (at least 1 dose)					Completion (3 or more doses)				
Characteristics	N	Crude OR	*P*	Adjusted OR	*P*	N	Crude OR	*P*	Adjusted OR	*P*
Sex										
Male	3026	1.00		1.00		2625	1.00		1.00	
Female	3426	4.18 (3.62-4.84)	<0.01	4.74 (3.94-5.72)	<0.01	2684	6.65 (5.41-8.16)	<0.01	7.23 (5.58-9.36)	<0.01
Born in the United States										
No	705	1.00		1.00		618	1.00		1.00	
Yes	5745	2.19 (1.71-2.79)	<0.01	2.16 (1.59-2.94)	<0.01	4689	2.25 (1.65-3.08)	<0.01	1.73 (1.13-2.66)	0.01
Age										
18-20	2043	1.00		1.00		1569	1.00		1.00	
21-26	4409	0.62 (0.54-0.72)	<0.01	0.58 (0.47-0.73)	<0.01	3740	0.73 (0.61-0.88)	<0.01	0.54 (0.40-0.74)	<0.01
Region										
Northeast	975	1.00		1.00		780	1.00		1.00	
Midwest	1256	0.73 (0.56-0.95)	0.02	0.77 (0.58-1.04)	0.09	1285	0.65 (0.47-0.88)	<0.01	0.64 (0.45-0.91)	0.01
South	2240	0.56 (0.43-0.72)	<0.01	0.69 (0.52-0.91)	0.01	1877	0.47 (0.35-0.63)	<0.01	0.60 (0.43-0.84)	<0.01
West	1675	0.78 (0.60-1.00)	0.05	0.81 (0.60-1.09)	0.16	1367	0.70 (0.52-0.95)	0.02	0.79 (0.56-1.10)	0.16
Race										
Black	864	1.00		—	—	671	1.00		1.00	
White	5013	1.13 (0.92-1.38)	0.24	—	—	4141	1.64 (1.23-2.19)	<0.01	1.25 (0.85-1.84)	0.25
Asian	420	0.99 (0.72-1.36)	0.95	—	—	360	1.56 (1.04-2.33)	0.03	1.11 (0.63-1.97)	0.71
Hispanic ethnicity										
Yes	1086	1.00		1.00		912	1.00		1.00	
No	5366	1.45 (1.20-1.74)	<0.01	1.28 (1.01-1.61)	0.04	4397	1.60 (1.24-2.07)	<0.01	1.33 (0.98-1.80)	0.07
Sexual orientation										
Not gay(male) lesbian(female)	5907	1.00		1.00		4905	1.00		1.00	
Gay(male) lesbian(female)/bisexual	367	2.39 (1.77-3.22)	<0.01	1.98 (1.38-2.85)	<0.01	262	1.99 (1.41-2.79)	<0.01	1.70 (1.10-2.64)	0.02
Marital status										
Never married	4815	1.00		1.00		3883	1.00		—	—
Married/living with partner	1513	0.76 (0.65-0.90)	<0.01	0.63 (0.51-0.77)	<0.01	1313	0.91 (0.75-1.11)	0.34	—	—
Class of worker										
Employee of Private company	5033	1.00		1.00		4139	1.00		1.00	
Government employee	669	1.41 (1.12-1.78)	<0.01	1.13 (0.86-1.50)	0.87	537	1.58 (1.19-2.11)	<0.01	1.08 (0.80-1.45)	0.63
Years on the job										
<1	2769	1.00		1.00		2189	1.00		1.00	
1-2	1807	0.80 (0.68-0.94)	<0.01	0.87 (0.72-1.06)	0.18	1520	0.85 (0.70-1.05)	0.13	0.85 (0.66-1.09)	0.20
≥3	1159	0.67 (0.56-0.82)	<0.01	0.86 (0.68-1.07)	0.18	989	0.77 (0.61-0.98)	0.03	0.87 (0.65-1.17)	0.36
Computer use										
Not every day	1618	1.00		1.00		1351	1.00		1.00	
Every day	4811	1.40 (1.19-1.64)	<0.01	0.95 (0.77-1.17)	0.63	3938	1.79 (1.44-2.23)	<0.01	1.15 (0.87-1.52)	0.34
Education										
High school or below	2191	1.00		1.00		1860	1.00		1.00	
Some college, no degree	2430	1.47 (1.23-1.76)	<0.01	1.11 (0.88-1.39)	0.37	1901	1.46 (1.15-1.86)	<0.01	0.99 (0.74-1.32)	0.99
Associate degree or higher	1820	1.57 (1.32-1.88)	<0.01	1.28 (1.01-1.63)	0.04	1538	2.00 (1.60-2.49)	<0.01	1.25 (0.92-1.68)	0.57
Health insurance										
None	807	1.00		1.00		699	1.00		1.00	
Private	4298	1.76 (1.36-2.27)	<0.01	0.81 (0.59-1.11)	0.19	3528	2.46 (1.79-3.39)	<0.01	1.00 (0.68-1.46)	0.99
Public	1278	1.60 (1.22-2.09)	<0.01	0.77 (0.55-1.08)	0.13	1031	1.99 (1.45-2.74)	<0.01	0.88 (0.58-1.35)	0.57
Ratio of family income to the poverty threshold										
<1	2137	1.00		1.00		1671	1.00		1.00	
1-2)	1264	0.76 (0.62-0.92)	<0.01	0.90 (0.70-1.17)	0.44	1047	0.78 (0.61-1.01)	0.06	0.84 (0.60-1.19)	0.34
2-4)	1501	0.80 (0.66-0.97)	0.02	1.15 (0.90-1.46)	0.26	1271	0.88 (0.70-1.10)	0.26	1.07 (0.80-1.43)	0.66
≥4	1102	0.95 (0.77-1.19)	0.66	1.16 (0.88-1.54)	0.30	950	1.19 (0.92-1.55)	0.18	1.20 (0.83-1.72)	0.33
Alcohol drinking										
Abstainer	1801	1.00		—	—	1466	1.00		1.00	
Former	273	0.77 (0.54-1.10)	0.16	—	—	227	0.66 (0.42-1.02)	0.06	0.64 (0.36-1.15)	0.14
Current	4331	1.12 (0.95-1.33)	0.17	—	—	3576	1.33 (1.09-1.63)	<0.01	1.54 (1.14-2.08)	<0.01
Smoking										
Never	5124	1.00		1.00		4184	1.00		1.00	
Current	890	0.70 (0.57-0.87)	<0.01	1.06 (0.81-1.40)	0.66	761	0.64 (0.79-0.84)	<0.01	0.95 (0.68-1.32)	0.74
Former	434	0.88 (0.69-1.12)	0.31	1.30 (0.97-1.73)	0.08	360	0.88 (0.65-1.18)	0.39	1.23 (0.86-1.76)	0.25
Light/moderate activity (times per week)										
Never	1909	1.00		1.00		1631	1.00		1.00	
1-4	2250	1.50 (1.25-1.80)	<0.01	1.26 (1.01-1.59)	0.04	1855	1.57 (1.23-1.99)	<0.01	1.17 (0.87-1.57)	0.30
≥5	2075	1.50 (1.24-1.82)	<0.01	1.23 (0.97-1.57)	0.09	1647	1.46 (1.14-1.86)	<0.01	1.06 (0.78-1.44)	0.72
Pneumococcal vaccine										
Never	5331	1.00		1.00		4450	1.00		1.00	
Ever	731	1.61 (1.30-1.99)	<0.01	1.45 (1.11-1.91)	<0.01	555	1.57 (1.19-2.08)	<0.01	1.50 (1.06-2.13)	0.02
Hepatitis B vaccine										
Never	3079	1.00		1.00		2740	1.00		1.00	
Ever	2874	3.77 (3.25-4.38)	<0.01	2.35 (1.93-2.87)	<0.01	2172	4.16 (3.44-5.02)	<0.01	2.36 (1.86-2.99)	<0.01

(*continued*)

Table 2 (*Continued*)

Characteristics	Initiation (at least 1 dose)					Completion (3 or more doses)				
	N	Crude OR	*P*	Adjusted OR	*P*	N	Crude OR	*P*	Adjusted OR	*P*
Hepatitis A vaccine										
Never	3705	1.00		1.00		3223	1.00		1.00	
Ever	1795	3.35 (2.84-3.95)	<0.01	2.02 (1.63-2.50)	<0.01	1339	3.54 (2.88-4.36)	<0.01	2.14 (1.64-2.80)	<0.01
Number of physician visits in the past 12 months										
0	1504	1.00		1.00		1334	1.00		1.00	
1	1433	1.82 (1.46-2.28)	<0.01	1.27 (0.97-1.66)	0.08	1187	1.99 (1.45-2.74)	<0.01	1.31 (0.93-1.87)	0.13
2-3	1676	2.92 (2.33-3.65)	<0.01	1.69 (1.28-2.23)	<0.01	1344	3.72 (2.74-5.05)	<0.01	1.90 (1.31-2.75)	<0.01
≥ 4	1828	4.04 (3.30-4.95)	<0.01	1.96 (1.49-2.58)	<0.01	1434	5.56 (4.19-7.37)	<0.01	2.19 (1.54-3.12)	<0.01
Having a usual place for sick care										
No	1545	1.00		1.00		1310	1.00		1.00	
Yes	4906	1.65 (1.38-1.97)	<0.01	1.03 (0.83-1.28)	0.80	3998	2.11 (1.69-2.65)	<0.01	1.23 (0.92-1.63)	0.16
Pap smear in the past 12 months										
No	2028	1.00		1.00		1484	1.00		1.00	
Yes	1591	1.26 (1.05-1.51)	0.01	1.37 (1.06-1.78)	0.02	1186	1.53 (1.23-1.90)	<0.01	1.25 (0.92-1.68)	0.15

OR: odds ratio

—: these variables were not included in the multivariate analysis.

This study has several limitations. First, HPV vaccination was based on self-report and may be subject to recall bias. However, parental recall is comparable to provider report in monitoring HPV vaccine uptake for adolescents, although parental recall is less comparable for HPV vaccine completion.[20] Second, knowledge and beliefs on vaccines were found associated with other recommended vaccines.[21,22] However, influences of knowledge on awareness of HPV and the HPV vaccine on the disparities in HPV vaccination coverage cannot be assessed, because these data are not available in this analysis.

CONCLUSIONS

The prevalence of HPV vaccination initiation and completion remains low among young adults aged 18-26 years. Prevalence of HPV vaccination initiation and completion were associated with a number of characteristics. Interventions that seek to facilitate HPV vaccination among subjects who are less likely to receive the HPV vaccine are needed to mitigate the observed HPV vaccination disparities and to further improve the HPV vaccination. Better education materials and communication methods focusing on the male sex, those having limited access to health care services, those not born in the United States, older age subjects, those being married/living with partner, those from the Midwest and South region, and others could be developed to improve the coverage of HPV vaccination initiation and completion among young adults.

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