Vaccination Interest and Trends in Human Papillomavirus Vaccine Uptake in Young Adult Women Aged 18 to 26 Years in the United States: An Analysis Using the 2008–2012 National Health Interview Survey

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Objectives. Human papillomavirus (HPV) vaccines have been approved since 2006, yet vaccination rates remain low. We investigated HPV vaccination trends, interest, and reasons for nonvaccination in young adult women.

Methods. We used data from the 2008–2012 National Health Interview Survey to analyze HPV vaccine uptake trends (≥ 1 dose) in women aged 18 to 26 years. We used data from the 2008 and 2010 National Health Interview Survey to examine HPV vaccination interest and reasons for nonvaccination among unvaccinated women.

Results. We saw significant increases in HPV vaccination for all young women from 2008 to 2012 (11.6% to 34.1%); however, Hispanics and women with limited access to care continued to have lower vaccination rates. Logistic regression demonstrated lower vaccination interest among unvaccinated women in 2010 than 2008. Respondents in 2010 were significantly less likely to give lack of knowledge as a primary reason for nonvaccination.

Conclusions. Uptake of HPV vaccine has increased from 2008 to 2012 in young women. Yet vaccination rates remain low, especially among women with limited access to care. However, unvaccinated women with limited health care access were more likely to be interested in receiving the vaccine. (*Am J Public Health.* 2014;104:946–953. doi:10.2105/AJPH.2013.301828)

Human papillomavirus (HPV) is widespread among young females in the United States, with an estimated prevalence of 59.8% in women aged 20 to 24 years in 2007 to 2010.[1] Persistent infection with high-risk strains of HPV has been linked to development of certain cancers, including cervical, oropharyngeal, and anal cancers, with an estimated 13.2 per 100 000 women diagnosed annually with HPV-associated cancers between 2004 and 2008.[2] Since 2006, 2 HPV vaccines have been approved by the Food and Drug Administration that safely[3] and effectively[1] prevent infection with several high-risk HPV strains.[2]

Since 2006, the Advisory Committee on Immunization Practices has recommended that 3 doses of the HPV vaccine be administered to young females aged 11 to 26 years, with a focus on early vaccination.[4,5] Data for 18- to 26-year-old women from the adult version of the 2007 National Immunization Survey estimated that 10% of young women had initiated the HPV vaccination series.[6] For the same year, vaccine initiation among California women aged 18 to 27 years was estimated to be 11.0%.[7] In 2011, vaccination rates (≥ 1 dose) among young women aged 19 to 26 years had increased to 29.5%.[8] Vaccination rates for adolescents were more favorable (53.8% for ≥ 1 dose, 33.4% for ≥ 3 doses for 13- to 17-year-old adolescents in 2012[3]), but are far from the national goal of 80% vaccination completion for 13- to 15-year-old adolescents by 2020.[9]

Despite these low vaccine initiation and even lower completion rates, few studies have examined reasons for nonvaccination of young adult women, and no study has specifically studied how these reasons may have changed over time.[6,10–13] A recent study focusing on parental attitudes showed an increase in parents not intending to vaccinate adolescent daughters and citing safety concerns as one of the main reasons for nonvaccination.[14] Furthermore, previous studies of trends in HPV vaccination have focused primarily on adolescents.[3,15,16] However, with high levels of nonvaccination continuing in 2011 for both the main target group and young adults, it is critical to understand trends in vaccination and risk factors for nonvaccination in this age group, as these young women can still benefit from receiving the HPV vaccine and promote greater herd immunity.

Therefore, using nationally representative data from the National Health Interview Survey (NHIS) for young women, our aim was to (1) estimate trends in HPV vaccination uptake (≥ 1 dose) in women aged 18 to 26 years from 2008 to 2012, (2) examine HPV vaccination interest among young unvaccinated women in 2008 and 2010, and (3) investigate reasons for nonvaccination among women who were not interested in receiving the vaccine in 2008 and 2010. Both vaccination interest, defined as whether an unvaccinated woman was interested in receiving the HPV vaccine in the survey, and reasons for nonvaccination for unvaccinated women, who were not interested or undecided, were only assessed in the 2008 and 2010 NHIS.

METHODS

The NHIS is an annual, nationally representative, cross-sectional, multipurpose health survey targeted at the US civilian, noninstitutionalized household population. Conducted by the National Center for Health Statistics and the Centers for Disease Control and Prevention, the NHIS utilizes a multistage area probability

design. Interviews are conducted through in-house, in-person interviews. The NHIS has an annual response rate of approximately 90%.[17] For the purpose of this study, we first examined trends in HPV vaccination initiation from the 2008, 2009, 2010, 2011, and 2012 public use files[18–22] among women aged 18 to 26 years (combined n = 10 513).

We then examined a sample of young unvaccinated women from the 2008 and 2010 NHIS to investigate HPV vaccination interest (n = 2817) and reasons for nonvaccination (n = 1770), because these questions were only assessed in these 2 years. For this purpose, we pooled the 2008 and 2010 NHIS and adjusted the sample adult weight for pooling in accordance to the guidelines provided by the NHIS.[23]

Outcome Measures

HPV vaccination uptake. Beginning in 2008, NHIS survey participants were asked whether they had ever received the HPV shot or cervical cancer vaccine, and were then asked how many of the 3 recommended shots they had received. Uptake of HPV vaccination is defined as having received at least 1 HPV vaccine dose.

Interest in HPV vaccination. In 2008 and 2010 unvaccinated females were asked "Would you be interested in getting the HPV vaccine?" Possible responses included "yes," "no," "don't know," or refused to answer. Being interested in receiving the HPV vaccine was defined as answering this question with "yes" compared with responding with "no" or "don't know." We excluded women who refused to respond to this question (n = 11) from the analysis.

Reasons for nonvaccination. Also in 2008 and 2010, respondents who were not interested in receiving the vaccine or did not know were prompted with the question: "What is the MAIN reason you would NOT want to get the vaccine." The response categories included "don't need it," "don't know enough about the vaccine," "worried about safety," "not sexually active," "doctor did not recommend," "too expensive," "too old," "already have HPV," "don't know where to get the vaccine," "spouse/family member is against it," "other," "don't know," and refused to answer.

Statistical Approach

We conducted all analyses with SAS version 9.3 (SAS Institute, Cary, NC) SURVEYFREQ and SURVEYLOGISTIC procedures accounting for complex survey design. We used strata and primary sampling units along with probability sampling weights provided by the NHIS. Characteristics of the pooled sample of women surveyed in 2008 through 2012 are displayed in Table 1. We also provide characteristics of women who had initiated the vaccine series in Table 1. To examine trends in HPV vaccination uptake (≥ 1 dose), we estimated weighted percentages, 95% confidence intervals (CIs), and χ^2 test results for each survey year between 2008 and 2012 for all young women and by subgroup (race/ethnicity, insurance, delayed or forgone medical care, usual place of care, poverty, and education; Table 2). In addition to the χ^2 test we conducted posthoc analyses for variables with more than 2 categories to confirm subgroup differences in vaccination uptake, resulting in consistent findings (results not shown).

We estimated logistic regression models for each subgroup with vaccine uptake (≥ 1 dose) as dependent variable and survey year as continuous independent variable to estimate trends in vaccination uptake. Odds ratios (ORs) and 95% CIs are reported (Table 2). We then used multivariable logistic regression models to examine sociodemographic factors associated with HPV vaccination interest in a pooled sample of unvaccinated young women surveyed in 2008 and 2010, because vaccination interest was only assessed in those 2 years. The model was adjusted for survey year (2008 and 2010), age group (18–21 and 22–26 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic other), marital status (married, not married), education (< high school, high school or general equivalency diploma, > high school), health insurance status (uninsured, public, private), whether a respondent had delayed or forgone medical care because of costs, whether a respondent had no usual place for care, whether the household income was below the federal poverty threshold (as defined in the NHIS), whether the respondent had other recommended vaccinations (hepatitis A, hepatitis B, or tetanus), whether a respondent had previously heard about the HPV vaccine, had seen a doctor or obstetrician/gynecologist, had received an influenza vaccine, had a Papanicolaou test in the past year, and region of residence (Northeast, Midwest, South, West). Survey design–adjusted percentages, χ^2 test results, ORs, and 95% CIs are reported (Table 3).

Finally, we analyzed unvaccinated women aged 18 to 26 years interviewed in 2008 and 2010, who were not interested in the vaccine or who were undecided, to estimate main reasons for nonvaccination and investigate whether reasons differed for women interviewed in 2008 and 2010. Reasons for nonvaccination were only available for women who indicated no interest in the vaccine or were undecided. Survey design–adjusted percentages, 95% CIs, and χ^2 test results are reported (Table 4).

We conducted a sensitivity analysis for vaccination interest by excluding unvaccinated women who were undecided about the vaccine (n = 175). Excluding these women from the logistic regression model did not change the results reported in Table 3. Because we are predicting the odds of positively being interested in receiving the vaccine, by including undecided women, we are providing more conservative estimates. Next, we excluded undecided women from our analysis of reasons for nonvaccination. Again, our major findings reported in Table 4 remained unchanged.

RESULTS

The sociodemographic characteristics of the pooled sample of women aged 18 to 26 years surveyed in the 2008–2012 NHIS are presented in Table 1. On average, 23.3%, 18.0%, and 13.6% of young women in 2008–2012 had received 1 or more HPV dose, 2 or more doses, and 3 or more doses, respectively. Approximately 24% of women were uninsured, and 21% had public insurance. Furthermore, 21.2% of women had no usual place of care and 15.3% had delayed or forgone medical care in the past year. Women who had received the vaccine (≥ 1 dose) were more likely to be aged 18 to 21 years, to be non-Hispanic White, to have private health insurance, to have a usual source of care, to have not delayed or forgone care, and to have more than a high-school education (all with $P < .05$). We found similar differences between women who

TABLE 1—Descriptive Statistics for Young US Women Aged 18 to 26 Years: Pooled National Health Interview Survey, 2008–2012

Characteristic	2008–2012		Received ≥ 1 HPV Dose		
	No. of Women	% (95% CI)	No. (Yes)	% (95% CI)	*P*
Year					
2008	1583	20.0 (18.8, 21.3)	179	11.6 (9.7, 13.6)	< .001
2009	1981	19.5 (18.5, 20.6)	356	19.0 (16.6, 21.4)	
2010	2011	19.9 (18.8, 20.9)	408	21.5 (19.2, 23.8)	
2011	2382	20.2 (19.2, 21.2)	659	29.7 (27.3, 32.2)	
2012	2556	20.4 (19.3, 11.5)	815	34.1 (31.6, 36.7)	
Received ≥ 1 HPV dose					
Yes	2417	23.3 (22.1, 24.5)	. . .	. . .	. . .
No	8096	76.7 (75.5, 77.9)	. . .	. . .	
Received ≥ 2 HPV doses					
Yes	1858	18.0 (16.9, 19.1)	. . .	. . .	. . .
No	8655	82.0 (80.9, 83.1)	. . .	. . .	
Received ≥ 3 HPV doses					
Yes	1375	13.6 (12.6, 15.6)	. . .	. . .	. . .
No	9138	86.4 (85.4, 87.4)	. . .	. . .	
Age group					
18–21	3909	42.9 (41.4, 44.4)	1261	31.8 (29.9, 33.7)	< .001
22–26	6604	57.1 (55.6, 58.6)	1156	16.9 (15.6, 18.1)	
Race/ethnicity					
Non-Hispanic White	5159	60.4 (59, 61.9)	1474	27.2 (25.6, 28.9)	< .001
Non-Hispanic Black	2065	15.5 (14.4, 16.7)	401	19.3 (17.0, 21.6)	
Hispanic	2466	18.0 (17.0, 19.1)	395	15.5 (13.7, 17.2)	
Non-Hispanic other	823	6.0 (5.3, 6.6)	147	17.2 (14.0, 20.5)	
Health insurance					
Uninsured	2677	24.1 (22.9, 25.3)	347	11.7 (10.1, 13.3)	< .001
Public	2578	21.6 (20.5, 22.7)	496	20.7 (18.7, 22.8)	
Private	5258	54.3 (52.8, 55.9)	1574	29.4 (27.7, 31.1)	
Usual place of care					
No usual place	2412	21.2 (20.1, 22.3)	352	13.0 (11.2, 14.9)	< .001
Has usual place	8101	78.8 (77.7, 79.9)	2065	26.0 (24.7, 27.4)	
Delayed or forgone care					
Yes	1778	15.3 (14.4, 16.1)	341	17.9 (15.8, 20.1)	< .001
No	8735	84.7 (83.9, 95.6)	2076	24.2 (22.9, 25.6)	
Income below the federal poverty threshold[a]					
Yes	3571	24.5 (23.0, 26.1)	847	23.1 (20.6, 25.6)	.847
No	6942	75.5 (73.9, 77.0)	1570	23.3 (22.1, 24.6)	
Education					
< high school	1522	13.9 (12.9, 15.0)	231	18.4 (15.6, 21.3)	< .001
High school or GED	2621	25.1 (26.9, 26.3)	472	18.9 (16.7, 21.1)	
> high school	6370	60.9 (59.4, 62.5)	1714	26.2 (24.6, 27.8)	

Note. CI = confidence interval; GED = general equivalency diploma; HPV = human papillomavirus. Adjusted for complex survey design. Weighted with WTFA_SA/5; percentages may not add up to 100 because of rounding. The sample size was n = 10 513.

[a]As defined in the National Health Interview Survey.

had initiated but not completed the vaccine series (1 or 2 doses) compared with women who had completed the series (≥ 3 doses; results not shown).

Among women aged 18 to 26 years, HPV vaccine uptake (≥ 1 dose) significantly increased from 11.6% in 2008 to 34.1% in 2012 ($P < .001$; Table 1; OR = 1.38; 95% CI = 1.32, 1.44; Table 2). This increase in vaccination was evident across all sociodemographic subgroups including race/ethnicity, insurance, delayed or forgone care, usual place of care, poverty, and education (Table 2). However, the greatest absolute differences in vaccination rates in 2012 compared with 2008 were seen among non-Hispanic Whites (2008: 14.6%; 2012: 42.0%; Δ = 27.4), those with private insurance (2008: 15.7%; 2012: 41.8%; Δ = 26.1), and women with more than a high-school education (2008: 12.8%; 2012: 38.1%; Δ = 25.3). Furthermore, the lowest absolute increase was noted for Hispanic women (2008: 7.1%; 2012: 19.7%; Δ = 12.6). Every year from 2008 to 2012, Hispanic women had significantly lower vaccine initiation rates than non-Hispanic Whites. The same was true for the uninsured compared with the privately insured and women without a usual place of care compared with those with. No significant differences in the HPV vaccination rate were observed by poverty status between 2009 and 2012. Finally, although vaccination uptake (≥ 1 dose) was no different for women across levels of education in 2008 and 2010, in 2009, 2011, and 2012, women with more than a high-school education were more likely to have initiated the vaccine series than women with lower levels of education.

We next investigated interest in receiving the HPV vaccine in unvaccinated women in 2008 and 2010 (Table 3). An estimated 34.9% (95% CI = 32.7, 37.2) of unvaccinated women were interested in receiving the HPV vaccine. In multivariable analysis, unvaccinated women in 2010 were significantly less likely to be interested in vaccination than women in 2008 (OR = 0.54; 95% CI = 0.42, 0.69), after we adjusted for sociodemographic characteristics. Hispanic women and non-Hispanic "other" race/ethnicity women (vs non-Hispanic Whites), the uninsured and the publicly insured (vs private insurance), those who had delayed or forgone medical care (vs those that

TABLE 2—Trends in Human Papillomavirus Vaccination Uptake (≥ 1 Dose) in Young US Women Aged 18–26 Years: National Health Interview Survey, 2008–2012

Variable	2008		2009		2010		2011		2012		
	% (95% CI)	*P*	% (95% CI)	*P*	% (95% CI)	*P*	% (95% CI)	*P*	% (95% CI)	*P*	OR (95% CI)
Total	11.6 (9.7, 13.6)		19.0* (16.6, 21.4)		21.5 (19.2, 23.8)		29.7* (27.3, 32.2)		34.1 (31.6, 36.7)		1.38 (1.32, 1.44)
Race/ethnicity		< .001[a]		< .001		.009		< .001		< .001	
Non-Hispanic White	14.6 (11.8, 17.4)		22.5* (18.8, 26.1)		24.2 (20.9, 27.5)		33.0* (29.7, 36.4)		42.0* (38.4, 45.5)		1.41 (1.32, 1.49)
Non-Hispanic Black	7.6 (3.8, 11.5)		13.9 (10.4, 17.3)		18.6 (13.4, 23.9)		29.0 (23.7, 34.3)		27.0 (21.6, 32.4)		1.44 (1.29, 1.59)
Hispanic	7.1 (3.8, 10.3)		13.9 (9.4, 18.4)		15.2 (11.6, 18.8)		20.5 (16.5, 24.6)		19.7 (15.9, 23.4)		1.28 (1.16, 1.41)
Non-Hispanic other	5.8[b] (1.2, 10.3)		11.4 (5.1, 17.7)		21.3 (12.5, 30.1)		24.9 (17.4, 32.5)		24.0 (16.0, 32.0)		1.44 (1.24, 1.67)
Health insurance		< .001		< .001		< .001		< .001		< .001	
Uninsured	2.3[b] (0.5, 4.0)		8.0* (5.3, 10.7)		12.0 (8.0, 16.0)		17.7 (14.1, 21.3)		19.2 (14.9, 23.5)		1.57 (1.41, 1.75)
Public	11.6 (7.1, 16.1)		13.0 (9.4, 10.7)		16.0* (15.3, 24.7)		28.8 (23.4, 32.6)		29.2 (23.9, 34.4)		1.38 (1.25, 1.52)
Private	15.7 (12.6, 18.7)		26.8* (23.0, 30.6)		26.7 (23.1, 30.4)		36.0* (32.6, 39.4)		41.8 (38.1, 45.5)		1.36 (1.28, 1.44)
Usual place of care		.002		< .001		< .001		< .001		< .001	
No usual place	5.8 (2.9, 8.6)		8.8 (5.5, 12.2)		10.0 (6.8, 13.2)		19.3* (14.8, 23.7)		21.0 (16.4, 25.7)		1.46 (1.31, 1.64)
Has usual place	13.1 (10.7, 15.4)		22.1* (19.2, 24.9)		24.8 (22.2, 27.4)		32.4* (29.7, 35.1)		37.7 (34.7, 40.7)		1.38 (1.32, 1.45)
Delayed or forgone care		.015		.153		.483		< .001		.064	
Yes	6.5 (3.1, 9.9)		15.8* (11.3, 20.3)		19.6 (14.0, 25.2)		20.6 (15.7, 25.5)		28.4 (22.2, 34.6)		1.40 (1.25, 1.57)
No	16.6 (10.3, 14.8)		19.7* (17.0, 22.4)		21.9 (19.3, 24.5)		31.4* (28.8, 34.0)		35.0 (32.2, 37.8)		1.38 (1.31, 1.45)
Income below the federal poverty threshold[c]		.046		.066		.346		.263		.558	
Yes	15.8 (10.1, 21.5)		15.9 (12.5, 19.4)		19.7 (15.7, 23.7)		27.7 (23.6, 31.8)		33.0 (28.8, 37.2)		1.32 (1.20, 1.44)
No	10.6 (8.7, 12.5)		20.0* (17.1, 22.8)		22.1 (19.3, 24.9)		30.4* (27.6, 33.3)		34.5 (31.4, 37.6)		1.40 (1.34, 1.47)
Education		.343		.003		.127		.005		< .001	
< high school	8.7 (4.3, 13.2)		14.2 (7.9, 20.4)		19.6 (13.4, 25.8)		23.4 (17.2, 29.5)		28.3 (21.1, 35.5)		1.39 (1.23, 1.58)
High school or GED	10.7 (6.8, 14.6)		13.5 (9.4, 17.5)		17.7 (13.2, 22.2)		25.0 (19.8, 30.2)		26.9 (21.9, 32.0)		1.35 (1.22, 1.49)
> high school	12.8 (10.0, 15.5)		22.5* (19.2, 25.7)		23.6 (20.3, 26.8)		33.1* (30.0, 36.3)		38.1 (34.7, 41.4)		1.39 (1.31, 1.47)
No. of women surveyed	1583		1981		2011		2382		2556		
No. of women with ≥ 1 dose	179		356		408		659		815		

Note. CI = confidence interval; GED = general equivalency diploma; OR = odds ratio from logistic regression with year as continuous independent variable and vaccine uptake (≥ 1 dose) as dependent variable. Adjusted for complex survey design. Estimates weighted with WTFA_SA; logistic regression weighted with WTFA_SA/5. The sample size was n = 10 513.

[a]*P* values correspond to the Rao-Scott χ^2 test for differences in vaccination uptake by subgroup category.

[b]Estimate does not meet National Health Interview Survey standard for reliability or precision.

[c]As defined in the National Health Interview Survey.

*Statistically significant difference ($P < .05$) compared with previous year's estimate.

TABLE 3—Interest in Human Papillomavirus Vaccination Among Unvaccinated Young US Women Aged 18–26 Years: Pooled National Health Interview Survey, 2008 and 2010

Variable	No. of Women	Vaccine Interest (Yes = 1047), % (95% CI)	P[a]	AOR (95% CI)
Survey year				
2008	1339	39.7 (36.6, 43.1)	< .001	1.00 (Ref)
2010	1478	29.3 (26.6, 32.0)		0.54 (0.42, 0.69)
Age, y				
18–21	939	34.8 (31.0, 38.5)	.913	0.93 (0.74, 1.17)
22–26	1878	35.0 (32.2, 37.9)		1.00 (Ref)
Race/ethnicity				
Non-Hispanic White	1328	33.7 (30.5, 36.9)	.411	1.00 (Ref)
Non-Hispanic Black	587	34.5 (29.9, 39.1)		0.96 (0.72, 1.28)
Hispanic	682	38.0 (33.1, 42.8)		1.46 (1.10, 1.94)
Non-Hispanic other	220	38.6 (29.2, 48.1)		1.85 (1.20, 2.84)
Region				
Northeast	364	32.4 (26.2, 38.5)	.04	1.23 (0.88, 1.73)
Midwest	630	31.1 (27.1, 35.1)		1.00 (Ref)
South	1108	39.0 (35.2, 42.8)		1.54 (1.19, 1.97)
West	715	33.9 (29.2, 38.7)		1.21 (0.92, 1.59)
Marital status				
Married	631	29.3 (24.8, 33.7)	.005	0.70 (0.54, 0.89)
Not married	2186	36.7 (34.2, 39.3)		1.00 (Ref)
Education				
< high school	470	35.6 (29.7, 41.5)	.959	1.09 (0.78, 1.52)
High school or GED	718	35.1 (30.7, 39.5)		1.00 (Ref)
> high school	1629	34.7 (31.6, 37.8)		0.89 (0.68, 1.16)
Income below the federal poverty threshold[b]				
Yes	881	37.3 (33.3, 41.4)	.188	1.08 (0.86, 1.35)
No	1936	34.2 (31.6, 36.8)		1.00 (Ref)
Health insurance status				
Uninsured	803	39.8 (35.4, 44.2)	< .001	1.31 (1.01, 1.60)
Public insurance	701	38.0 (33.9, 42.2)		1.53 (1.17, 2.01)
Private insurance	1313	31.1 (28.1, 34.1)		1.00 (Ref)
Usual place of care				
No usual place of care	691	42.6 (37.8, 47.5)	< .001	1.61 (1.24, 2.09)
Has usual place of care	2126	32.6 (30.2, 35.1)		1.00 (Ref)
Delayed or forgone medical care				
Yes	514	47.4 (41.9, 53.0)	< .001	1.50 (1.14, 1.97)
No	2303	32.6 (30.2, 34.9)		1.00 (Ref)
Ever heard of the HPV vaccine				
Yes	1828	40.9 (38.0, 43.7)	< .001	2.67 (2.10, 3.39)
No	989	22.7 (19.5, 25.8)		1.00 (Ref)
Has other recommended vaccinations[c]				
Yes	2158	37.7 (35.1, 40.3)	< .001	1.63 (1.26, 2.12)
No	659	24.8 (20.7, 29.0)		1.00 (Ref)
Had Papanicolaou test in past year				
Yes	847	32.1 (28.5, 35.6)	.098	1.14 (0.87, 1.48)
No	1970	36.0 (33.2, 38.7)		1.00 (Ref)

Continued

had not), those who had no usual place of care (vs those that had a usual place), those who had received other recommended vaccinations (vs those who had not), and young women residing in the South (vs Midwest) had higher odds of being interested in receiving the HPV vaccine ($P < .05$ for all). Women who had previously heard about the vaccine were more likely to intend vaccination compared with those that had not (OR = 2.67; 95% CI = 2.10, 3.39). Married women, however, were less likely to be interested in the vaccine compared with not-married women. We observed no statistically significant difference in vaccination interest for age, educational attainment, poverty status, and other health behaviors (having received an influenza vaccine, having had a Papanicolaou test, having seen a doctor or obstetrician/gynecologist).

Finally, we examined the main reasons for nonvaccination among unvaccinated women in 2008 and 2010 who were not interested in the vaccine or were undecided (Table 4). In both years, the 3 most common reasons for nonvaccination were (1) "don't need the vaccine," (2) "don't know enough about the vaccine," and (3) "worried about safety of the vaccine." Respondents in 2010 were significantly less likely to give lack of knowledge as the main reason for nonvaccination (17% in 2008; 12% in 2010; $P = .007$). Interestingly, only 1.8% and 2.5% of women provided "too expensive" as main reason for nonvaccination in 2008 and 2010. We also found that a small percentage of women stated that they were too old for the vaccine (3.6% in 2008; 2.3% in 2010), which, according to vaccine recommendations, is not the case for this age group. Lack of doctor's recommendation was stated as the sixth most common reason for nonvaccination in both years.

DISCUSSION

Among young women aged 18 to 26 years, HPV vaccine uptake increased from 11.6% in 2008 to 34.1% in 2012. This increase can be seen across all subgroups, but Hispanics, those with limited health care access, and those with lower levels of education continued to have lower vaccination rates in 2012. Furthermore, we found that those surveyed in 2010, Hispanics, the uninsured or publicly insured, those

TABLE 3—*Continued*

Had influenza vaccine in past year				
Yes	570	35.4 (30.4, 40.5)	.837	1.14 (0.86, 1.51)
No	2247	34.8 (32.2, 37.4)		1.00 (Ref)
Saw a doctor or obstetrician/gynecologist in past year				
Yes	2142	35.7 (33.2, 38.2)	.214	1.22 (0.93, 1.58)
No	675	32.5 (27.9, 37.0)		1.00 (Ref)

Note. AOR = adjusted odds ratio; CI = confidence interval; GED = general equivalency diploma; HPV = human papillomavirus. Adjusted for complex survey design. Weighted with WTFA_SA/2. The sample size was n = 2817.
[a]*P* value for the Rao-Scott χ^2 test.
[b]As defined in the National Health Interview Survey.
[c]Includes either having had a tetanus vaccine in the past 10 years, or ever having received a hepatitis A or hepatitis B vaccine.

who had delayed or forgone medical care, and those who had no usual place of care were more likely to be interested in receiving the vaccine. However, not knowing enough about the vaccine or being worried about vaccine safety remain top concerns among the nonvaccinated. Importantly, our study focused on the young adult (aged 18–26 years) age group, complementing previous studies of 13- to 17-year-old adolescents surveyed in the National Immunization Survey–Teen. Specifically, we examined how trends in interest and vaccine uptake have evolved over time in this young adult population by using one of the largest, nationally representative surveys for this age group. In addition, our analysis provides the most current information on continued reasons and risk factors for nonvaccination in young adult women, identifying that women with limited access to health care are those least likely to be vaccinated; however, these women are more likely to indicate an interest in being vaccinated. Overall, our research contributes to knowledge of the trends in HPV vaccination initiation in young women. Furthermore, it points toward the need for future research to focus on improving vaccination among subgroups with continuously lower HPV vaccination uptake while addressing reasons for nonvaccination.

TABLE 4—Main Reasons Why Unvaccinated US Women Aged 18–26 Years, Who Were Not Interested in Receiving the Human Papillomavirus Vaccine or Who Were Undecided, Chose to Forgo Vaccination: Pooled National Health Interview Survey, 2008 and 2010

	2008 (n = 782)		2010 (n = 988)		
Main Reason[a]	No. of Women	% (95% CI)	No. of Women	% (95% CI)	*P*
Don't need it	269	35.9 (31.1, 40.8)	396	40.7 (37.0, 44.5)	.131
Don't know enough about the vaccine	154	17.1 (13.7, 20.5)	135	11.8 (9.4, 14.1)	.007
Worried about safety	80	12.6 (9.4, 15.8)	106	12.3 (9.4, 15.2)	.887
Not sexually active	66	10.3 (6.8, 13.7)	71	8.1 (5.6, 10.5)	.289
Doctor did not recommend	45	5.4 (3.7, 7.0)	77	7.4 (5.2, 9.7)	.089
Too expensive	16	1.8[b] (0.6, 2.9)	27	2.5 (1.2, 3.8)	.412
Too old	32	3.6 (2.1, 5.1)	28	2.3 (1.3, 3.2)	.143
Already have HPV	23	2.7 (1.4, 4.0)	25	2.7 (1.5, 3.9)	.958
Other[c]	59	6.5 (4.5, 8.5)	105	10.8 (8.5, 13.2)	.007
Don't know or refused to answer	38	4.1 (2.2, 6.0)	18	1.4 (0.6, 2.3)	.001

Note. CI = confidence interval; HPV = human papillomavirus. Survey design adjusted estimate and corresponding 95% CI. Adjusted for complex survey design. Weighted with WTFA_SA/2.
[a]All response categories were mutually exclusive.
[b]Does not meet National Health Interview Survey standard for reliability or precision.
[c]Includes "Other," "Don't know where to get the vaccine," and "Spouse/family member is against it."

Overall, we found that vaccination uptake increased significantly from 2008 to 2012 for all young women, but was adopted differently across sociodemographic groups. Specifically, Hispanics and women with limited access to care continued to have lower vaccination rates. These findings are similar to vaccination trends in other populations, where significant HPV vaccine coverage increases have been reported for girls aged 11 to 17 years in the United States in general[3,16] and in North Carolina[15] and for young women aged 19 to 26 years in a nationally representative sample.[8] Moss et al. noted increases in vaccine coverage from 2008 to 2010 for adolescents who were non-White and non-Black, who had a regular health care provider, and who lived in households with higher incomes and higher education levels.[15] Our findings are in part supported by these previous findings, but go beyond these studies in providing estimates for HPV vaccine uptake for a broader range of sociodemographic factors. Furthermore, our results provide evidence for continuously lower vaccination rates within sociodemographic risk factors for young women.

In addition, we found that approximately 35% of unvaccinated women were interested in receiving the vaccine. Other studies reported vaccination interest rates that ranged from 31% to 61% depending on the population studied.[24–26] We also found that vaccination interest was lower for respondents in 2010 compared with 2008. This could be a potentially alarming development that may make it more difficult to encourage vaccination in young women. Specifically, one study focusing on parental attitudes showed an increase in parents not intending to vaccinate adolescent daughters.[14] Because of the cross-sectional nature of our data, we are unable to determine potential causes of this development. However, the findings are counterintuitive as we had expected an increase in vaccination interest because of awareness campaigns that would likely lead to more familiarity and interest. Further investigation is warranted to determine whether there is an ongoing trend in young women and what may lead to such a development.

Furthermore, our analysis demonstrated an association between increased HPV

vaccination interest and minority status (Hispanic, other), public insurance, having no usual place of care, delaying or forgoing medical care, having other recommended vaccinations, having heard of the HPV vaccine before the NHIS interview, and living in the South. However, married young women were less interested in receiving the vaccine, which may be attributable to a lower self-perceived risk of contracting HPV.[25] Other studies have noted that those with peer approval,[25] with lower perceived barriers to the vaccine, and with a doctor's recommendation[24] were more likely to intend vaccination. Others have reported that uninsurance was associated with lower vaccination interest, while publicly insured women were no different in terms of vaccination interest than privately insured women.[27] Pourat and Jones investigated vaccination interest among California women who had not heard of the vaccine, noting that women who had delayed or forgone care because of cost or uninsurance and women who had received the annual influenza vaccine had higher odds of being interested in vaccination.[26]

Our study builds on these studies and extends them in utilizing nationally representative data on young women to investigate vaccination interest. The analysis of HPV vaccination interest is particularly important if one considers that, if all unvaccinated young women in 2010 who were interested in vaccination had received the vaccine, the vaccination rate for young women would have increased to 42.7% (95% CI = 40.5, 45.4). Therefore, vaccination coverage would have doubled in young women aged 18 to 26 years (vaccine coverage in 2010: 21.5%; 95% CI = 19.2, 23.8). We acknowledge that, although important to investigate, interest in HPV vaccination may not be indicative of future behavior. However, it does provide a starting point for policymakers and vaccination campaigns to increase vaccination coverage among women who are interested in the vaccine. Educational efforts and vaccination initiatives should easily fit into the schedules of young women. This may be achieved by offering vaccinations and vaccine information in neighborhood pharmacies and college health clinics. Utilizing such alternative vaccine administration strategies could be especially beneficial for women with no usual place of care.[28]

Finally, we found that the 3 most common main reasons for nonvaccination in 2008 (lack of need, lack of knowledge, and safety concerns) remained the most common reasons for nonvaccination in 2010. However, respondents in 2010 were less likely to state lack of knowledge about the vaccine as the main reason for nonvaccination compared with respondents in 2008. This finding has also been shown in parental reasons for nonvaccination[14] and may be indicative of the success of educational campaigns informing about the vaccine as well as more familiarity with the vaccine because of its media coverage and gradual adoption of the vaccine by peers. Furthermore, although we observed no change in doctor's recommendation, we did see that lack of recommendation was the sixth most common reason for nonvaccination. The importance of doctor's recommendation has been noted in previous studies for young women and adolescents alike,[12,24,29,30] highlighting the importance for educational campaigns targeted at young women as well as at their health care providers to provide continued vaccination recommendations to all young unvaccinated women fit for vaccination. Therefore, any visit to a health care provider should be used as a primary opportunity to encourage vaccination initiation.

Limitations

We acknowledge the following limitations. First, the NHIS is a cross-sectional data set. Second, all information was self-reported and may therefore be subject to recall bias. Third, analysis of vaccination interest and reasons for nonvaccination was not possible for the most recent survey year (2012), because these survey items were not included in the questionnaire. Fourth, no information was available about whether respondents had received HPV vaccination recommendation from their doctor, which has been shown to be associated with vaccination interest and uptake.[12,24,29,30] Fifth, the HPV vaccines were approved beginning in June 2006 with vaccination recommendations published in 2007. The first year the NHIS included the questionnaire items related to HPV vaccination was 2008, and we are unable to assess trends before this time in the data. However, previously published data from the 2007 National Immunization Survey–Adult estimated a vaccine uptake rate of 10% among young women,[6] which lends support to our results for 2008. Sixth, our analysis is limited because of the lack of information regarding women's general attitudes toward vaccines, which may have an impact on vaccination interest. However, we included factors such as whether young women had received other recommended vaccinations to help account for potential differences in attitudes. Although these limitations apply, the results present a nationally representative sample of young women that contributes to knowledge of the trends in HPV vaccination uptake in young women.

Conclusions

Uptake of HPV vaccine has increased from 2008 to 2012 in young women. However, vaccination rates remain low especially for women with limited access to care. Furthermore, vaccination interest among unvaccinated women was lower in 2010 than in 2008. If unvaccinated women interested in the vaccine had received the vaccine, the HPV vaccination coverage among young women would have been twice as high in 2010. This calls for continued efforts by policymakers and educational vaccination initiatives to develop strategies and interventions to improve HPV vaccine initiation and completion in the US population. ■

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This article was accepted November 22, 2013.

Contributors

Both authors conceptualized the study. S. Schmidt analyzed the data. Both authors contributed equally to writing, reviewing, revising, and approving the final article. Both authors discussed the results and implications and commented on the article at all stages.

Acknowledgments

H. M. Parsons is supported by a National Cancer Institute Cancer Prevention and Control Career Development Award (K07CA175063).

Human Participant Protection

This research has been reviewed and determined exempt by the internal review board of the University of Texas Health Science Center at San Antonio.

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