Human Papillomavirus Vaccine Use Among Adolescent Girls and Young Adult Women: An Analysis of the 2007 California Health Interview Survey

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Abstract

Background: Administration of the human papillomavirus (HPV) vaccine is recommended for adolescent girls and young adult women. Little is known about the factors associated with vaccination. This study examined prevalence and correlates of HPV vaccine initiation (≥ 1 dose) among a statewide representative sample of adolescent and young adult females living in California.

Methods: HPV vaccination data on 3615 parents of adolescent girls aged 12–17 and 2068 young adult women aged 18–27 from the 2007 California Health Interview Survey (CHIS) were examined by sociodemographic, healthcare access, and health behavior factors using chi-square and multivariable logistic regression models.

Results: Nineteen percent of adolescent girls and 11% of young adult women had initiated the HPV vaccine series. In both groups, lower educational attainment (parental/own) was associated with lack of vaccine initiation. For adolescents, vaccine initiation was also significantly lower among those whose parents had low incomes or no usual source of care. For young adults, initiation was lower among the older group and those who spent less time in the United States, had public insurance, had no recent provider visit, or had fewer sexual partners.

Conclusions: In a statewide representative sample, different correlates of early initiation of HPV vaccination emerged for Californian adolescent girls and young adult women. These different patterns may be due to differential access to programs that provide free or low-cost HPV vaccines. Because several of these factors are associated with disparities in use of Pap tests, disparities will persist or even worsen unless greater effort is placed on vaccinating populations at highest risk for cervical cancer.

Introduction

THE CENTERS FOR DISEASE CONTROL AND PREVENTION'S (CDC) Advisory Committee on Immunization Practices (ACIP) and other organizations recommend routine human papillomavirus (HPV) vaccination of girls aged 11–12 and catch-up vaccination for females aged 13–26 who have not already initiated the vaccine series.^{1–3} Most U.S. studies on HPV vaccination have focused on use in adolescent populations and have documented their initiation rates (receipt of ≥ 1 dose in the 3-dose series).^{4–20} Fewer studies have documented vaccination in young adult women, the catch-up popula-

tion.^{4,5,8,11,16,21–26} Past studies examining HPV initiation rates found lower uptake among young adults (range 9%–16%)^{11,16,21–26} than among adolescents (range 10%–64%)^{6,7,9–20} Comparing HPV vaccine rates and correlates of initiation in adolescent vs. young adult populations is of particular interest because few studies have systematically sampled both age groups,¹⁶ and the federal Vaccines for Children (VFC) program provides the vaccine only for eligible individuals aged ≤ 18 (for more information about the VFC program, go to www.cdc.gov/vaccines/programs/vfc/default.htm).

Adoption of the HPV vaccine by populations at highest risk for cervical cancer has the potential to reduce disparities.^{27–30}

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Studies have shown that nonwhite, low socioeconomic status (SES), and immigrant populations who are medically underserved are at high risk because of low screening rates with the Pap test and inadequate follow-up of abnormal results. Other cervical cancer risk factors that also may play a role in disparities include smoking, co-infection with HIV and other sexually transmitted infections (STIs), high parity, and long-term oral contraceptive use.³¹ Even after implementation of the federally funded Breast and Cervical Cancer Early Detection Program in 1990, disparities in screening use and follow-up persist.^{32,33}

We assessed prevalence and correlates of HPV vaccine initiation among adolescent girls aged 12–17 and among young adult women aged 18–27 living in California and compared them. California has the highest number of new cervical cancer cases and deaths among all states and higher mortality rates among Asians, Hispanics, and African Americans compared to non-Hispanic whites.^{34–37} Despite efforts to increase Pap testing among nonwhite, low-income, uninsured, and immigrant populations,^{38,39} screening remains underused. HPV vaccination could reduce disparities in cervical cancer that Pap testing and follow-up have not been able to address. Thus, monitoring HPV vaccination is critical for assessing the potential impact of this new prevention method on cervical cancer disparities.

Materials and Methods

We used data from the 2007 California Health Interview Survey (CHIS). CHIS is a random-digit dial (RDD) telephone survey of households representative of California's noninstitutionalized residents. CHIS provides information on health behaviors, health status, and healthcare access in California's diverse population, offering interviews in six languages: English, Spanish, Cantonese, Mandarin, Korean, and Vietnamese. All observations and variables included in this analysis were collected from June 2007 to March 2008, when only the quadrivalent HPV vaccine had been approved and recommended in the United States.⁴⁰

Study sample

In CHIS 2007, questions related to receipt, knowledge, and acceptance of the HPV vaccine were administered to women aged 18–27 (27-year-olds were included because they were age eligible when the vaccine became available in 2006) and to respondents who were parents of a female adolescent aged 12–17 (determined by household enumeration). If there were more than one age-eligible daughter, interviewers randomly selected one of them and asked the parent to restrict answers to that particular adolescent. HPV data reported by adolescents were not examined in this study. The CHIS 2007 adult overall response rate was 18.3%,⁴¹ similar to other RDD surveys, including the 2007 California Behavioral Risk Factor Surveillance System (BRFSS) and the 2007 Health Information National Trends Survey (HINTS).⁴¹ We analyzed data from 3615 parents and 2068 young adult women.

HPV vaccine outcomes

HPV measures were developed by a working group of local, state, and national experts, including scientists from the California Department of Public Health, CDC, National Cancer

Institute (NCI), and UCLA Center for Health Policy Research. All measures were tested in the National Center for Health Statistics Cognitive Lab for fielding on the 2008 National Health Interview Survey (NHIS) and CHIS 2007. They were then translated, culturally assessed, and pilot tested using standard CHIS protocol. Our primary outcome was HPV vaccine initiation. Respondents were asked if they had ever heard of the HPV vaccine (yes, no). Those who had were asked if they/their daughter had ever received it (yes, no) and, if yes, how many doses. Adolescents and young adults who received ≥ 1 dose were coded as having initiated the vaccine.

Secondary outcomes we assessed were heard of HPV and knowledge that HPV can cause cervical cancer, can be transmitted through sexual contact, and can go away on its own without treatment (yes, no, don't know). Item nonresponse to HPV items was $<1\%$. All CHIS data were imputed using standard methods by CHIS investigators at the UCLA Center for Health Policy Research.⁴¹

Covariates

Sociodemographic, healthcare access, and health behavior variables were selected based on the variables collected in the survey and literature supporting their association with cervical cancer screening, acceptability and uptake of the HPV vaccine, or knowledge of HPV.^{16,29,42,43} Analysis categories are shown in Table 1.

Sociodemographics. Variables measured included age of respondent, race/ethnicity, educational attainment, marital status, household income as a percentage of the federal poverty level (FPL), time in the United States, and language of survey administration. For the adolescent sample, we report the sociodemographic characteristics of the parent. Parent's gender and age of the adolescent daughter were also collected. Eighteen-year-old women in the young adult sample were analyzed separately because VFC program eligibility includes 18-year-olds.

Healthcare access. Three variables were measured: type of health insurance, usual source of healthcare other than emergency room, and whether respondent had visited a healthcare provider in the past year. Parents were asked about their child's healthcare access.

Health behaviors. For young adult women, three variables were assessed: influenza vaccination in the past year, ever had Pap test, and number of sexual partners in the past year. Parents were not asked to report these behaviors for their child; therefore, they were not included in the correlates analyses.

Statistical analysis

To assess prevalence and correlates of initiation in both samples, we assumed that respondents who had not heard of the vaccine had not gotten it for their daughter or received it themselves. We believed this was a reasonable assumption because the 2008 NHIS data showed that $<1\%$ of women who had not heard of the HPV vaccine reported getting it.²⁶ Chi-square tests were conducted to identify significant associations between HPV vaccine initiation and covariates of interest. A series of multivariable logistic regression models, using a

TABLE 1. SOCIODEMOGRAPHIC, HEALTHCARE ACCESS, HEALTH BEHAVIOR, AND HUMAN PAPILLOMAVIRUS CHARACTERISTICS OF CALIFORNIAN PARENTS OF ADOLESCENT FEMALES AGED 12–17 AND WOMEN AGED 18–27, CALIFORNIA HEALTH INTERVIEW SURVEY, 2007

Variable	Parents of female adolescents aged 12–17			Women aged 18–27		
	(n = 3615)			(n = 2068)		
	n	W%	(95% WCI)	n	W%	(95% WCI)
Sociodemographic^a						
Age group of parent/woman, years						
<40, 18	757	27.0	(24.2–30.1)	238	14.2	(12.2–16.3)
40–49, 19–22	1781	49.0	(46.3–51.6)	725	41.4	(38.9–44.1)
50+, 23–27	1077	24.0	(22.2–26.0)	1105	44.4	(42.2–46.6)
Age group of adolescent daughter, years						
12–14	1681	48.1	(45.2–51.0)			
15–17	1934	51.9	(49.0–54.8)			
Gender of parent						
Male	1322	45.4	(42.9–47.8)			
Female	2293	54.6	(52.2–57.1)			
Race/ethnicity						
White, non-Hispanic (NH)	1928	39.6	(37.2–42.2)	770	33.2	(30.8–35.8)
Black, NH	184	5.4	(4.3–6.6)	139	6.9	(5.7–8.4)
Hispanic	1016	42.5	(39.9–45.2)	838	43.0	(40.6–45.3)
Asian/Hawaiian/Pacific Islander, NH	382	10.8	(9.4–12.3)	227	14.7	(12.9–16.8)
Other (AI/AN, 2+ races)	105	1.7	(1.3–2.2)	94	2.1	(1.6–2.9)
Education						
<12 years	496	25.4	(22.7–28.4)	236	13.1	(11.2–15.3)
High school graduate	759	23.5	(21.4–25.7)	711	34.9	(32.5–37.4)
Some college	948	21.5	(19.7–23.5)	677	33.0	(30.4–35.6)
College graduate	1412	29.5	(27.3–31.9)	444	19.0	(16.8–21.4)
Marital status						
Married	2617	79.2	(77.0–81.3)	479	18.7	(16.5–21.2)
Living with partner	192	7.0	(5.6–8.6)	276	11.9	(9.9–14.2)
Other	806	13.8	(12.3–15.5)	1313	69.3	(66.6–72.0)
Household income						
0–99% federal poverty level (FPL)	504	18.2	(15.7–21.0)	495	25.8	(23.2–28.5)
100–199% FPL	613	19.7	(17.8–21.8)	491	21.3	(18.9–24.0)
200–299% FPL	492	14.5	(12.9–16.3)	313	15.1	(13.1–17.4)
≥300% FPL	2006	47.6	(45.1–50.1)	769	37.8	(34.8–40.9)
Time in United States						
Born in US	2437	55.0	(52.6–57.4)	1569	74.2	(71.5–76.8)
In US 5+ years	1108	42.1	(39.6–44.7)	366	18.3	(16.0–20.9)
In US <5 years	70	2.8	(1.6–5.0)	133	7.4	(5.8–9.4)
Language of survey interview						
English	3031	73.5	(70.6–76.2)	1833	89.3	(87.3–91.1)
Non-English	584	26.5	(23.8–29.4)	235	10.7	(8.9–12.7)
Healthcare access^a						
Type of health insurance						
Uninsured	443	16.9	(14.6–19.5)	433	21.3	(18.5–24.4)
Public	544	14.6	(12.7–16.7)	519	22.9	(20.3–25.7)
Private	2628	68.5	(65.7–71.2)	1116	55.8	(52.5–59.0)
Usual source of healthcare other than ER						
Yes	3029	78.8	(76.2–81.2)	1452	68.3	(65.3–71.1)
No	586	21.2	(18.8–23.8)	616	31.7	(28.9–34.7)
Visited healthcare provider past year						
1+ times	3028	81.3	(78.8–83.6)	1724	82.6	(80.4–84.6)
Never	587	18.7	(16.4–21.2)	344	17.4	(15.4–19.6)
Health behavior^a						
Influenza vaccine past year						
Yes				402	21.0	(18.0–24.3)
No				1666	79.0	(75.7–82.0)
Pap test ever						
Yes				1579	70.6	(67.2–73.9)
No				489	29.4	(26.1–32.8)

(continued)

TABLE 1. (CONTINUED)

Variable	Parents of female adolescents aged 12–17			Women aged 18–27		
	(n = 3615)			(n = 2068)		
	n	W%	(95% WCI)	n	W%	(95% WCI)
No. of sexual partners past year						
0				433	24.8	(22.0-27.8)
1				1338	59.1	(55.5-62.6)
2+				297	16.1	(13.7-18.8)
HPV outcomes						
HPV vaccine initiation (at least 1 dose)						
Yes	749	19.4	(17.7-21.1)	190	11.0	(8.9-13.6)
No	2866	80.6	(78.9-82.3)	1878	89.0	(86.4-91.1)
Heard of vaccine ^b						
Yes	1918	58.5	(55.7-61.3)	1294	66.1	(62.7-69.4)
No	948	41.5	(38.7-44.3)	584	33.9	(30.6-37.3)
Heard of HPV disease ^c						
Yes	1821	76.6	(73.6-79.5)	1691	79.1	(76.2-81.8)
No	450	23.4	(20.5, 26.4)	377	20.9	(18.2-23.8)
Knows HPV causes cervical cancer ^d						
Yes	1351	72.0	(68.4-75.4)	1365	81.0	(77.9-83.7)
No/refused	80	5.0	(3.5-7.0)	55	3.1	(2.1-4.5)
Don't know	380	23.0	(19.8-26.5)	260	15.5	(12.9-18.5)
Knows HPV is sexually transmitted ^d						
Yes	1226	64.7	(61.0-68.3)	1174	68.2	(65.0-71.3)
No/refused	228	13.4	(11.4-15.5)	224	14.3	(12.1-16.8)
Don't know	357	21.9	(18.9-25.2)	282	17.0	(14.7-19.6)
Knows HPV can go away without treatment ^d						
Yes	125	6.8	(5.1-9.1)	210	12.6	(10.3-15.3)
No/refused	1415	78.9	(75.4-82.0)	1312	79.0	(75.9-81.8)
Don't know	271	14.3	(11.6-17.5)	158	7.9	(6.4-9.8)

^aFor the adolescent sample, parents were asked to report their own sociodemographic characteristics and the healthcare access of their adolescent daughter. They were not asked about their daughter's Pap test and sexual behaviors.

^bAmong those who did not receive the HPV vaccine (young adult women: $n = 1878$; parents: $n = 2866$).

^cSurvey item only asked of adult women aged 65 or younger ($n = 2293$).

^dSurvey item only asked of those who had heard of HPV disease; missing for 11 young adults and 10 mothers (young adult women: $n = 1680$; mothers: $n = 1821$).

CI, confidence interval; ER, emergency room; W%, weighted %.

backwards elimination process, were run to identify covariates that remained associated with initiation in the presence of other variables.⁴⁴ Variables associated with initiation in bivariate analyses ($p \leq 0.20$) were entered into the initial multivariable model. Variables with the largest Wald F p values were removed sequentially from subsequent models. At each step, if the likelihood ratio test comparing the reduced and full models was significant or if the beta coefficients of statistically significant variables in the previous step changed by $> 25\%$ (i.e., evidence of possible confounding), the full model was retained. This backwards elimination process was continued until all covariates had a Wald F p value ≤ 0.05 . Health behavior covariates were not entered into the models for adolescent girls because of availability (e.g., parents were not asked about daughter's Pap test use and number of sexual partners). All estimates and 95% confidence intervals (CIs) were weighted to incorporate the CHIS 2007 sampling design. Analyses were conducted using Sudaan 10.0.1 (Research Triangle Park, NC).

Results

Table 1 shows the distribution of sociodemographic, healthcare access, health behavior characteristics, and HPV

vaccine and knowledge outcomes for parents of adolescent girls and for young adult women who responded to the CHIS 2007. In both samples, the most prevalent racial/ethnic group was Hispanic, followed by non-Hispanic whites, Asians/Pacific Islanders, blacks, and American Indians/Alaskan Natives/multiracial. Most respondents had graduated from high school, were born in the United States, completed the survey in English, had private health insurance, had a usual source of healthcare, and visited a provider in the past year. Most parents were married (79.2 weighted % [W%], 95% CI 77.0-81.3), and only 18.7 W% (95% CI 16.5-21.2) of young adult women were married. Among young adults, most had a Pap test and one or more sexual partners in the past year; only 21.0 W% (95% CI 18.0-24.3) received the influenza vaccine in the past year.

Nineteen percent of adolescent girls (reported by parents) and 11.0 W% of young adult women had initiated the HPV vaccine series (Table 1). Among those not vaccinated, 41.5 W% of parents and 33.9 W% of young adults had not heard of the vaccine. Most parents and young women had heard of HPV disease. Most knew that it can cause cervical cancer and that it is sexually transmitted, but few knew that it could go away without treatment.

Correlates of HPV vaccine initiation for adolescent girls

Table 2 shows the distribution of parent-reported covariates in relation to daughter's HPV vaccine initiation status, *p* values from chi-square analyses, and adjusted odds ratios (OR) from the final multivariate model. Chi-square analyses found the following associated with lack of vaccine initiation: lower educational attainment, being married/living with a partner, lower income, less time in the United States, completing the survey in a language other than English, being uninsured, having no usual source of health care, and not having visited a provider in the past year ($p < 0.05$). In multivariate analyses, parents who had less than a college degree, incomes 100%–199% of the FPL, or no usual source of care remained significantly less likely to have initiated the HPV vaccine series for their daughter compared to those who graduated from college, reported an income $\geq 300\%$ above the FPL, or had a usual source of care. Hispanics parents were more likely than non-Hispanic whites to have their daughters vaccinated (OR 1.61, 95% CI 1.10–2.35). Although not significantly associated with initiation, marital status and time in the United States were retained in the multivariable model because their absence altered the magnitude of associations for other variables.

Correlates of HPV vaccine initiation for young adult women

Table 3 shows the distribution of self-reported covariates in relation to young women's initiation status, along with *p* values from chi-square analyses, and adjusted ORs from the final multivariate model. In bivariate analyses, the following were associated with lack of initiation: older age, nonwhite race/ethnicity, lower educational attainment, being married/living with partner, less time in the United States, non-English survey interview, no/public insurance, no provider visit in the past year, no influenza vaccine, and fewer sexual partners ($p < 0.05$). In multivariate analyses, women with the following characteristics remained significantly less likely to have initiated the HPV vaccine: being older than 18, having less than a college degree, living in the United States for < 5 years, having public insurance, not having visited a provider in the past year, and having fewer than two sexual partners in the past year. Although not significantly associated, the following were retained in the multivariable model because their absence altered the magnitude of associations for other variables: race/ethnicity, income, language of survey, influenza vaccine, and Pap test.

Discussion

Early measures of HPV vaccine initiation in California were 19.4% for adolescent girls and 11.0% for young adult women. Compared to national data from 2007, which showed 25% uptake among adolescents aged 13–17,⁷ the California adolescent vaccination rate is lower; however, the young adult estimate for California parallels the U.S. estimate (11.7%).^{22,23} CHIS population-based estimates were lower than published reports of adolescent and young adult females enrolled in a large managed care organization in Southern California (adolescent: 19% vs. 37%; adult: 11% vs. 16%).¹⁷ CHIS data show that socioeconomically disadvantaged groups (e.g., poor, less educated, and immigrants) and those with poor access to care

had lower vaccine initiation when the HPV vaccine was released. Our data measured a range of correlates of vaccination for California adolescent girls and young adult women. Consistent with some other studies, our analyses of both age groups showed that populations with lower educational attainment and poor access to care (indicated by lack of insurance or usual source of care) had lower rates of HPV vaccination.^{8,17,22,23} For young adult women, being 18 years old was also consistently associated with vaccine initiation in our and other studies,^{8,16,26} perhaps due to eligibility in the federally funded VFC program. Among adolescents, we found no association between age and vaccine initiation.

There are several possible reasons why vaccination among those ≤ 18 is higher than among adults, including VFC eligibility, greater availability of the vaccine in the pediatric care setting, routine pediatric care immunization practices differing from adult immunization practices, parental awareness and support, endorsement of vaccination before sexual debut, and provider recommendations. With respect to the underserved adolescent population eligible for VFC, the state health department notified VFC providers in December 2006 that they could begin ordering. Clearly, the VFC program removes cost as a barrier to vaccination among those ≤ 18 who are VFC eligible. Efforts to help parents identify a medical home may help those lacking a usual source of care to take advantage of adolescent vaccines through the VFC program.⁴⁵ Although Medicaid in California provided coverage of the HPV vaccine for young adult women aged 19–26 from January 2007, Medicaid did not announce coverage to providers until September 2007, halfway through the CHIS 2007 data collection.⁴⁶ Delayed awareness of Medicaid's HPV vaccine policy relative to the CHIS data collection cycle could have negatively impacted vaccine recommendation rates by providers and vaccine uptake by those covered by public insurance. Lower vaccination rates among publicly insured adult women may be partly explained by the fact that many young adult women become eligible for public insurance programs when they become pregnant, and the vaccine is not recommended for pregnant women. For privately insured women, lower rates may be due to the fact that many receive primary care through gynecologists or family planning clinics who do not routinely offer vaccines. Also, because ACIP recommendations for use of HPV vaccine were not published until March 2007, providers may have chosen to wait to purchase this expensive vaccine until they were certain it was covered by all health plans and programs; this may have contributed to the delay in uptake of the vaccine.

Previously published studies of HPV vaccine initiation have reported conflicting results about its association with race/ethnicity, income, and education in both age groups. Some studies show higher vaccination rates among those with higher incomes,^{16,18,22} higher educational attainment,^{16,19} and white race/ethnicity,^{9,16,17,24,26} whereas others show negative or no association.^{8,9,11,17,22,23} The conflicting results may be because of different multivariate models or distribution of other key variables in the populations being studied. In our data on adolescents, Hispanic ethnicity was associated with higher vaccination rates. Future research needs to monitor HPV vaccination trends by race/ethnicity and age to determine if racial/ethnic disparities in cervical cancer attributable to low screening in the past may continue because of lower uptake of the HPV vaccine.

TABLE 2. WEIGHTED DISTRIBUTION OF CHARACTERISTICS AND MULTIVARIATE LOGISTIC REGRESSION MODEL OF HUMAN PAPILLOMAVIRUS VACCINE INITIATION AMONG CALIFORNIA PARENTS OF ADOLESCENT FEMALES 12–17 YEARS OLD, CALIFORNIA HEALTH INTERVIEW SURVEY 2007 (UNWEIGHTED $n = 3615$)

Covariate	HPV vaccine initiation			Multivariate model ^a	
	n ^b	W% (95% WCI)	p value ^c	AOR	(95% CI)
Overall	749	19.4 (17.7-21.1)			
Parent sociodemographic					
Parent age group, years					
< 40	757	17.3 (13.7-21.6)	0.2189		
40–49	1781	19.3 (17.0-21.8)			
50+	1077	21.7 (18.6-25.2)			
Adolescent age group, years			0.1776		
12–14	1681	18.1 (15.7-20.8)			
15–17	1934	20.5 (18.2-23.1)			
Gender			0.5115		
Male	1322	18.7 (16.1-21.7)			
Female	2293	19.9 (17.9-22.0)			
Race/ethnicity			0.1605		
White, NH	1928	21.4 (18.8-24.2)		1.00	Reference
Black, NH	184	15.3 (10.2-22.3)		0.87	(0.52-1.45)
Hispanic	1016	19.0 (16.3-22.1)		1.61	(1.10-2.35)
Asian/PI/Native Hawaiian, NH	382	15.1 (11.0-20.4)		0.89	(0.56-1.43)
Other (AI/AN, 2+ races)	105	20.1 (12.1-31.5)		1.13	(0.60-2.13)
Educational attainment			0.0050		
< 12 years	496	16.5 (12.6-21.2)		0.79	(0.49-1.28)
High school graduate	759	16.4 (13.1-20.4)		0.63	(0.46-0.87)
Some college	948	19.3 (15.2-24.3)		0.70	(0.50-0.99)
College graduate	1412	24.2 (21.2-27.5)		1.00	Reference
Marital status			0.0169		
Married	2617	20.6 (18.4-22.9)		1.00	Reference
Living with partner	192	12.1 (7.4-19.4)		0.58	(0.31-1.09)
Other	806	16.0 (12.8-19.7)		0.78	(0.56-1.09)
Household Income			0.0042		
0–99% FPL	504	16.5 (12.6-21.4)		0.87	(0.55-1.40)
100%–199% FPL	613	13.0 (9.4-17.9)		0.60	(0.38-0.96)
200%–299% FPL	492	20.4 (15.9-25.8)		1.00	(0.68-1.48)
> 300% FPL	2006	22.7 (19.9-25.8)		1.00	Reference
Time in United States ^a			0.0050		
Born in United States	2437	22.2 (19.7-25.0)		1.00	Reference
In United States 5+ years	1108	16.2 (13.6-19.2)		0.70	(0.49-1.01)
In United States < 5 years	70	10.0 (3.2-27.1)		0.45	(0.15-1.30)
Language of survey interview ^a			0.0430		
English	3031	20.7 (18.6-22.9)			
Non-English	584	15.7 (12.3-19.8)			
Daughter's healthcare access					
Type of health insurance ^a			0.0005		
Uninsured	443	11.4 (7.9-16.1)			
Public	544	18.7 (14.6-23.7)			
Private	2628	21.5 (19.4-23.7)			
Usual source of care other than ER ^a			< 0.0001		
Yes	3029	21.6 (19.8-23.6)		1.00	Reference
No	586	11.0 (8.4-14.3)		0.51	(0.36-0.72)
Visit with healthcare provider past			0.0184		
1+ times	3028	20.4 (18.5-22.5)			
Never	587	14.7 (11.2-19.1)			

^aAll sociodemographic and healthcare access variables were entered into initial multivariate model; health behaviors were not assessed and included in the model. Backwards stepwise regression was used to determine final model.

^bUnweighted.

^cp values from chi-square test for independence.

AOR, adjusted odds ratio; FPL, federal poverty level.

TABLE 3. WEIGHTED DISTRIBUTION OF CHARACTERISTICS AND MULTIVARIATE LOGISTIC REGRESSION MODEL OF HUMAN PAPILLOMAVIRUS VACCINE INITIATION AMONG CALIFORNIA WOMEN AGED 18–27, CALIFORNIA HEALTH INTERVIEW SURVEY, 2007 (UNWEIGHTED $n=2068$)

Covariate	HPV vaccine initiation				Multivariate model ^a	
	n ^b	W%	(95% WCI)	p value ^c	AOR	(95% CI)
Overall	190	11.0	(8.9-13.6)			
Sociodemographic						
Age group, years ^a						
18	54	24.6	(18.1-32.4)	<0.0001	1.00	Reference
19–22	70	11.0	(7.6-15.7)		0.24	(0.11-0.52)
23–27	66	6.7	(4.4-10.1)		0.09	(0.04-0.18)
Race/ethnicity ^a						
White, NH	86	15.9	(11.9-20.9)	0.0115	1.00	Reference
Black, NH	5	5.6	(1.6-18.2)		0.38	(0.07-2.09)
Hispanic	68	8.1	(5.4-12.0)		0.86	(0.45-1.64)
Asian/Hawaiian/Pacific Islander, NH	25	11.8	(6.6-20.1)		1.02	(0.42-2.50)
Other (AI/AN, 2+ races)	6	6.4	(2.4-16.0)		0.27	(0.07-1.01)
Education ^a						
<12 Yrs	8	5.1	(2.2-11.0)	0.0084	0.21	(0.06-0.68)
High school graduate	70	12.9	(9.4-17.3)		0.35	(0.16-0.73)
Some college	57	8.7	(5.8-12.7)		0.33	(0.17-0.64)
College graduate	55	15.8	(10.1-23.9)		1.00	Reference
Marital status ^a						
Married	21	4.7	(2.5-8.6)	0.0002		
Living with partner	13	7.8	(3.8-15.2)			
Other	156	13.3	(10.5-16.6)			
Household income ^a						
0–99% FPL	27	8.7	(4.8-15.2)	0.0892	1.65	(0.68-4.04)
100%–199% FPL	36	8.9	(5.6-13.9)		1.20	(0.62-2.32)
200%–299% FPL	29	8.2	(4.9-13.6)		0.70	(0.34-1.41)
>300% FPL	98	14.9	(11.1-19.7)		1.00	Reference
Time in the United States ^a						
Born in United States	169	13.4	(10.9-16.5)	<0.0001	1.00	Reference
In United States 5+ years	18	5.0	(1.7-14.2)		0.53	(0.09-3.07)
In United States <5 years	3	1.6	(0.5-5.0)		0.23	(0.06-0.83)
Language of survey interview ^a						
English	188	12.2	(9.9-15.1)	<0.0001	1.00	Reference
Non-English	2	0.8	(0.2-2.7)		0.24	(0.05-1.04)
Healthcare access						
Type of health insurance ^a						
Uninsured	17	5.7	(3.0-10.8)	0.0017	0.52	(0.19-1.42)
Public	28	6.2	(3.8-9.8)		0.29	(0.14-0.63)
Private	145	15.0	(11.6-19.3)		1.00	Reference
Usual source of healthcare other than ER ^a						
Yes	156	12.4	(9.8-15.5)	0.0751		
No	34	8.1	(5.0-12.8)			
Visit with healthcare provider past year ^a						
1+ times	182	12.7	(10.2-15.7)	<0.0001	1.00	Reference
Never	8	3.0	(1.1-7.7)		0.23	(0.08-0.73)
Health behavior/status						
Influenza vaccine past year ^a						
Yes	50	17.0	(11.3-24.7)	0.0331	1.00	Reference
No	140	9.4	(7.6-11.7)		0.52	(0.27-1.02)
Pap test ever ^a						
Yes	149	11.2	(8.9-14.1)	0.8020	1.00	Reference
No	41	10.6	(6.7-16.3)		0.63	(0.26-1.51)
No. of sexual partners past year ^a						
0	41	11.0	(6.9-17.0)	0.0130	0.41	(0.18-0.95)
1	107	8.2	(6.2-10.8)		0.40	(0.22-0.72)
2+	42	21.4	(14.1-31.2)		1.00	

^aAll sociodemographic, healthcare access, and health behavior variables were entered into initial multivariate model; backwards stepwise regression was used to determine final model.

^bUnweighted.

^cp values from chi-square test for independence.

Our study could not confirm whether or not HPV vaccination is associated with other preventive behaviors in young adult women. Although the association between HPV and influenza vaccination was not statistically significant in this study, the direction and magnitude are consistent with other studies, where they were significant.^{16,26} We did not find an association between HPV vaccination and Pap screening. This may be because vaccination was higher among younger women not eligible for screening (recommended age to begin screening is 21 years).^{47–49} Other studies have shown lower vaccination rates among married than single women and argued that marital status is a proxy for a perceived lower risk of future HPV infection because of fewer new sexual contacts.^{22,26}

Our study is the first to examine the association between HPV vaccination and number of sexual partners in the past year. We found that women with more partners have higher vaccination rates than those with one partner or none. If this reflects perceived risk of future infection, it may help explain higher use of vaccine in this group. Women vaccinated as young adults may be sexually active before vaccination and, thus, already exposed to oncogenic HPV types in the vaccine. Therefore, it is especially important that future Pap testing among this catch-up population be monitored.

Structural interventions and policies designed to improve access to the HPV vaccine, such as the VFC program and campaigns to increase awareness about the vaccine, may be especially beneficial for parents and young women who are less educated, have low incomes, less time in the United States, or do not have a usual source of care.^{50,51} Affordable Care Act (ACA) legislation, which expands coverage for young adults under their parents' plans and Medicaid eligibility to low-income childless adults and prohibits copays for preventive care, will likely improve access to the vaccine. Future studies should monitor whether the ACA will have a positive impact on young adults' and adolescents' access to and receipt of the HPV vaccine.

Our study is subject to some limitations. First, data were collected early after licensure of the HPV vaccine and a couple of months after publication of the official ACIP recommendations; therefore, lower initiation rates are to be expected. Access may have been limited because of providers' decisions to purchase and stock the vaccine. California data from the 2008 and 2009 National Immunization Survey-Teen show that HPV vaccine initiation rates held steady at 46.6% and 49.2%, respectively (data at the state level were not reported in 2007).^{9,20} Second, our data are subject to self-report bias; however, a recent study showed very high agreement between parent-reported adolescent vaccination status and medical record data.⁵² No studies have examined accuracy of self-report for HPV vaccination in young adult populations. Third, the CHIS response rate was low, but it was similar to that in other RDD surveys (California BRFSS 2007 and HINTS 2007 response rates were 24.1% and 24.0%, respectively^{53,54}), and lower response rates do not automatically equate to more biased estimates.^{55,56} Studies comparing sociodemographics from CHIS and the California Census indicate that CHIS is representative of the California population. In addition, CHIS 2007 included a sample of cell phone-only households weighted to represent adults who only have a cell phone and do not have access to a landline telephone.

Conclusions

This is the first study to provide statewide correlates of HPV vaccine initiation using a diverse, population-based sample of adolescent girls and young adult women. Early after HPV vaccine licensure (June 2007–March 2008), we found 19% of California adolescents and 11% of young adult women had initiated the HPV vaccine series. Our estimates parallel levels documented in other studies during the same time period. We found lack of vaccination was associated with key markers of healthcare disparities: lower educational attainment and poor access to healthcare among young adult women. Because these same factors have been associated with lower rates of Pap screening for cervical cancer, our analysis suggests that unless greater effort is placed on vaccinating the populations at highest risk for cervical cancer, disparities will persist or worsen. Better access to preventive healthcare and the HPV vaccine because of the ACA and better immunization of our younger populations over time may help improve immunization rates in our young adults and prevent gaps from emerging among adolescent girls.

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