

Health Care Provider Recommendation, Human Papillomavirus Vaccination, and Race/Ethnicity in the US National Immunization Survey

Kelly R. Ylitalo, PhD, Hedwig Lee, PhD, and Neil K. Mehta, PhD

Human papillomavirus (HPV) is one of the most common sexually transmitted infections in the United States.^{1,2} In 2006, the Food and Drug Administration (FDA) licensed the first HPV vaccine for use in females aged 9 to 26 years. Subsequently, the Advisory Committee on Immunization Practices (ACIP) recommended routine HPV vaccination of 11- and 12-year-old girls, with ensuing catch-up vaccinations recommended for older female adolescents and young adults.³ However, HPV vaccine coverage of adolescents remains less than 50%,⁴ and Healthy People 2020 recognizes the facilitation of HPV vaccination as an emerging issue in sexually transmitted diseases.⁵

Health care provider recommendation has been shown to be a strong predictor of vaccination for a wide range of vaccines in older age groups.^{6–8} Therefore, one potential explanation for the low levels of HPV vaccine coverage is that parents and adolescents are not receiving HPV vaccine recommendations from their health care providers. A previous study indicated that less than 40% of adolescents discussed the HPV vaccine with their health care provider.⁹

African Americans and other minority groups are disproportionately affected by HPV infection and subsequent cervical cancer compared with non-Hispanic Whites.^{10,11} A better understanding of how to prevent HPV infection among racial/ethnic minorities will have important implications for reducing these health disparities. At the national level, little is known about racial/ethnic differences in the likelihood of receiving an HPV vaccine recommendation by a health care provider. In addition, little is known about the association between receiving a provider recommendation and actual HPV vaccine receipt and whether this association differs by race/ethnicity.

Objectives. Human papillomavirus (HPV) is a common sexually transmitted infection in the United States, yet HPV vaccination rates remain relatively low. We examined racial/ethnic differences in the prevalence of health care provider recommendations for HPV vaccination and the association between recommendation and vaccination.

Methods. We used the 2009 National Immunization Survey–Teen, a nationally representative cross-section of female adolescents aged 13 to 17 years, to assess provider-verified HPV vaccination (≥ 1 dose) and participant-reported health care provider recommendation for the HPV vaccine.

Results. More than half (56.9%) of female adolescents received a recommendation for the HPV vaccine, and adolescents with a recommendation were almost 5 times as likely to receive a vaccine (odds ratio = 4.81; 95% confidence interval = 4.01, 5.77) as those without a recommendation. Racial/ethnic minorities were less likely to receive a recommendation, but the association between recommendation and vaccination appeared strong for all racial/ethnic groups.

Conclusions. Provider recommendations were strongly associated with HPV vaccination. Racial/ethnic minorities and non-Hispanic Whites were equally likely to obtain an HPV vaccine after receiving a recommendation. Vaccine education efforts should target health care providers to increase recommendations, particularly among racial/ethnic minority populations. (*Am J Public Health.* 2013;103:164–169. doi:10.2105/AJPH.2011.300600)

Using the National Immunization Survey (NIS), a nationally representative sample of female adolescents aged 13 to 17 years in the United States, we examined racial/ethnic differences in the prevalence of health care provider recommendations for HPV vaccination and in the association between provider recommendation and provider-verified HPV vaccine initiation. In addition, we examined the roles of parental socioeconomic status and health insurance status in influencing the likelihood of provider recommendation and vaccine initiation.

METHODS

The NIS is an annual survey used to estimate the official Centers for Disease Control and Prevention–reported vaccination rates of children living in noninstitutionalized households in the United States. The NIS–Teen survey is 1

component of the NIS, which uses random-digit dialing to identify eligible households and screen for the presence of a 13- to 17-year-old adolescent to participate in the NIS–Teen survey. The details of the survey sampling procedure have been described elsewhere.¹²

Vaccination history was obtained primarily through written vaccine records (e.g., shot card). If a written record was unavailable, the survey respondent (the person most knowledgeable for the adolescent's vaccination history—usually the mother or female guardian [80.7%]) was asked to recall this information. The NIS–Teen also collected information on the general health status of the adolescent, previous doctor visits, health insurance status, and sociodemographic characteristics. In addition, the survey collected information and consent to contact the adolescent's vaccination provider to verify the adolescent's immunization history.

Study Participants

For the 2009 NIS–Teen survey, there were 34 976 (16 647 girls) eligible adolescents aged 13 to 17 years with complete household interviews in the United States, excluding the US Virgin Islands. Of the 16 647 girls, 9621 (57.8%) had provider-verified vaccination records and were included in previously published national vaccination rate estimates.⁴ The present study was limited to the 9274 (96.4%) female adolescents with provider-verified vaccination records and complete information on all variables (adolescent age, race/ethnicity, mother's age, mother's education, mother's marital status, type of health insurance, state of residence, Vaccines for Children [VFC] program eligibility, HPV vaccine recommendation, and HPV vaccination) used in the analysis.

Exclusions ($n = 347$) included female adolescents who were missing information on type of health insurance, recommendation of the HPV vaccine from a health care provider, and eligibility status for the VFC program. There were no differences between participants in the final sample and those excluded with regard to HPV vaccination ($P = .78$), mother's age ($P = .6$), mother's education ($P = .06$), and mother's marital status ($P = .37$); however, excluded participants were more likely to be older ($P = .02$) and to be of a racial/ethnic group other than non-Hispanic White ($P < .001$) compared with the final sample.

Measures

To assess HPV vaccination, the survey respondent was asked to report the total number of HPV vaccines (either bivalent or quadrivalent) that the female adolescent received. We dichotomized provider-verified responses as 0 doses of the HPV vaccine or as 1 or more doses of the HPV vaccine, which included 1, 2, 3, or 4 total doses. To assess HPV vaccine recommendation, the survey respondent was asked whether a doctor or other health care provider had ever recommended that the female adolescent receive HPV vaccinations; HPV vaccine recommendation was categorized as yes or no.

Race/ethnicity of the adolescent was identified by the survey respondent and categorized as Hispanic, non-Hispanic White (reference category), non-Hispanic Black, and non-Hispanic other. We categorized type of health insurance as provided by an employer

or union (reference category), provided by Medicaid or the State Children's Health Insurance Program (SCHIP), provided by some other entity including the military or Indian Health Service, and none. We categorized the mother's education as less than 12 years, 12 years including a high-school diploma or general equivalency diploma (reference category), more than 12 years but without a college degree, and college degree or higher. Mother's age was categorized as 34 years or younger (reference category), 35 to 44 years, and 45 years or older. Mother's marital status was categorized as currently married (reference category) and not currently married. Eligibility for the VFC program was categorized as yes or no.

Statistical Analysis

To provide consideration for the complex survey sampling design, we used the subsample weight (PROVWT) for adolescents with health care provider-verified data (PDAT = 1) in all analyses. The weighted estimates are used for official estimates of vaccination coverage in the United States and the use of correct subsample weights reduces bias attributable to differences between adolescents with adequate provider information and adolescents with missing provider information.¹² For our analyses, we used frequencies and standard errors for categorical variables and means and standard errors for continuous variables to describe the characteristics of the sample. We estimated the distribution of HPV vaccine recommendation, HPV vaccination, insurance status, and VFC eligibility for each racial/ethnic group and used F statistics to test the association of these variables with race/ethnicity. We used multivariable analyses to conduct logistic regression models that incorporated a priori-selected sociodemographic characteristics of the adolescent and adolescent's mother: age, race/ethnicity, mother's education, mother's age, mother's marital status, and type of health insurance. These sociodemographic variables have been shown as important predictors of vaccine decision-making in a variety of studies.

Model 1 predicts the log-odds of receiving an HPV vaccine recommendation with regard to sociodemographic characteristics. Model 2 predicts the log-odds of receiving an HPV

vaccine with regard to sociodemographic characteristics. Model 3 predicts the log-odds of receiving an HPV vaccine with regard to sociodemographic characteristics and HPV vaccine recommendation. In addition, we examined the association between HPV vaccine recommendation and HPV vaccination by race/ethnicity, given sociodemographic characteristics. We present the adjusted odds ratios (ORs) and corresponding 95% confidence intervals (CIs) for each model. We used fixed effects (indicator variables) for state residence of the adolescent in multivariate models to account for the possibility of differing state-level vaccination policies and implementation initiatives.¹³

We conducted all statistical analyses with SAS version 9.2 (SAS Institute, Cary, NC). We considered $P < .05$ to be statistically significant.

RESULTS

Overall, almost 60% of female adolescents aged 13 to 17 years received a recommendation by a health care provider for the vaccine, but only about 45% had received a vaccine (Table 1). There were significant differences in vaccine recommendation by race/ethnicity (Table 2; $P < .001$). More than 60% of non-Hispanic Whites reported a recommendation, whereas only 50% of non-Hispanic Blacks and Hispanics received a vaccine recommendation. There were no differences in HPV vaccination by race/ethnicity ($P = .95$). Racial/ethnic minorities also had higher proportions of Medicaid or SCHIP coverage and VFC eligibility.

Table 3 shows adjusted ORs from multivariable regression models. After we adjusted for other characteristics, non-Hispanic Blacks were the only racial/ethnic group significantly less likely to report having received a vaccine recommendation. Non-Hispanic Black adolescent females were 27% less likely to have received an HPV vaccine recommendation compared with non-Hispanic Whites (model 1 OR = 0.73; 95% CI = 0.57, 0.93). However, there were no differences in HPV vaccination receipt by racial/ethnic group (model 2), even after we adjusted for vaccine recommendation (model 3). Mothers with college degrees were more likely than mothers with only 12 years of education to have received a vaccine recommendation for their daughter (model 1

TABLE 1—Weighted Characteristics of HPV Outcomes Among Female Adolescents Aged 13 to 17 Years and Their Families: National Immunization Survey–Teen, 2009

Characteristics	% (SE) or Mean ±SE
HPV outcomes	
HPV vaccine recommendation	
Yes	56.9 (1.0)
No	43.1 (1.0)
HPV vaccination (≥ 1 dose)	
Yes	44.2 (1.0)
No	55.8 (1.0)
Characteristics of female adolescents	
Age, y	15.0 ±2.5
Race/ethnicity	
Hispanic	18.0 (0.9)
Non-Hispanic White	60.2 (1.0)
Non-Hispanic Black	14.9 (0.7)
Non-Hispanic other	6.9 (0.5)
Type of insurance	
Employer or union	65.1 (1.0)
Medicaid or SCHIP	22.3 (0.8)
IHS, military, or other	6.2 (0.6)
None	6.4 (0.5)
VFC eligible	
Yes	30.6 (0.9)
No	69.4 (0.9)
Characteristics of families	
Mother's age, y	
≤ 34	7.2 (0.5)
35–44	46.8 (1.0)
≥ 45	46.0 (1.0)
Mother's education	
< 12 y	12.9 (0.7)
12 y	27.1 (1.0)
> 12 y (no college degree)	25.5 (0.8)
College degree	34.5 (0.9)
Mother's marital status	
Married	72.9 (0.9)
Not married	27.1 (0.9)

Note. HPV = human papillomavirus; IHS = Indian Health Service; PROWWT = subsample weight; SCHIP = State Children's Health Insurance Program; VFC = Vaccines for Children program. Data were weighted with PROWWT sampling weight. The sample size was n = 9274.

OR = 1.49; 95% CI = 1.20, 1.85) and to report vaccination for their daughter (model 2 OR = 1.23; 95% CI = 1.00, 1.52); however, after we adjusted for recommendation, daughters of

college-educated mothers were not significantly more likely to have received a vaccine (model 3 OR = 1.09; 95% CI = 0.86, 1.38). Adolescents without health insurance coverage were significantly less likely to have received a recommendation (model 1 OR = 0.38; 95% CI = 0.27, 0.54) and the vaccine (model 2 OR = 0.62; 95% CI = 0.42, 0.89); however, after we adjusted for recommendation, adolescents without health insurance were not significantly less likely to have received the vaccine (model 3 OR = 0.85; 95% CI = 0.59, 1.23). Compared with adolescents with employer or private insurance, those with insurance provided by Medicaid or SCHIP were more likely to have received the vaccine (model 2 OR = 1.37; 95% CI = 1.09, 1.71) even after we adjusted for recommendation (model 3 OR = 1.46; 95% CI = 1.14, 1.88). Older adolescents were also more likely to have received the vaccine, even after we accounted for recommendation.

Adolescents with a health care provider recommendation for the HPV vaccine were almost 5 times as likely to report at least 1 vaccine dose (model 3 OR = 4.81; 95% CI = 4.01, 5.77) compared with respondents who reported no provider recommendation, even after we adjusted for all other characteristics of adolescents and families, as well as state-level fixed effects.

The association between a recommendation for the HPV vaccine and vaccination receipt was strong for all racial/ethnic groups (Table 4). Hispanic adolescents with a recommendation were almost 4 times as likely to report vaccination (OR = 3.61; 95% CI = 2.28, 5.73); non-Hispanic Whites were more than 5 times as likely to report vaccination (OR = 5.33; 95% CI = 4.34, 6.55); non-Hispanic Blacks were 7 times as likely to report vaccination (OR = 7.02; 95% CI = 4.37, 11.27); and non-Hispanic other races/ethnicities were more than 7 times as likely to report vaccination (OR = 7.45; 95% CI = 3.97, 13.98) compared with those without recommendations.

DISCUSSION

Although the coverage rate for many routine childhood vaccines approaches 90%, adolescent vaccines have not shared the same success rates despite recommendations by the ACIP.^{4,9} Although the overall HPV

vaccination rates remain relatively low (< 50% for all racial/ethnic groups), we found that female adolescents who received a provider recommendation for the HPV vaccine were almost 5 times as likely to receive an HPV vaccine as adolescents who did not receive this recommendation. Most importantly, this strong association remained after we adjusted for sociodemographic factors and state-level fixed effects, and was evident for all racial/ethnic groups. Despite these patterns, provider recommendation remains lower for non-Hispanic Blacks compared with non-Hispanic Whites.

To our knowledge, our study is the first to examine the association between health care provider recommendation for the HPV vaccine and provider-verified HPV vaccination by race/ethnicity in a nationally representative sample of female adolescents. The use of provider-verified vaccination history is considered the gold standard estimate and we used the NIS–Teen to further explore previously reported HPV vaccination estimates with these data. Our exclusion of individuals with incomplete covariate information changed the coverage rate of the HPV vaccine (≥ 1 dose) from 44.3%, as previously reported by the *Morbidity and Mortality Weekly Report*,⁴ to 44.2% in the present study.

Overall, our results are consistent with the literature on HPV vaccination; in smaller and more localized studies, recommendations from health care providers for the HPV vaccine are important predictors of HPV vaccination among differing age groups.^{5,14–19} Although vaccinations were not provider-verified, a national study of adolescents reported that those who discussed the HPV vaccine with their health care provider were 4.5 times as likely to report vaccine receipt.⁹ Our main results are also consistent with vaccination literature, which supports the role of the health care provider in decision-making for other vaccines. Older adults' receipt of the influenza vaccine⁷ and sexually transmitted disease clinic attendees' acceptance of the hepatitis B vaccine⁸ are strongly associated with receiving a vaccine recommendation from a health care provider.

Less than 60% of respondents in our study reported that they received a recommendation for the HPV vaccine, and receipt of a vaccine recommendation differed by race/ethnicity. Smaller studies in limited populations indicate

TABLE 2—Weighted Characteristics of Female Adolescents Aged 13 to 17 Years by Race/Ethnicity: National Immunization Survey–Teen, 2009

	All, % (SE)	Hispanic, % (SE)	Non-Hispanic White, % (SE)	Non-Hispanic Black, % (SE)	Non-Hispanic Other, % (SE)	P
HPV vaccine recommendation	56.9 (1.0)	50.8 (2.9)	60.7 (1.1)	49.7 (2.5)	54.7 (3.9)	<.001
HPV vaccination (≥ 1 dose)	44.2 (1.0)	44.2 (2.8)	43.9 (1.1)	45.6 (2.5)	44.2 (4.1)	.95
Type of health insurance						<.001
Employer or union	65.1 (1.0)	47.8 (2.9)	75.9 (1.1)	47.1 (2.5)	44.7 (4.0)	
Medicaid or SCHIP	22.3 (0.8)	34.4 (2.7)	12.4 (0.7)	43.8 (2.5)	30.7 (3.8)	
IHS, military, or other	6.2 (0.6)	4.1 (0.9)	7.1 (0.9)	3.5 (0.9)	9.6 (2.5)	
None	6.4 (0.5)	13.7 (2.1)	4.6 (0.4)	5.6 (1.2)	5.0 (1.6)	
VFC eligible	30.6 (0.9)	47.9 (2.9)	17.9 (0.8)	53.0 (2.5)	48.1 (4.0)	<.001

Note. HPV = human papillomavirus; IHS = Indian Health Service; PROWWT = subsample weight; SCHIP = State Children's Health Insurance Program; VFC = Vaccines for Children program. Data were weighted with PROWWT sampling weight. The sample size was n = 9274.

that the prevalence of provider recommendation for the HPV vaccine is less than 40%, but it is unclear if this prevalence differs by race/ethnicity.^{9,20} Despite the higher prevalence observed in the NIS, it appears that health care providers are still missing patient education opportunities. The importance of the health care provider in vaccine decision-making has key implications, particularly for racial/ethnic minorities. Research suggests that Whites are more likely to complete the vaccine series than are other races;^{4,21} therefore, vaccine recommendations to racial/ethnic minorities may increase the prevalence of vaccination and in turn lower the cervical cancer rates that disproportionately affect these groups. This is particularly important as we reported that non-Hispanic Blacks were least likely to receive a recommendation for the vaccine. Recommendations may become more salient for health disparities if they are related to vaccine series completion.

Overall, less than 45% of female adolescents had received at least 1 dose of HPV vaccine, but it is important to note that HPV vaccination did not differ by race/ethnicity. These findings are consistent with previously published literature.^{4,9,18,20} As noted by Brewer et al.,²⁰ equivalent but low vaccination receipt may not be enough to reduce health disparities for racial/ethnic minorities. Their findings also highlight the importance of continuity of care among racial/ethnic minority groups for vaccine series completion,²² as well as the role of other social factors in having an impact on health.²³

The reasons for low overall vaccination rates are not entirely clear, and we did not evaluate health beliefs regarding vaccination in our study. Research exploring HPV vaccination

before its license and ACIP recommendation suggested that possible parental concerns regarding the sexual mode of HPV transmission would be a barrier to vaccination, but evidence is now mixed on the importance of this issue.²⁴ More recent reports suggest that concerns with long-term vaccine safety may play a larger role in vaccination intentions.^{20,25,26} In addition, less than 50% of adolescents and young adults perceive themselves to be at risk for HPV infection,²⁴ whereas, in reality, the majority of females will become infected with HPV within 2 to 3 years of sexual activity onset.²⁷

An individual's financial ability to obtain the vaccine may play an important role. It was previously reported that individuals without health insurance were less likely to report vaccination compared with those with public or private insurance.²⁸ However, we found that individuals without health insurance were not only less likely to have received a vaccine, they were also significantly less likely to have received a vaccine recommendation compared with individuals with private or employer insurance. It is interesting that we also found that individuals with Medicaid or SCHIP insurance were more likely to receive the HPV vaccine than those with employer insurance, even after we adjusted for vaccine recommendation and other characteristics such as race/ethnicity. In a supplemental analysis (results not shown), we found similar results even after we adjusted for family income and VFC eligibility. The VFC program offers ACIP-recommended vaccines such as the HPV vaccine at no cost to eligible children, including those children enrolled in or eligible for Medicaid or those

children who are uninsured or underinsured with private insurance.²⁹ Therefore, all adolescents without health insurance that covers the cost of the vaccine would be eligible to receive the HPV vaccine. Nevertheless, other government-sponsored coverage, such as Indian Health Service and military insurance, did not appear to increase vaccination, and those without health insurance were least likely to have received an HPV vaccine recommendation despite the availability of the nationwide VFC program.

Limitations and Strengths

There are limitations of the current study. As previously discussed, the NIS–Teen survey utilizes landline telephones; although sampling weights account for exclusive use of landlines, a nonresponse bias may have occurred.⁴ Our main findings were that a health care provider recommendation increased the likelihood of at least 1 dose of the HPV vaccine, and the recommendation for this vaccine was recalled by the survey respondent. It is possible that differential recall bias occurred, such that individuals who received the vaccine were more likely to remember the recommendation than individuals who did not receive the vaccine.

We dichotomized HPV vaccination into at least 1 dose versus none. For the HPV vaccine to be effective, a vaccination series is required; as previously reported, less than 30% of female adolescents received 3 or more doses in 2009.⁴ The cross-sectional study design precluded examination of the total sample's long-term compliance with the vaccination protocol. It is unclear if a health care provider's recommendation predicts just 1 dose of the

TABLE 3—Association Between Characteristics of Female Adolescents Aged 13 to 17 Years and Their Families and HPV Vaccine Recommendation and HPV Vaccination: National Immunization Survey–Teen, 2009

	HPV Vaccine Recommendation		HPV Vaccination (≥ 1 dose)	
	Model 1, OR (95% CI)		Model 2, OR (95% CI)	Model 3, OR (95% CI)
Age, y				
13 (Ref)	1.00	1.00	1.00	
14	0.95 (0.74, 1.21)	1.17 (0.92, 1.50)	1.22 (0.94, 1.59)	
15	1.10 (0.86, 1.40)	1.50* (1.18, 1.90)	1.54* (1.20, 1.97)	
16	1.10 (0.85, 1.43)	1.82* (1.42, 2.32)	1.90* (1.45, 2.50)	
17	1.08 (0.84, 1.37)	1.64* (1.29, 2.09)	1.72* (1.33, 2.21)	
Race/ethnicity				
Hispanic	0.85 (0.64, 1.13)	0.95 (0.72, 1.24)	1.00 (0.73, 1.37)	
Non-Hispanic White (Ref)	1.00	1.00	1.00	
Non-Hispanic Black	0.73* (0.57, 0.93)	0.98 (0.77, 1.25)	1.11 (0.85, 1.44)	
Non-Hispanic other	0.81 (0.58, 1.15)	0.83 (0.58, 1.18)	0.87 (0.59, 1.27)	
Mother's education				
< 12 y	0.95 (0.69, 1.29)	1.01 (0.74, 1.38)	1.04 (0.74, 1.46)	
12 y (Ref)	1.00	1.00	1.00	
> 12 y (no college grad)	1.19 (0.95, 1.50)	1.08 (0.87, 1.35)	1.02 (0.80, 1.31)	
College grad	1.49* (1.20, 1.85)	1.23* (1.00, 1.52)	1.09 (0.86, 1.38)	
Mother's age, y				
≤ 34 (Ref)	1.00	1.00	1.00	
35–44	0.77 (0.56, 1.06)	0.62* (0.45, 0.83)	0.64* (0.47, 0.86)	
≥ 45	0.80 (0.58, 1.11)	0.63* (0.46, 0.86)	0.64* (0.46, 0.89)	
Mother's marital status				
Married (Ref)	1.00	1.00	1.00	
Not married	0.96 (0.78, 1.17)	1.30* (1.06, 1.58)	1.37* (1.09, 1.73)	
Type of insurance				
Employer or union (Ref)	1.00	1.00	1.00	
Medicaid or SCHIP	0.95 (0.75, 1.19)	1.37* (1.09, 1.71)	1.46* (1.14, 1.88)	
IHS, military, or other	0.74 (0.48, 1.13)	0.81 (0.54, 1.22)	0.90 (0.52, 1.57)	
None	0.38* (0.27, 0.54)	0.62* (0.42, 0.89)	0.85 (0.59, 1.23)	
HPV vaccine recommendation				
No (Ref)	1.00	
Yes	4.81* (4.01, 5.77)	

Note. CI = confidence interval; HPV = human papillomavirus; IHS = Indian Health Service; OR = odds ratio, calculated from weighted multivariable logistic regression; PROVWT = subsample weight; SCHIP = State Children's Health Insurance Program. Models were weighted with PROVWT sampling weight. Models also included state fixed effects. The sample size was n = 9274. *Results significant at the $\alpha = .05$ level.

vaccine or if that recommendation actually increases the likelihood of HPV vaccination series completion. As previously reported, non-Hispanic Whites were the highest race/ethnicity proportion of the subsample that completed the vaccine series in the 2009 NIS–Teen survey,⁴ but future longitudinal studies, including possible oversamples of racial/ethnic minority respondents, are needed to assess the predictors of series completion for the entire sample.

There may also be unmeasured confounders that were not accounted for in our analysis. For example, racial/ethnic concordance between the health care provider and the female adolescent or adolescent's family may be important to consider in future research on HPV vaccination as there is some indication in the literature that racial/ethnic concordance can increase a patient's report of a positive health care experience.³⁰ In addition, our use of state-level fixed effects, though novel, may not have

completely accounted for state-level differences in vaccination policies. Furthermore, our analysis was limited to adolescents with health care provider-verified vaccination records. There may be important differences between adolescents with adequate provider records and adolescents without provider records that were not accounted for with our use of subsample weights. Adolescents with provider information may be more likely to be up to date on their shots and have a higher total family income than adolescents without provider records.¹² In addition, there was a small amount of overlap between health insurance groups. We prioritized the classification of the employer-based insurance and no insurance groups. There may be heterogeneity in the other insurance groups because some adolescents had multiple forms of coverage. Finally, our sample was limited to adolescent females. Future studies may wish to address the relationship between vaccine recommendation and subsequent vaccination among male adolescents, because of the recent ACIP recommendation for routine vaccination of 11- to 12-year-old boys.³¹

To our knowledge, this was the first investigation to demonstrate that a health care provider recommendation increased the likelihood of provider-verified HPV vaccination (≥ 1 dose) among female adolescents in the United States. Our use of provider-verified vaccination history, rather than vaccination intentions or self-reports, makes a substantial contribution to the current body of literature on

TABLE 4—Association Between HPV Vaccine Recommendation and HPV Vaccination by Race/Ethnicity Among Female Adolescents Aged 13 to 17 Years: National Immunization Survey–Teen, 2009

Race/Ethnicity	OR (95% CI)
Hispanic	3.61 (2.28, 5.73)
Non-Hispanic White	5.33 (4.34, 6.55)
Non-Hispanic Black	7.02 (4.37, 11.27)
Non-Hispanic other	7.45 (3.97, 13.98)

Note. CI = confidence interval; HPV = human papillomavirus; OR = odds ratio, calculated from weighted multivariable logistic regression; PROVWT = subsample weight; Models were weighted with PROVWT sampling weight. Models also included adolescent age; mother's education, age, and marital status; health insurance; and state fixed effects. The sample size was n = 9274.

predictors of HPV vaccination, because provider-verified vaccination records are more accurate than self-reports.⁴ In addition, our large representative sample makes results generalizable to noninstitutionalized female adolescents aged 13 to 17 years in the United States.

Conclusions

Vaccination goals for HPV in the United States have not been met. Racial/ethnic minorities are less likely to receive an HPV vaccine recommendation than are non-Hispanic Whites. Individuals who receive a vaccine recommendation from a health care provider are significantly more likely to obtain an HPV vaccine than individuals who do not receive a recommendation and this relationship is generally consistent across all racial/ethnic groups. If public health officials wish to increase coverage of the HPV vaccine among female adolescents and reduce disparities in vaccination, they should target education efforts at health care providers to increase the amount of recommendations, particularly for our most disadvantaged populations. ■

About the Authors

Kelly R. Ylitalo is with the Department of Epidemiology, University of Michigan, Ann Arbor. Hedwig Lee is with the Department of Sociology, University of Washington, Seattle. Neil K. Mehta is with the Department of Global Health at the Rollins School of Public Health, Emory University, Atlanta, GA. Correspondence should be sent to Kelly R. Ylitalo, 1415 Washington Heights, Ann Arbor, MI 48109-2029 (e-mail: kylitalo@umich.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link. This article was accepted November 21, 2011.

Contributors

K. R. Ylitalo had full access to the data in the study and takes responsibility for the integrity of the data analysis. All authors have participated sufficiently in the work to take public the whole content. K. R. Ylitalo and H. Lee took part in the origination and design. K. R. Ylitalo acquired the data and analyzed the data. All authors interpreted the data, planned the statistical analysis and methodological design, took part in drafting of the article and critical revision of the article for important intellectual content, and gave final approval of the submitted article.

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Human Participant Protection

The National Immunization Survey was approved by the Research Ethics Review Board of the Centers for Disease Control and Prevention.

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