Human Papillomavirus Vaccination and Pap Smear Uptake Among Young Women in the United States: Role of Provider and Patient

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Abstract

Background: It has been reported that Pap smear use is higher among U.S. women who received the human papillomavirus (HPV) vaccine than unvaccinated women. This study assessed the role of provider and patient in the difference of Pap smear use by vaccination status.

Methods: We conducted a cross-sectional study of 5416 young women (21–30 years of age) with detailed information on Pap smear use and HPV vaccination status from the National Health Interview Survey (NHIS) 2013–2015. Vaccinated women received at least one dose of HPV vaccine. Main outcomes included Pap smear in the past year, provider's recommendation for Pap smear, and patient-initiated Pap smear.

Results: The prevalence of Pap smear in the past year was much higher among vaccinated women than unvaccinated women (67.5% vs. 52.8%, $p < 0.001$). Compared with unvaccinated women, vaccinated women were more likely to receive a provider's recommendation for Pap testing (60.8% vs. 50.8%, $p < 0.001$), to obtain Pap testing after receiving a provider's recommendation (75.1% vs. 67.9%, $p = 0.004$), and to initiate Pap testing themselves (57.7% vs. 38.2%, $p < 0.001$). However, among women who visited an obstetrician/gynecologist (OB/GYN) in the past year, the positive association between HPV vaccination and Pap smear recommendation and uptake vanished.

Conclusions: Unvaccinated women who have not visited an OB/GYN in the past year are less likely to receive a recommendation for Pap testing from their providers or to initiate Pap testing themselves without a provider's recommendation. They should be encouraged to visit an OB/GYN provider for cervical cancer screening.

Keywords: human papillomavirus vaccine, cervical cancer, papanicolaou test, cancer screening, health communication

Introduction

CERVICAL CANCER IS caused by oncogenic types of human papillomavirus (HPV).^{1,2} In women, to prevent HPV infection, vaccination is recommended for girls 9–12 years of age, with catchup vaccination up to 26 years in the United States. In other countries, the recommended age for HPV vaccine varies slightly. For example, Australia recommends vaccination among girls 12–13 years of age with a time-limited catch-up program (women aged 14–26 years), and is recommended for girls 11–14 years of age in Canada. The HPV vaccine can reduce vaccine-type HPV infections and abnormal Papanicolaou (Pap) test results,^{3–8} but shows little protection against nonvaccine oncogenic types in postmarket surveillance.^{9,10} Moreover, it has no efficacy against prior infections.^{7,11} As such, cervical cancer screening is still essential for cancer prevention.

National guidelines in the United States currently recommend that women undergo Pap testing at 3-year intervals starting at 21 years of age and HPV DNA testing starting at 30 years of age, regardless of HPV vaccination status.^{12–14} HPV vaccination and Pap smears are preventive care recommended by the U.S. Preventive Services Task Force (USPSTF), and are freely available to women with health insurance coverage (private insurance, or public insurance, such as Medicaid) as required by the Affordable Care Act (ACA).¹²

However, before ACA was issued in 2010, cervical care coverage by health insurance program varied. Assistance programs, such as the Vaccines for Children (VFC) program, and the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), provide free HPV vaccines and cervical screening to low-income and uninsured women to reduce disparities in cervical cancer incidence.^{15–17}

It has been reported that Pap smear use is higher among young women vaccinated against HPV in the United States.¹⁸ A positive association between HPV vaccination and Pap smear uptake has been observed across race/ethnicity and socioeconomic status.¹⁹

We have studied the role of provider-patient communications in cancer screening service utilization, and found that providers' recommendations for cancer screening tests are essential for both the proper use of screening services in eligible women²⁰ and overutilization of cervical cancer screening among certain female populations. These include women who are recommended not to receive Pap testing, such as those over 65 years with adequate prior screening and no history of precancerous cervical lesions and those who have had a total hysterectomy for noncancerous conditions.^{21,22} On the other hand, about 20%–25% of screening services are requested by the patients themselves among women.^{21,22}

In this study, we assessed differences in provider's recommendation for Pap testing and patient-initiated Pap testing between vaccinated and unvaccinated women, using data from the National Health Interview Survey (NHIS) 2013–2015.

Methods

NHIS collected health information through an annual, in-person household survey from a representative cross-sectional noninstitutionalized sample to assess the health status and behaviors of U.S. adults. NHIS used a complex, stratified, multistage sample design to provide nationally representative data. Verbal consent for survey participation was provided by each subject.

We included data from NHIS 2013 to 2015, which had detailed information on HPV vaccination status, Pap smear use, personal history of cervical cancer, and history of hysterectomy. We combined data from those 2 years to generate reliable estimates. After excluding women with a history of hysterectomy ($n=39$), history of cervical cancer ($n=44$), no valid information on Pap smear use ($n=276$), and Pap testing performed for a health problem ($n=216$), we had 5416 young women (21–30 years old) remaining in the analyses. This study was exempt from full board review by the Institutional Review Board at University of Texas Medical Branch.

NHIS obtained information about the most recent Pap smear, as well as whether and when the HPV vaccine was received, and doses of vaccine administered. The time of the most recent Pap smear was recoded using the NHIS 2000 method by combining information contained in month/year, days/weeks/months/years ago, the original time interval grouping, and the interview date. HPV vaccination status was derived from the following questions: "Have you ever received an HPV shot or vaccine?," "How many HPV shots did you receive?," and "How old were you when you received your first HPV shot?." Vaccinated women received at least one dose of HPV vaccine.

Women were also asked whether they had received recommendations for Pap smears from their providers "Was your most recent Pap test recommended by a doctor or other health professional?" or "In the past 12 months, has a doctor or other health professional recommended that you have a PAP test?" If they had not received a provider's recom-

mendation for Pap testing, but obtained a Pap smear anyway, they were determined as having initiated Pap testing themselves.

Age was classified into two groups: 21–25 and 26–30 years of age. NHIS data are from a nationally representative sample. Estimates of HPV vaccination rates among women in these two age groups were comparable between NHIS and The National Health and Nutrition Examination Survey (NHANES), another national survey in the United States.²³

Race was self-reported as non-Hispanic white, non-Hispanic black, Hispanic, and other. Immigration status included born in the United States, and not born in the United States. Regions of residence included Northeast, Midwest, South, and West. We also included education level in the analyses: <high school, high school, and >high school.

NHIS collected information on health insurance coverage (public, private, and none) and usual place of healthcare. Those who listed the emergency room as their usual place of healthcare were combined with those who reported no access to a usual source of care. We also included whether participants had visited an obstetrician/gynecologist (OB/GYN), a nurse practitioner/physician assistant/midwife, or other healthcare provider (*e.g.*, general doctor, therapist, and medical specialist) in the past 12 months, as visiting an OB/GYN was associated with Pap smear use.^{20–22}

We compared prevalence of Pap testing in the past 3 years or in the past year between vaccinated women and unvaccinated women from NHIS 2013 to 2015 and assessed the role of providers and patients in the initiation of Pap testing. We used Pap smear utilization in the past year as an outcome of interest, because this study aimed to examine the effect of providers' recommendations for Pap smears in the past year on uptake of Pap smear by vaccination status. We also assessed how visiting an OB/GYN in the past year affected the relationship between HPV vaccination and Pap smear use.

Multivariate logistic regression models were used to assess differences in screening use and recommendation received by vaccination status. Controlled variables included age, race/ethnicity, region of residence, insurance type, and education level. Adjusted prevalence ratios were obtained from average marginal predictions in the fitted logistic regression model.^{24,25}

Sample weights of final annual person weights were incorporated into all analyses through a "weight" statement in SAS survey analysis procedures following NHIS analyses guidelines,²⁶ to account for differential probabilities of selection and the complex sample design, and nonresponse and noncoverage. Sensitivity analysis was performed by excluding women who received the first dose of HPV vaccine after 26 years of age. Statistical analyses were conducted using SAS software version 9.4 (SAS Institute, Cary, NC) and SAS-callable SUDAAN software version 11 (Research Triangle Institute, Research Triangle Park, NC). A two-sided p -value <0.05 was considered statistically significant.

Results

Among 5416 young women from NHIS 2013 to 2015, the proportion of women who received a Pap smear in the past 3 years was much higher among vaccinated than unvaccinated women (88.4% vs. 75.6%, adjusted prevalence ratio 1.17, 95% confidence interval [CI] 1.13–1.21, Table 1). The

TABLE 1. SCREENING PAP SMEAR IN THE PAST 3 YEARS AMONG YOUNG WOMEN ACCORDING TO HUMAN PAPILLOMAVIRUS VACCINATION STATUS, NATIONAL HEALTH INTERVIEW SURVEY 2013–2015 (N=5416)

Characteristics	n (%) ^a		Pap smear in the past 3 years		Adjusted PR ^b (95% CI)
			% (95% CI)		
	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated	
Total	1618 (29.9)	3798 (70.1)	88.4 (86.3–90.5)	75.6 (73.7–77.5)	1.17 (1.13–1.21)
Age					
21–25	941 (18.9)	1557 (32.4)	84.1 (80.9–87.4)	66.5 (63.3–69.7)	1.23 (1.15–1.32)
26–30	677 (10.9)	2241 (37.7)	95.7 (94.0–97.4)	83.4 (81.4–85.5)	1.13 (1.1–1.17)
Race/ethnicity					
NH-white	946 (19.0)	1792 (38.6)	90.1 (87.5–92.7)	79.3 (76.5–82.1)	1.14 (1.09–1.2)
NH-black	221 (3.6)	630 (9.9)	89.9 (85.2–94.5)	81.6 (77.6–85.7)	1.1 (1.03–1.18)
Hispanic	285 (4.9)	954 (14.9)	83.0 (76.6–89.5)	69.5 (65.9–73.0)	1.19 (1.09–1.31)
Other	166 (2.4)	422 (6.7)	83.3 (75.2–91.3)	59.2 (52.7–65.6)	1.46 (1.27–1.67)
Immigration status					
Born in the United States	1469 (27.3)	2971 (56.4)	88.8 (86.7–90.9)	78.6 (76.4–80.7)	1.14 (1.1–1.18)
Not born in the United States	149 (2.6)	827 (13.7)	83.6 (75.4–91.8)	63.4 (59.4–67.4)	1.32 (1.19–1.48)
Region of residence					
Northeast	292 (5.9)	464 (10.2)	89.6 (85.0–94.2)	77.1 (71.9–82.2)	1.15 (1.06–1.25)
Midwest	333 (6.5)	774 (15.9)	88.9 (83.9–94.0)	77.0 (72.3–81.7)	1.18 (1.08–1.28)
South	552 (10.0)	1501 (27.9)	88.3 (85.0–91.6)	76.9 (74.2–79.6)	1.14 (1.08–1.21)
West	441 (7.5)	1059 (16.2)	86.9 (82.7–91.2)	71.1 (67.4–74.9)	1.23 (1.15–1.32)
Education level					
<High school	69 (1.4)	485 (7.4)	86.1 (74.8–97.4)	72.1 (66.2–77.9)	1.16 (0.98–1.36)
High school	215 (4.0)	880 (16.7)	91.7 (87.2–96.1)	73.3 (69.4–77.1)	1.26 (1.17–1.36)
>High school	1334 (24.5)	2423 (45.8)	87.9 (85.6–90.3)	77.0 (74.6–79.4)	1.16 (1.12–1.21)
Missing		10			
Health insurance coverage					
None	197 (3.1)	882 (15.6)	82.5 (75.5–89.5)	61.1 (57.1–65.1)	1.36 (1.24–1.5)
Private	1087 (20.7)	1949 (38.8)	88.5 (85.8–91.1)	78.8 (76.1–81.5)	1.15 (1.1–1.21)
Public	323 (5.9)	951 (15.3)	91.3 (86.6–96.0)	83.1 (80.0–86.2)	1.11 (1.04–1.18)
Missing	11	16			
Having a usual source of care					
No	315 (5.5)	946 (17.0)	80.9 (75.4–86.4)	64.8 (61.0–68.6)	1.22 (1.12–1.34)
Yes	1303 (24.4)	2851 (53.1)	90.0 (87.7–92.4)	79.1 (76.9–81.2)	1.16 (1.11–1.2)
Missing		1			
Visiting an OB/GYN in the past year					
No	624 (11.2)	1968 (35.7)	74.6 (70.1–79.1)	57.3 (54.4–60.3)	1.32 (1.21–1.43)
Yes	992 (18.6)	1829 (34.4)	96.6 (95.1–98.1)	94.6 (93.0–96.1)	1.03 (1–1.05)
Missing	2	1			

Bold indicates statistical significance ($p < 0.05$).

^aSample weights were used to calculate weighted percentage.

^bAdjusted prevalence ratio (vaccinated women vs. unvaccinated women) was adjusted for age, race/ethnicity, region of residence, insurance type, and education level.

CI, confidence interval; NH-black, non-Hispanic black; NHIS, National Health Interview Survey; NH-white, non-Hispanic white; OB/GYN, obstetrician/gynecologist; PAP, Papanicolaou; PR, prevalence ratio.

proportion of women who received a Pap smear in the past year was also much higher among vaccinated than unvaccinated women (67.5% vs. 52.8%, $p < 0.001$, Table 2). The higher utilization of Pap testing among vaccinated women was observed across all subgroups. Compared with unvaccinated women, vaccinated women were more likely to have a college education, to have private health insurance coverage, to have a usual place of care, and to have visited an OB/GYN in the past year.

Compared with unvaccinated women, those who had been vaccinated against HPV were more likely to have received a provider's recommendation for a Pap smear (60.8% vs. 50.8%, adjusted prevalence ratio 1.17, 95% CI 1.09–1.25,

$p < 0.001$, Table 3), and had a higher likelihood of obtaining a Pap smear in the past year after receiving a provider's recommendation (75.1% vs. 67.9%, $p = 0.004$, Table 4). Among those who did not receive a provider's recommendation, vaccinated women still had a higher likelihood of receiving a Pap smear (57.7% vs. 38.2%, $p < 0.001$).

Among vaccinated women, 66.9% of Pap tests were received under providers' recommendations, and 33.1% of Pap tests were initiated by women themselves. Among unvaccinated women, 64.7% of women who received Pap tests had recommendations for them by their providers and 35.3% initiated by patients who did not have a health provider recommendation for a Pap smear.

TABLE 2. SCREENING PAP SMEAR IN THE PAST 12 MONTHS AMONG YOUNG WOMEN ACCORDING TO HUMAN PAPILLOMAVIRUS VACCINATION STATUS, NATIONAL HEALTH INTERVIEW SURVEY 2013–2015 (N=5416)

Characteristics	Pap smear in the past year		Adjusted PR ^a (95% CI)
	% (95% CI)		
	Vaccinated (n=1618)	Unvaccinated (n=3798)	
Total	67.5 (64.2–70.8)	52.8 (50.7–54.9)	1.27 (1.19–1.34)
Age			
21–25	63.6 (59.1–68.1)	45.4 (42.3–48.6)	1.34 (1.21–1.48)
26–30	74.3 (69.7–79.0)	59.2 (56.3–62.0)	1.21 (1.12–1.31)
Race/ethnicity			
NH-white	67.4 (63.1–71.7)	54.1 (51.1–57.2)	1.23 (1.13–1.34)
NH-black	75.4 (68.5–82.2)	64.7 (59.9–69.4)	1.16 (1.03–1.29)
Hispanic	64.0 (56.8–71.3)	48.6 (45.0–52.2)	1.29 (1.13–1.48)
Other	63.7 (52.9–74.5)	37.4 (30.9–43.9)	1.74 (1.36–2.23)
Immigration status			
Born in the United States	68.6 (65.2–71.9)	55.2 (52.8–57.7)	1.24 (1.16–1.32)
Not born in the United States	56.0 (45.1–66.9)	43.0 (39.2–46.8)	1.29 (1.05–1.6)
Region of residence			
Northeast	78.1 (71.7–84.4)	58.7 (52.9–64.6)	1.34 (1.18–1.51)
Midwest	68.0 (61.7–74.3)	53.6 (48.5–58.7)	1.31 (1.18–1.45)
South	69.6 (63.9–75.2)	54.9 (51.9–57.9)	1.24 (1.12–1.37)
West	56.0 (48.4–63.6)	44.8 (40.8–48.9)	1.24 (1.05–1.46)
Education level			
<High school	62.3 (47.1–77.5)	45.4 (39.0–51.8)	1.32 (1–1.75)
High school	68.6 (59.2–78.0)	49.6 (45.6–53.6)	1.35 (1.15–1.57)
>High school	67.6 (64.2–71.0)	55.3 (52.6–57.9)	1.25 (1.17–1.34)
Health insurance coverage			
None	49.9 (40.7–59.1)	37.9 (34.0–41.8)	1.32 (1.09–1.62)
Private	69.0 (65.0–73.0)	56.4 (53.4–59.4)	1.26 (1.17–1.37)
Public	71.7 (64.3–79.0)	59.3 (55.3–63.3)	1.22 (1.08–1.38)
Having a usual source of care			
No	52.2 (44.6–59.8)	38.8 (34.5–43.2)	1.27 (1.06–1.54)
Yes	71.0 (67.3–74.6)	57.3 (54.9–59.7)	1.26 (1.18–1.34)
Visiting a care provider in the past year ^b			
An OB/GYN	84.5 (81.4–87.6)	81.1 (78.7–83.4)	1.04 (0.99–1.09)
A NP/PA/midwife	47.9 (37.9–58.0)	32.8 (25.9–39.7)	1.56 (1.19–2.05)
Other care provider	39.4 (33.0–45.9)	28.4 (25.5–31.3)	1.48 (1.22–1.79)

Bold indicates statistical significance ($p < 0.05$).

^aAdjusted prevalence ratio (vaccinated women vs. unvaccinated women) was adjusted for age, race/ethnicity, region of residence, insurance type, and education level.

^bYoung adult women who did not visit any care provider in the past year ($n = 256$, including 31 vaccinated women and 225 unvaccinated women) were excluded from analysis.

NP/PA, nurse practitioner/physician assistant.

There was no relationship between doses of HPV vaccine received and Pap smear in the past 3 years or in the past year (Fig. 1). Proportions of young vaccinated women who received a Pap smear in the past 3 years or in the past year were similar across doses of HPV vaccine received. Young women who received one, two, or three doses of HPV vaccine had similar likelihood to have received their providers' recommendations for a Pap test in the past 12 months.

The types of providers that a women visited last year modified the relationship between HPV vaccination and Pap smear use. In the past year, 35.7% only visited an OB/GYN, 17.3% visited both an OB/GYN and another provider who was not OB/GYN, 8.5% only visited a nurse practitioner/physician assistant/midwife, and 33.0% only visited another type of health provider. Among women who visited an OB/GYN in the past year, both vaccinated women and unvaccinated women had a similar

likelihood of receiving a Pap smear in the past year (84.5% vs. 81.1%, $p = 0.097$), to receive a provider's recommendation for Pap testing (66.0% vs. 64.4%, $p = 0.69$), to obtain Pap testing after receiving a provider's recommendation (87.8% vs. 85.2%, $p = 0.29$), and to initiate Pap testing themselves without a provider's recommendation (78.2% vs. 74.2%, $p = 0.22$).

In contrast, among women who only visited a nurse practitioner/physician assistant/midwife in the past year, vaccinated women had a higher likelihood of receiving a Pap smear and initiating Pap smear themselves. Among women who only visited other health providers in the past year, vaccinated women had a higher likelihood of receiving a Pap smear and receiving a recommendation for a Pap smear. Furthermore, vaccinated women were more likely to receive a Pap smear whether their provider recommended it or not. When the variable of whether visiting an OB/GYN or not in

TABLE 3. PROVIDER'S RECOMMENDATION FOR PAP SMEAR AMONG YOUNG WOMEN ACCORDING TO HUMAN PAPILLOMAVIRUS VACCINATION STATUS, NATIONAL HEALTH INTERVIEW SURVEY 2013–2015 (N=5355)

Characteristics	Provider's recommendation % (95% CI)		Adjusted PR ^a (95% CI)
	Vaccinated (n=1603)	Unvaccinated (n=3752)	
Total	60.8 (57.4–64.3)	50.8 (48.7–52.9)	1.17 (1.09–1.25)
Age			
21–25	58.4 (54.0–62.9)	47.2 (43.7–50.7)	1.18 (1.06–1.3)
26–30	64.9 (59.7–70.1)	53.9 (51.3–56.4)	1.17 (1.06–1.28)
Race/ethnicity			
NH-white	63.8 (59.6–68.1)	52.3 (48.9–55.6)	1.2 (1.1–1.31)
NH-black	47.5 (38.6–56.3)	54.9 (50.2–59.7)	0.85 (0.69–1.05)
Hispanic	58.4 (50.6–66.2)	46.4 (42.7–50.0)	1.22 (1.05–1.41)
Other	62.3 (51.3–73.2)	45.9 (39.7–52.2)	1.36 (1.09–1.69)
Immigration status			
Born in the United States	61.5 (57.9–65.1)	52.1 (49.7–54.6)	1.17 (1.09–1.25)
Not born in the United States	53.5 (42.9–64.1)	45.2 (40.7–49.7)	1.15 (0.93–1.42)
Region of residence			
Northeast	70.6 (63.6–77.6)	58.1 (52.7–63.5)	1.16 (1.01–1.33)
Midwest	63.4 (56.5–70.3)	51.8 (46.6–57.1)	1.23 (1.09–1.38)
South	55.8 (50.5–61.0)	49.9 (46.4–53.4)	1.1 (0.98–1.25)
West	57.5 (49.5–65.6)	46.7 (43.3–50.1)	1.21 (1.05–1.39)
Education level			
<High school	67.7 (53.0–82.3)	48.0 (42.3–53.7)	1.28 (0.97–1.69)
High school	53.5 (43.8–63.2)	49.2 (45.1–53.3)	1.08 (0.89–1.31)
>High school	61.6 (57.8–65.4)	51.8 (49.0–54.6)	1.18 (1.09–1.28)
Health insurance coverage			
None	46.3 (37.6–55.1)	37.9 (34.0–41.8)	1.25 (1.02–1.54)
Private	62.7 (58.7–66.6)	51.8 (48.7–54.9)	1.23 (1.13–1.33)
Public	62.0 (54.3–69.6)	61.7 (58.0–65.4)	1 (0.88–1.14)
Having a usual source of care			
No	42.3 (35.5–49.1)	37.2 (33.4–41.0)	1.08 (0.89–1.31)
Yes	65.0 (61.2–68.9)	55.2 (52.7–57.7)	1.18 (1.09–1.26)
Visiting a care provider in the past year			
An OB/GYN	66.0 (61.5–70.6)	64.4 (61.3–67.5)	1.02 (0.93–1.11)
A NP/PA/midwife	52.7 (42.1–63.4)	49.1 (41.4–56.8)	1.07 (0.83–1.38)
Other care provider	56.4 (49.9–62.9)	41.3 (37.7–44.9)	1.37 (1.19–1.58)

Bold indicates statistical significance ($p < 0.05$).

Young adult women with missing data on the status of provider's recommendation for Pap testing ($n=61$) were excluded from analysis.

^aAdjusted prevalence ratio (vaccinated women vs. unvaccinated women) was adjusted for age, race/ethnicity, region of residence, insurance type, and education level.

the past year was introduced into the multivariate logistic regression model, the intensity of positive association between HPV vaccination and Pap smear use was reduced (adjusted prevalence ratio and its 95% CIs reduced from 1.27 [1.19–1.34] to 1.15 [1.09–1.22]).

Sensitivity analysis that excluded women who received the first dose of the HPV vaccine after 26 years of age ($n=29$) showed similar results to those that included all women.

Discussion

We explored the role of providers and patients in the relationship between HPV vaccination and Pap testing among young women in the United States, and found that those who were vaccinated were more likely to receive cervical cancer screening recommendations from their healthcare providers, to obtain Pap testing after a provider's recommendation, and to initiate screening themselves even when they did not receive a provider's recommendation.

Among women who visited an OB/GYN in the past year, vaccinated women and unvaccinated women had a similar likelihood of receiving a provider's recommendation for Pap testing, to obtain Pap testing after a provider's recommendation, and to initiate Pap testing themselves without a provider's recommendation. In contrast, women who saw providers other than an OB/GYN were less likely to receive a Pap smear. This demonstrates the need for referral to an OB/GYN if that provider does not offer cervical cancer screening.

Since unvaccinated women are not protected against HPV, not receiving regular screening leaves them particularly vulnerable to developing cervical cancer. Barriers, such as personal beliefs, literacy, lack of health insurance, and limited access to care may contribute to disparities in cervical cancer prevention among unvaccinated women.^{27,28} Thus, greater efforts are needed to implement vaccination and screening programs to improve cervical cancer preventive care among underserved women by eliminating barriers at both provider and patient level.

TABLE 4. PAP SMEAR IN THE PAST YEAR AMONG YOUNG WOMEN WHO HAD RECEIVED AND HAD NOT RECEIVED PROVIDER'S RECOMMENDATION FOR PAP SMEAR, NATIONAL HEALTH INTERVIEW SURVEY 2013–2015 (N=5355)

Characteristics	Among recommended ^a			Among unrecommended ^c			Adjusted PR ^b (95% CI)
	% (95% CI)			% (95% CI)			
	Vaccinated (n = 968)	Unvaccinated (n = 1903)	Adjusted PR ^b (95% CI)	Vaccinated (n = 635)	Unvaccinated (n = 1849)		
Total	75.1 (71.4–78.9)	67.9 (65.4–70.5)	1.1 (1.03–1.17)	57.7 (52.0–63.4)	38.2 (35.2–41.1)	1.51 (1.33–1.72)	
Age							
21–25	73.5 (68.3–78.8)	64.9 (60.3–69.4)	1.12 (1.01–1.23)	52.4 (45.2–59.6)	29.1 (25.2–32.9)	1.7 (1.38–2.1)	
26–30	77.6 (72.3–82.9)	70.2 (66.9–73.5)	1.09 (1–1.19)	68.3 (60.6–76.1)	47.1 (43.0–51.1)	1.35 (1.16–1.57)	
Race/ethnicity							
NH-white	73.1 (68.2–78.1)	67.4 (63.7–71.1)	1.07 (0.98–1.17)	59.8 (52.2–67.5)	40.3 (35.9–44.7)	1.48 (1.25–1.74)	
NH-black	80.4 (71.1–89.6)	79.3 (73.6–84.9)	1.01 (0.89–1.14)	70.8 (61.0–80.7)	47.4 (40.5–54.2)	1.48 (1.21–1.82)	
Hispanic	80.2 (72.8–87.6)	66.1 (60.4–71.8)	1.22 (1.07–1.39)	43.6 (32.1–55.0)	34.2 (30.0–38.4)	1.26 (0.94–1.69)	
Other	75.7 (65.3–86.0)	55.1 (45.0–65.2)	1.35 (1.08–1.69)	45.7 (29.1–62.3)	24.5 (17.1–31.8)	2.11 (1.32–3.38)	
Immigration status							
Born in the United States	75.3 (71.4–79.2)	69.0 (66.2–71.8)	1.09 (1.02–1.16)	60.0 (54.2–65.9)	41.1 (37.7–44.6)	1.47 (1.29–1.68)	
Not born in the United States	73.3 (61.1–85.5)	63.0 (56.5–69.5)	1.18 (0.97–1.42)	37.1 (20.6–53.7)	27.5 (22.7–32.4)	1.33 (0.84–2.11)	
Region of residence							
Northeast	83.8 (77.7–90.0)	70.7 (64.0–77.4)	1.2 (1.06–1.36)	64.8 (53.4–76.2)	41.6 (33.8–49.3)	1.56 (1.2–2.04)	
Midwest	76.0 (69.3–82.6)	69.8 (64.3–75.3)	1.11 (1–1.23)	57.4 (45.6–69.3)	37.0 (30.5–43.6)	1.68 (1.27–2.23)	
South	75.8 (68.1–83.4)	70.2 (66.8–73.6)	1.08 (0.97–1.21)	63.8 (54.9–72.6)	40.5 (35.6–45.4)	1.51 (1.24–1.83)	
West	65.0 (55.9–74.0)	59.6 (53.2–66.0)	1.07 (0.89–1.28)	45.5 (33.8–57.2)	33.7 (28.7–38.7)	1.34 (1.02–1.77)	
Education level							
<High school	75.0 (58.6–91.3)	59.9 (50.7–69.2)	1.28 (0.97–1.69)	35.8 (13.0–58.6)	33.4 (25.3–41.4)	0.98 (0.48–1.99)	
High school	83.4 (73.7–93.1)	67.0 (61.7–72.2)	1.22 (1.04–1.42)	53.1 (38.7–67.6)	33.5 (28.0–38.9)	1.59 (1.18–2.15)	
>High school	74.0 (69.9–78.0)	69.6 (66.3–72.8)	1.08 (1–1.16)	59.7 (53.6–65.7)	40.8 (37.1–44.6)	1.52 (1.32–1.75)	
Health insurance coverage							
None	64.5 (52.2–76.8)	59.0 (52.6–65.4)	1.09 (0.89–1.34)	37.4 (25.2–49.7)	25.6 (21.3–29.9)	1.47 (1.02–2.11)	
Private	75.6 (71.1–80.2)	70.5 (66.9–74.1)	1.09 (1–1.18)	60.4 (53.3–67.4)	42.5 (38.2–46.7)	1.51 (1.29–1.76)	
Public	78.1 (70.1–86.0)	68.7 (63.6–73.7)	1.14 (0.99–1.3)	62.2 (50.0–74.5)	45.5 (40.0–51.1)	1.47 (1.15–1.88)	
Having a usual source of care							
No	64.3 (53.9–74.7)	58.0 (51.3–64.7)	1.05 (0.86–1.27)	44.3 (33.7–54.9)	28.0 (23.4–32.5)	1.45 (1.06–1.99)	
Yes	76.7 (72.6–80.8)	70.1 (67.3–72.8)	1.1 (1.03–1.18)	62.7 (56.3–69.1)	42.8 (39.2–46.4)	1.53 (1.33–1.76)	
Visiting a care provider in the past year							
An OB/GYN	87.8 (84.6–91.0)	85.2 (83.0–87.5)	1.03 (0.98–1.07)	78.2 (71.7–84.6)	74.2 (69.5–78.9)	1.07 (0.96–1.19)	
A NP/PA/midwife	52.2 (38.5–65.8)	43.4 (33.1–53.7)	1.15 (0.83–1.6)	45.2 (29.5–60.9)	24.9 (16.0–33.7)	2.07 (1.35–3.16)	
Other care provider	45.8 (36.6–55.0)	38.0 (33.2–42.9)	1.28 (1.14–1.60)	34.8 (24.7–44.9)	22.2 (18.3–26.0)	1.67 (1.20–2.33)	

Bold indicates statistical significance ($p < 0.05$).

Young adult women with missing data on the status of provider's recommendation for Pap testing ($n=61$) were excluded from analysis.

^aProportion of women who had a Pap smear in the past 12 months among those who received provider's recommendations for Pap testing.

^bAdjusted prevalence ratio (vaccinated women vs. unvaccinated women) was adjusted for age, race/ethnicity, region of residence, insurance type, and education level.

^cProportion of women who had a Pap smear in the past 12 months among those who had not received provider's recommendations for Pap testing.

FIG. 1. Pap smear and provider's recommendation for Pap smear by doses of HPV vaccine, NHIS 2013–2015 ($n = 1497$). Young adult women with valid information on the doses of HPV vaccine received ($n = 1497$) were included in the analyses. HPV, human papillomavirus; NHIS, National Health Interview Survey; Pap, Papanicolaou.

Innovative vaccination delivery methods and assistance programs need to be explored to improve initiation of HPV vaccination and access to preventive care.^{17,29} Unvaccinated women should be encouraged to visit OB/GYN for their routine care whenever this is feasible. However, unvaccinated women had a lower socioeconomic status compared to vaccinated women, which may affect their access to preventive healthcare. Continued support and promotion of the NBCCEDP is also an important way to target disparities in Pap testing uptake, as this program provides cervical cancer screening to low-income, underserved, and uninsured women.^{15,16}

Among unvaccinated women, over 35% of Pap smears were initiated by the women themselves, underscoring the importance of education and outreach to improve the awareness of the benefits of cervical cancer screening. Therefore, targeted educational and outreach programs may also be utilized to eliminate barriers for HPV vaccination and cervical screening in underserved women.^{30,31}

We found overall that vaccinated women underwent Pap testing more than unvaccinated women. These results are consistent with prior studies, which found that HPV vaccination was positively associated with Pap smear uptake in young U.S. women.^{18,19} An U.K. study³² also found increased Pap smear uptake in vaccinated young women. In contrast, an Australian study³³ found decreased cervical screening among vaccinated young women, which may be partly due to the study design (linked registries) and campaigns for catch-up vaccination delivered through schools, general practices, and community immunization services.

Using data from administrative insurance claims records, our team assessed the impact of HPV vaccine doses on adherence to cervical cancer screening guidelines and found that young women who received three doses were more likely to be screened 3 years following vaccine initiation.³⁴ A nested case-control study in Alberta, Canada also found that vaccinated women had a higher screening rate than unvac-

inated women.³⁵ Moreover, Lash and coworkers found that women who received three doses of the HPV vaccine and were screened after 21 years of age had much higher screening rates than unvaccinated women.³⁶

Together, these studies demonstrate that there is no adverse impact of HPV vaccination on Pap smear uptake among young adult women in the United States. Conversely, vaccination may act as a marker for women who are getting adequate care and screening, while unvaccinated women are not receiving the same level of healthcare. Recognition of disparities in screening among unvaccinated women is the first step toward improving cancer preventive care and health equity in this group.

The main strength of this study is the use of multiple years of data from NHIS, a large, nationally representative sample with high response rates and available information on sociodemographic characteristics and healthcare access. We were able to combine data from recent years to reliably estimate prevalence of Pap testing between vaccinated and unvaccinated women, and to explore potential reasons for disparities in Pap smear use.

One limitation of this study is that Pap smear use and HPV vaccination were self-reported and may subject to recall bias. We may have overestimated Pap smear use as we did not have medical records to confirm participants' reports.^{37–43} Validity of self-reported HPV vaccination could not be determined. Additionally, NHIS lacks data on how often providers decline a patient's request for cervical cancer screening. Furthermore, we could not make causal inferences about provider recommendations associations with HPV vaccination and cervical cancer screening due to the cross-sectional nature of this study.

Conclusions

Young women who have been vaccinated against HPV were more likely to have received a Pap smear in the past

3 years or in the past year than unvaccinated women. Vaccinated young women are more likely to receive providers' recommendations for Pap testing and to initiate screening themselves without providers' recommendations. Unvaccinated women are more vulnerable to developing cervical cancer. Recognition of disparities in screening among unvaccinated women demonstrates the need to focus on improving screening in this group, by eliminating barriers at both the provider and patient level. Assistance programs and targeted educational and outreach programs may be adopted to improve cervical cancer preventive care among underserved women.

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