

Racial and Ethnic Disparities in Vaccination Coverage Among Adult Populations in the U.S.

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Introduction: Reducing racial/ethnic disparities in immunization rates is a compelling public health goal. Disparities in childhood vaccination rates have not been observed in recent years for most vaccines. The objective of this study is to assess adult vaccination by race/ethnicity in the U.S.

Methods: The 2012 National Health Interview Survey was analyzed in 2014 to assess adult vaccination by race/ethnicity for five vaccines routinely recommended for adults: influenza, tetanus, pneumococcal (two vaccines), human papilloma virus, and zoster vaccines. Multivariable logistic regression analysis was performed to identify factors independently associated with all adult vaccinations.

Results: Vaccination coverage was significantly lower among non-Hispanic blacks, Hispanics, and non-Hispanic Asians compared with non-Hispanic whites, with only a few exceptions. Age, sex, education, health insurance, usual place of care, number of physician visits in the past 12 months, and health insurance were independently associated with receipt of most of the examined vaccines. Racial/ethnic differences narrowed, but gaps remained after taking these factors into account.

Conclusions: Racial and ethnic differences in vaccination levels narrow when adjusting for socioeconomic factors analyzed in this survey, but are not eliminated, suggesting that other factors that are associated with vaccination disparities are not measured by the National Health Interview Survey and could also contribute to the differences in coverage. Additional efforts, including systems changes to ensure routine assessment and recommendations for needed vaccinations among adults for all racial/ethnic groups, are essential for improving vaccine coverage.

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Introduction

Every year, thousands of adults in the U.S. suffer serious health problems, are hospitalized, and even die because of diseases for which vaccines are available.¹ For example, an annual average of 226,000 people may be hospitalized for influenza, 75% of which are among adults aged ≥ 50 years.² Annual deaths from influenza have ranged from approximately 3,000 to 49,000,³ with 90% of these deaths occurring among adults. In 2012, approximately 32,000 cases of invasive

pneumococcal disease occurred, about 90% of which were among adults.^{1,4} As many as 3,300 invasive pneumococcal disease patients died in 2012, with more than 95% of these deaths occurring among adults.^{1,4} As many as 8,300 adults die annually from human papilloma virus (HPV)-associated cancers.¹ About 1 million cases of shingles occur annually among older adults, with approximately 10%–50% suffering post-herpetic neuralgia.^{5–7}

Vaccination is the most effective strategy for reducing the incidence of vaccine-preventable diseases and their complications. The adult immunization schedule,⁸ updated annually by the Advisory Committee on Immunization Practices (ACIP), provides current recommendations for vaccinating adults and a ready resource for practitioners who provide healthcare services for adults in various settings. Adult vaccination coverage, however, remains low for most routinely recommended vaccines

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and well below *Healthy People 2020* targets.^{9–11} Further, uptake of vaccines has historically been lower among all minority racial and ethnic groups compared with non-Hispanic white populations.^{9,12–25}

Data from the 2012 National Health Interview Survey (NHIS) are used to assess national levels of vaccination by race and ethnicity in the U.S. for five vaccines—influenza, pneumococcal (including both polysaccharide and conjugate vaccines), tetanus (tetanus-diphtheria toxoid [Td]), HPV, and herpes zoster (shingles)—routinely recommended for adults and to examine associations of vaccination uptake with demographic and access-to-care factors.

Methods

Study Sample

The 2012 NHIS data were analyzed in 2014. The NHIS is an annual household survey conducted by the National Center for Health Statistics, CDC, which collects health information on the U.S. civilian, non-institutionalized population.²⁶ The NHIS sample is selected through the use of complex sampling design involving stratification, clustering, and multistage sampling. Face-to-face interviews are conducted each week throughout the year in a probability sample of households. In the sample adult core, questions about receipt of recommended vaccinations for adults and other factors are asked of one randomly selected adult within each family in the household. In 2012, the final response rate for the sample adult core was 61.2%.²⁶

Measures

Influenza, pneumococcal, Td, shingles, and HPV vaccination were assessed. To determine influenza vaccination status, respondents were asked: *During the past 12 months, have you had a flu shot?* and *The seasonal flu vaccine sprayed in the nose is also called FluMist™. During the past 12 months, have you had a seasonal flu vaccine that was sprayed in your nose?* An affirmative answer to either question was considered receiving influenza vaccination. Racial/ethnic groups were defined as non-Hispanic white only, non-Hispanic black only, Hispanic, non-Hispanic Asian only, and other race. “Other race” included American Indian/Alaska Native and people reporting multiple races.

Selected adult vaccination coverage (influenza, pneumococcal, Td, shingles, HPV) was stratified by race and ethnicity. People with high-risk conditions for pneumococcal vaccination included those who reported asthma, diabetes, cardiovascular disease, liver disease, kidney disease, chronic obstructive pulmonary disease, emphysema, chronic bronchitis, cancer (excluding non-melanoma skin cancer), and current smoking.

Statistical Analysis

SUDAAN, version 10.1, was used to calculate point estimates and 95% CIs of vaccination coverage. Data were weighted by age, sex, and race/ethnicity to reflect the U.S. adult civilian population. *T*-tests were used to check for associations with the significance level set at $p < 0.05$. Multivariable logistic and predictive marginal

models were conducted to derive adjusted vaccination coverage, and to identify factors independently associated with vaccinations. Multivariable logistic regression and predictive marginal analyses on age-stratified samples were conducted to assess adjusted vaccination coverage and prevalence ratio adjusted for age group (age groups vary by vaccine: 19–64 years: 19–49 years, 50–64 years; ≥ 65 years: 65–74 years, 75–84 years, ≥ 85 years; ≥ 60 years: 60–64 years, 65–74 years, 75–84 years, ≥ 85 years; 19–26 years: 19–21 years, 22–26 years), sex (male/female), race/ethnicity (non-Hispanic white only, non-Hispanic black only, Hispanic, non-Hispanic Asian only, other), marital status (married, widowed/divorced/separated, never married), education (less than high school, high school, some college or more), employment status (employed, unemployed, not in work force), number of physician contacts in the previous year (0, 1, 2–3, 4–9, ≥ 10), routine place of care (yes, no), health insurance status (private, public, none), self-reported health status (excellent/very good, good, fair, poor), duration of residence in the U.S. (born in the U.S., born outside the U.S. and stayed < 10 years in the U.S., born outside the U.S. and stayed ≥ 10 years in the U.S.), and region of residence (Northeast, Midwest, South, West). All listed variables were also included in multivariable models. A predictive marginal model is a multivariable analysis that can generate prevalence estimates adjusted for all variables in a multivariable logistic model using a direct standardization procedure. The NHIS was approved by the Research Ethics Review Board (ERB number, 2009-16) of the National Center for Health Statistics, CDC.

Results

A total of 34,218 adults aged ≥ 18 years from the 2012 NHIS were included in the study. The demographic characteristics of the study populations are shown in [Table 1](#). For both age groups (19–64 and ≥ 65 years), the distribution of race and ethnicity differed significantly by all demographic and access-to-care characteristics ([Table 1](#)).

Influenza vaccination coverage among adults aged 19–64 years was 33.5% for non-Hispanic whites, 27.5% for non-Hispanic blacks, 25.3% for Hispanics, 37.4% for Asians, and 32.4% for other races ([Table 2](#)). Influenza vaccination coverage among adults aged ≥ 65 years was 68.8% for non-Hispanic whites, 53.0% for non-Hispanic blacks, 57.5% for Hispanics, 65.2% for Asians, and 56.5% for other races ([Table 2](#)). Pneumococcal vaccination coverage among adults aged 19–64 years with high-risk conditions was 21.4% for non-Hispanic whites, 19.7% for non-Hispanic blacks, 13.8% for Hispanics, 13.2% for Asians, and 20.2% for other races. Pneumococcal vaccination coverage among adults aged ≥ 65 years was 64.0% for non-Hispanic whites, 46.1% for non-Hispanic blacks, 43.4% for Hispanics, 41.3% for Asians, and 44.7% for other races. Td vaccination coverage among adults aged 19–64 years was 68.9% for non-Hispanic whites, 54.9% for non-Hispanic blacks, 53.6% for Hispanics, 52.8% for Asians, and 71.5% for other races. Td vaccination

Table 1. Demographic and Access-to-Care Characteristics of Study Population, National Health Interview Survey, 2012

Characteristic	19–64 years (N=26,836)					≥ 65 years (N=7,382)				
	Non-Hispanic white % ^a	Non-Hispanic black %	Hispanic %	Non-Hispanic Asian %	Other %	Non-Hispanic white %	Non-Hispanic black %	Hispanic %	Non-Hispanic Asian %	Other %
Sex										
Male	49.5	45.1	50.7	46.6	48.1	44.7	39.7	42.9	43.4	37.8
Female	50.5	54.9	49.3	53.4	51.9	55.3	60.3	57.1	56.6	62.2
Marital status										
Married	56.3	34.6	53.8	61.9	40.8	58.3	38.9	47.7	58.3	47.5
Widowed/divorced/separated	13.1	17.6	11.3	6.4	14.7	36.2	54.1	42.4	34.8	46.2
Never married	30.6	47.8	34.9	31.7	44.5	5.5	7.0	9.8	6.9	6.3
Education										
< High school	7.2	13.8	33.2	8.0	10.9	14.7	36.3	47.5	18.9	26.2
High school graduate	25.0	29.2	27.2	14.9	23.8	31.4	26.4	22.9	24.0	27.6
College or higher	67.8	57.1	39.7	77.1	65.3	53.9	37.3	29.6	57.1	46.2
Employment										
Employed	73.3	64.4	68.7	71.6	64.0	16.1	11.8	19.4	19.1	13.5
Unemployed	6.0	12.3	8.9	6.1	9.0	0.8	1.1	1.3	0.3	0.7
Not in work force	20.7	23.3	22.4	22.2	27.0	83.1	87.1	79.3	80.6	85.8
Health insurance										
Private	73.8	52.4	40.5	71.4	55.3	56.3	38.5	23.0	38.6	52.1
Public	11.5	23.9	17.6	9.7	26.1	43.3	60.8	73.9	59.5	46.8
None	14.7	23.7	41.9	18.9	18.6	0.4	0.7	3.1	1.8	1.0
# of doctor visits in past year										
0	18.8	22.6	35.5	27.9	19.8	6.2	6.4	10.1	10.8	12.4
1	19.0	19.4	19.1	22.9	20.0	11.5	8.4	9.1	8.1	0.8
2–3	26.4	27.3	21.8	26.6	22.8	26.5	25.8	24.7	26.7	15.4

(continued on next page)

Table 1. Demographic and Access-to-Care Characteristics of Study Population, National Health Interview Survey, 2012 (continued)

Characteristic	19–64 years (N=26,836)					≥ 65 years (N=7,382)				
	Non-Hispanic white % ^a	Non-Hispanic black %	Hispanic %	Non-Hispanic Asian %	Other %	Non-Hispanic white %	Non-Hispanic black %	Hispanic %	Non-Hispanic Asian %	Other %
4–9	22.3	20.1	15.1	15.3	21.4	35.5	41.0	35.9	37.2	31.1
≥ 10	13.5	10.6	8.4	7.2	15.9	20.2	18.5	20.2	17.1	40.3
Usual source of health care										
Yes	84.6	81.6	66.8	79.6	79.4	96.7	97.9	95.1	96.9	96.9
No	15.4	18.4	33.2	20.4	20.6	3.3	2.1	4.9	3.1	3.1
Self-reported health status										
Excellent/very good	66.3	53.0	58.2	68.5	58.9	49.5	26.5	29.7	35.9	29.0
Good	23.7	29.9	28.5	24.7	24.5	32.5	36.1	37.0	41.4	41.6
Fair	7.4	13.0	10.8	4.6	12.7	13.5	28.8	23.4	15.6	16.4
Poor	2.6	4.1	2.5	2.2	3.9	4.5	8.6	10.0	7.1	12.9
Duration of U.S. residence										
U.S. born	95.1	88.5	40.7	24.8	91.3	95.0	93.1	36.5	21.1	92.2
In U.S. < 10 years	0.8	2.9	12.8	23.0	1.9	0.0	0.4	1.6	5.5	0.7
In U.S. ≥ 10 years	4.1	8.6	46.5	52.2	6.7	4.9	6.5	61.9	73.4	7.1
Region of residence										
Northeast	19.3	18.3	14.3	19.3	7.5	19.0	16.1	12.5	20.0	4.4
Midwest	28.4	15.7	9.0	16.6	20.0	24.9	18.6	7.7	8.0	21.1
South	33.1	57.8	37.0	21.2	33.8	36.5	55.8	42.9	19.2	41.7
West	19.2	8.1	39.8	42.8	38.6	19.6	9.5	36.8	52.8	32.8

Note: Boldface indicates statistical significance ($p < 0.05$ by chi-square test).

^aWeighted percentage.

Table 2. Unadjusted Adult Vaccination Coverage by Race and Ethnicity,^a National Health Interview Survey - 2012, U.S.

Vaccination Age in years	Total unweighted N	Total weighted N	Non-Hispanic white	Non-Hispanic black	Hispanic	Non-Hispanic Asian	Other
			% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Influenza vaccination (past 12 months) ^b							
19–64	26,309	185,655,124	33.5 (32.4–34.5)	27.5 (25.8–29.3)*	25.3 (23.5–27.1)*	37.4 (34.5–40.3)*,**,***	32.4 (27.5–37.7)***
65+	7,234	40,926,304	68.8 (67.0–70.5)	53.0 (48.9–57.1)*	57.5 (52.9–62.1)*	65.2 (58.7–71.2)**	56.5 (44.1–68.2)
Pneumococcal vaccination (ever received)							
19–64 HR ^c	9,333	63,041,071	21.4 (20.1–22.9)	19.7 (17.4–22.2)	13.8 (11.5–16.4)*,**,***	13.2 (9.5–18.1)*,**,***	20.2 (15.2–26.2)***,****
65+	7,076	40,052,113	64.0 (62.3–65.7)	46.1 (41.7–50.6)*	43.4 (39.0–48.0)*	41.3 (35.4–47.5)*	44.7 (32.6–57.5)*
Tetanus vaccination (past 10 yrs)							
19–64	25,452	179,536,112	68.9 (67.9–69.9)	54.9 (52.8–57.0)*	53.6 (51.6–55.6)*	52.8 (49.6–56.0)*	71.5 (66.7–75.8)**,***,****
65+	6,905	39,054,443	57.7 (55.9–59.5)	44.6 (40.8–48.4)*	44.8 (40.1–49.6)*	45.8 (39.5–52.2)*	50.2 (36.8–63.6)
Shingles vaccination (ever received)							
60+	9,924	58,333,459	22.8 (21.5–24.0)	8.8 (6.9–11.2)*	8.7 (6.6–11.4)*	16.9 (13.2–21.5)*,***,****	19.7 (11.5–31.6)**,****
Human papillomavirus vaccination (≥ 1 dose)							
19–26 Female	2,300	16,721,170	42.2 (38.5–46.0)	29.1 (23.4–35.7)*	18.7 (14.9–23.1)*,**,***	15.6 (9.5–24.5)*,**,***	41.2 (28.7–55.0)***,****

Note: Boldface indicates statistical significance. * $p < 0.05$ by t-test (comparing against non-Hispanic white); ** $p < 0.05$ by t-test (comparing against non-Hispanic black); *** $p < 0.05$ by t-test (comparing against Hispanic); **** $p < 0.05$ by t-test (comparing against non-Hispanic Asian).

^aPeople of Hispanic or Latino origin may be of any race or combination of races. “Others” included American Indian/Alaska Native and multiple race.

^bInfluenza vaccination coverage estimates represent the proportion of respondents who answered that they had received an influenza vaccination in the past 12 months based on NHIS 2012 data. These estimates may differ from the Kaplan Meier influenza vaccination coverage estimates based on coverage for an influenza season (e.g., NHIS interviews conducted from September 2012–June 2013 and vaccinations received from July 2012–May 2013) published on FluVaxView (www.cdc.gov/flu/fluvoxview/nhis-flu-vax.htm).

^cAdults were considered at high risk for pneumococcal disease if they had ever been told by a doctor or other health professional that they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; had a diagnosis of cancer during the previous 12 months (excluding non-melanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; had been told by a doctor or other health professional that they had chronic bronchitis or weak or failing kidneys during the preceding 12 months or had an asthma episode or attack during the preceding 12 months; or they were current smokers.

HR, high risk.

coverage among adults aged ≥ 65 years was 57.7% for non-Hispanic whites, 44.6% for non-Hispanic blacks, 44.8% for Hispanics, 45.8% for Asians, and 50.2% for other races. Shingles vaccination coverage among adults aged ≥ 60 years was 22.8% for non-Hispanic whites, 8.8% for non-Hispanic blacks, 8.7% for Hispanics, 16.9% for Asians, and 19.7% for other races. HPV vaccination coverage among women aged 19–26 years was 42.2% for non-Hispanic whites, 29.1% for non-Hispanic blacks, 18.7% for Hispanics, 15.6% for Asians, and 41.2% for other races (Table 2).

Overall, vaccination coverage was significantly lower among non-Hispanic blacks compared with non-Hispanic whites, except for pneumococcal vaccination among people aged 19–64 years with high-risk conditions (Table 2). Hispanics had significantly lower vaccination coverage compared with non-Hispanic whites for all the examined vaccines (Table 2). Except for influenza vaccination among people aged 19–64 years, non-Hispanic Asians had significantly lower vaccination coverage compared with non-Hispanic whites for all vaccines (Table 2). People of “other race” had coverage similar to non-Hispanic whites except for pneumococcal vaccination among adults aged ≥ 65 years (Table 2). Vaccination coverage was similar among Hispanics compared with non-Hispanic blacks, except for pneumococcal vaccination among people aged 19–64 years with high-risk conditions and HPV vaccination among women aged 19–26 years (Table 2). Other multiple comparisons are shown in Table 2.

For influenza and pneumococcal vaccination, smaller racial and ethnic disparities among adults aged 19–64 years were observed compared with adults aged ≥ 65 years (Table 2). Differences in vaccination compared with non-Hispanic whites among adults aged 19–64 years ranged from -1.1 (influenza vaccination among other racial/ethnic group) to -8.2 (influenza vaccination among Hispanics and pneumococcal vaccination among non-Hispanic Asians). Differences in vaccination compared with non-Hispanic whites among adults aged ≥ 65 years ranged from -3.6 (influenza vaccination among non-Hispanic Asians) to -22.7 (pneumococcal vaccination among non-Hispanic Asians) (Table 2).

In most of the multivariable logistic models, non-Hispanic blacks, Hispanics, and non-Hispanic Asians were significantly less likely to receive vaccinations compared with non-Hispanic whites after controlling for other demographic and access-to-care characteristics (including age, sex, marital status, education, employment status, health insurance, number of doctor visits in the past year, usual source of care, self-reported health status, duration of U.S. residence, and region of residence) (Table 3). People of “other race” had adjusted vaccination coverage

similar to non-Hispanic whites except for pneumococcal vaccination among adults aged ≥ 65 years. Racial and ethnic differences in adjusted vaccination coverage narrowed compared with gaps in unadjusted vaccination coverage, but most of the coverage disparities remained statistically significant after taking these sociodemographic and access-to-care factors into account (Table 3). Other multiple comparisons are shown in Table 3.

Factors that were independently associated with each vaccine in the multivariable logistic models are shown in Table 4. Race and ethnicity, age, sex, education, health insurance, and usual place of care were independently associated with receipt of most of the examined vaccines (Table 4). The number of physician visits in the past 12 months was also independently associated with all the vaccinations assessed in this study. Having any health insurance was associated with adult vaccination coverage except for HPV vaccination among women and shingles vaccination among older adults (Table 4).

Discussion

Overall, vaccination coverage among non-Hispanic blacks, Hispanics, and non-Hispanic Asians was lower compared with that of non-Hispanic whites. Racial and ethnic differences narrowed, but gaps remained after taking into account sociodemographic and access-to-care factors for most vaccines and populations. Race and ethnicity, age, sex, education, health insurance, and having a usual place for medical care were independently associated with vaccination coverage for most of the selected vaccines, and number of physician visits in the past 12 months was independently associated with all the vaccinations assessed in this study. For the three vaccines in this report that are included in *Healthy People 2020* (influenza, pneumococcal, and shingles), vaccination coverage in all race and ethnic groups was well below the respective target levels of 70% for influenza vaccination among adults aged ≥ 18 years, 60% for pneumococcal vaccination among adults aged 18–64 years with high-risk conditions, 90% for pneumococcal vaccination among adults aged ≥ 65 years, and 30% for shingles vaccination among adults aged ≥ 60 years.¹¹

Although studies indicate that racial and ethnic disparities in childhood vaccination have been significantly reduced or not observed in recent data for some vaccinations,^{12,13,27} racial and ethnic disparities in adult vaccination persist and have been reported previously.^{9,14–23} School entry vaccination requirements and the Vaccines for Children program, which provides vaccines to uninsured children, children on Medicaid, and other selected children, might contribute to the reduced racial and ethnic disparities in vaccination coverage for children.^{28–30}

Table 3. Adjusted^a Adult Vaccination Coverage by Race and Ethnicity,^b National Health Interview Survey – 2012, U.S.

Vaccination Age in years	Non-Hispanic white	Non-Hispanic black	Hispanic	Non-Hispanic Asian	Other
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Influenza vaccination (past 12 months) ^c					
19–64	31.2 (30.2, 32.2)	28.7 (27.0, 30.5)*	33.5 (31.1, 35.9)**	38.7 (35.3, 42.2)*,***,****	33.2 (28.8, 37.9)
65+	67.6 (65.8, 69.4)	54.4 (50.1, 58.7)*	66.4 (61.0, 71.3)**	71.9 (65.0, 77.9)*	56.8 (45.1, 67.8)****
Pneumococcal vaccination (ever received)					
19–64 HR ^d	21.2 (19.9, 22.6)	17.6 (15.5, 19.9)*	16.5 (13.5, 20.1)*	15.7 (11.4, 21.3)*	18.5 (14.3, 23.6)
65+	62.5 (60.7, 64.3)	46.4 (42.1, 50.7)*	56.4 (51.1, 61.6)*,***	53.7 (45.9, 61.2)*	42.5 (30.7, 55.1)*,***
Tetanus vaccination (past 10 yrs)					
19–64	67.0 (65.8, 68.1)	56.2 (54.1, 58.3)*	60.8 (58.2, 63.2)*,***	56.2 (52.5, 59.8)*,***	69.5 (64.8, 73.8)*,***,****
65+	56.4 (54.6, 58.2)	48.7 (44.5, 53.0)*	54.8 (49.2, 60.3)	51.0 (43.9, 58.1)	48.9 (35.4, 62.5)
Shingles vaccination (ever received)					
60+	21.4 (20.2, 22.7)	11.4 (8.9, 14.5)*	14.4 (10.6, 19.3)*	21.0 (15.7, 27.5)*,***	20.7 (12.4, 32.5)
Human papillomavirus vaccination (≥ 1 dose)					
19–26 Female	39.3 (35.6, 43.1)	28.7 (23.1, 34.9)*	24.1 (19.1, 29.9)*	20.9 (13.2, 31.6)*	37.4 (27.3, 48.8)*,***,****

Note: Boldface indicates statistical significance. * $p < 0.05$ by t-test (comparing against non-Hispanic white); ** $p < 0.05$ by t-test (comparing against non-Hispanic black); *** $p < 0.05$ by t-test (comparing against Hispanic); **** $p < 0.05$ by t-test (comparing against non-Hispanic Asian).

^aAdjusted estimates control for age, sex, marital status, education, employment status, health insurance, number of doctor visits in the past year, usual source of care, self-reported health status, duration of U.S. residence, and region of residence.

^bPeople of Hispanic or Latino origin may be of any race or combination of races. “Others” included American Indian/Alaska Native and multiple race.

^cInfluenza vaccination coverage estimates represent the proportion of respondents who answered that they had received an influenza vaccination in the past 12 months based on NHIS 2012 data. These estimates may differ from the Kaplan Meier influenza vaccination coverage estimates based on coverage for an influenza season (e.g., NHIS interviews conducted from September 2012–June 2013 and vaccinations received from July 2012–May 2013) published on FluVaxView (www.cdc.gov/flu/fluvoxview/nhis-flu-vax.htm).

^dAdults were considered at high risk for pneumococcal disease if they had ever been told by a doctor or other health professional that they had diabetes, emphysema, chronic obstructive pulmonary disease, coronary heart disease, angina, heart attack, or other heart condition; had a diagnosis of cancer during the previous 12 months (excluding non-melanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; had been told by a doctor or other health professional that they had chronic bronchitis or weak or failing kidneys during the preceding 12 months or had an asthma episode or attack during the preceding 12 months; or they were current smokers.

HR, high risk; NHIS, National Health Interview Survey.

Table 4. Adult Vaccination and Multivariable Logistic Regression Analysis Among Adults Aged ≥ 18 Years in the U.S., by Demographic and Access-to-Care Characteristics –NHIS 2012

	Influenza vaccination (past 12 months)		Pneumococcal vaccination (ever received)		Tetanus vaccination (past 10 years)		Shingles vaccination (ever received)	Human papillomavirus vaccination (≥ 1 dose)
	19-64 APR ^a (95% CI)	65+ APR (95% CI)	19-64 HR APR (95% CI)	65+ APR (95% CI)	19-64 APR (95% CI)	65+ APR (95% CI)	60+ APR (95% CI)	19-26 female APR (95% CI)
Race/ethnicity								
Non-Hispanic white	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Non-Hispanic black	0.92 (0.86, 0.99)	0.80 (0.74, 0.87)	0.83 (0.73, 0.95)	0.74 (0.67, 0.82)	0.84 (0.81, 0.87)	0.86 (0.79, 0.95)	0.53 (0.42, 0.68)	0.73 (0.58, 0.92)
Hispanic	1.07 (0.99, 1.17)	0.98 (0.90, 1.07)	0.78 (0.63, 0.97)	0.90 (0.82, 1.00)	0.91 (0.87, 0.95)	0.97 (0.87, 1.09)	0.67 (0.49, 0.92)	0.61 (0.48, 0.78)
Non-Hispanic Asian	1.24 (1.13, 1.37)	1.06 (0.96, 1.17)	0.74 (0.54, 1.02)	0.86 (0.74, 1.00)	0.84 (0.78, 0.90)	0.90 (0.78, 1.05)	0.98 (0.73, 1.31)	0.53 (0.35, 0.82)
Other	1.06 (0.92, 1.23)	0.84 (0.68, 1.03)	0.87 (0.68, 1.13)	0.68 (0.51, 0.91)	1.04 (0.97, 1.11)	0.87 (0.65, 1.15)	0.97 (0.60, 1.57)	0.95 (0.71, 1.28)
Age (years)								
19-49	Ref	—	Ref	—	Ref	—	—	—
50-64	1.36 (1.30, 1.44)	—	1.72 (1.53, 1.94)	—	0.94 (0.91, 0.97)	—	—	—
65-74	—	Ref	—	Ref	—	Ref	—	—
75-84	—	1.10 (1.05, 1.16)	—	1.16 (1.10, 1.22)	—	0.84 (0.79, 0.89)	—	—
≥ 85	—	1.19 (1.14, 1.26)	—	1.08 (0.99, 1.18)	—	0.72 (0.64, 0.81)	—	—
60-64	—	—	—	—	—	—	Ref	—
65-74	—	—	—	—	—	—	1.58 (1.35, 1.84)	—
75-84	—	—	—	—	—	—	1.63 (1.37, 1.94)	—
≥ 85	—	—	—	—	—	—	1.45 (1.16, 1.82)	—
19-21	—	—	—	—	—	—	—	Ref
22-26	—	—	—	—	—	—	—	0.71 (0.62, 0.82)

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Table 4. Adult Vaccination and Multivariable Logistic Regression Analysis Among Adults Aged ≥ 18 Years in the U.S., by Demographic and Access-to-Care Characteristics –NHIS 2012 (continued)

	Influenza vaccination (past 12 months)		Pneumococcal vaccination (ever received)		Tetanus vaccination (past 10 years)		Shingles vaccination (ever received)	Human papillomavirus vaccination (≥ 1 dose)
	19–64 APR ^a (95% CI)	65+ APR (95% CI)	19–64 HR APR (95% CI)	65+ APR (95% CI)	19–64 APR (95% CI)	65+ APR (95% CI)	60+ APR (95% CI)	19–26 female APR (95% CI)
Sex								
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	–
Female	1.12 (1.06, 1.17)	1.03 (0.98, 1.07)	1.07 (0.95, 1.20)	1.10 (1.05, 1.16)	0.91 (0.89, 0.94)	0.90 (0.85, 0.96)	1.30 (1.17, 1.45)	–
Marital status								
Married	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Widowed/ divorced/ separated	0.92 (0.86, 0.98)	0.95 (0.91, 1.00)	1.17 (1.03, 1.33)	0.97 (0.92, 1.02)	0.97 (0.93, 1.00)	0.96 (0.91, 1.02)	0.83 (0.75, 0.94)	1.14 (0.57, 2.30)
Never married	0.86 (0.81, 0.91)	0.97 (0.89, 1.06)	1.02 (0.90, 1.16)	0.92 (0.83, 1.03)	0.99 (0.96, 1.02)	0.89 (0.79, 1.02)	0.83 (0.67, 1.03)	1.76 (1.36, 2.28)
Education								
< High school	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
High school graduate	0.95 (0.87, 1.04)	1.01 (0.95, 1.08)	0.99 (0.85, 1.16)	1.05 (0.97, 1.13)	1.05 (1.01, 1.10)	1.10 (1.01, 1.21)	1.26 (1.02, 1.55)	0.81 (0.59, 1.12)
College or higher	1.18 (1.09, 1.27)	1.11 (1.04, 1.18)	1.20 (1.03, 1.40)	1.14 (1.06, 1.22)	1.11 (1.06, 1.16)	1.35 (1.23, 1.47)	1.84 (1.52, 2.21)	1.14 (0.86, 1.50)
Employment								
Employed	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Unemployed	0.89 (0.80, 1.00)	0.92 (0.69, 1.23)	1.08 (0.87, 1.35)	1.13 (0.88, 1.46)	1.02 (0.97, 1.06)	1.01 (0.68, 1.49)	0.89 (0.52, 1.52)	1.11 (0.89, 1.39)
Not in work force	1.04 (0.98, 1.10)	1.10 (1.03, 1.17)	1.38 (1.21, 1.58)	1.21 (1.11, 1.31)	0.97 (0.94, 1.01)	1.02 (0.94, 1.10)	1.23 (1.08, 1.41)	0.90 (0.76, 1.07)
Health insurance								
Private	1.54 (1.41, 1.68)	1.54 (1.00, 2.36)	1.45 (1.22, 1.71)	1.26 (0.84, 1.89)	1.06 (1.02, 1.10)	1.25 (0.82, 1.91)	1.40 (0.94, 2.08)	1.19 (0.93, 1.52)
Public	1.53 (1.39, 1.69)	1.47 (0.96, 2.24)	1.44 (1.21, 1.72)	1.20 (0.80, 1.79)	1.05 (1.01, 1.11)	1.24 (0.81, 1.88)	1.16 (0.78, 1.74)	1.10 (0.84, 1.44)
None	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref

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Table 4. Adult Vaccination and Multivariable Logistic Regression Analysis Among Adults Aged ≥ 18 Years in the U.S., by Demographic and Access-to-Care Characteristics –NHIS 2012 (continued)

	Influenza vaccination (past 12 months)		Pneumococcal vaccination (ever received)		Tetanus vaccination (past 10 years)		Shingles vaccination (ever received)	Human papillomavirus vaccination (≥ 1 dose)
	19–64 APR ^a (95% CI)	65+ APR (95% CI)	19–64 HR APR (95% CI)	65+ APR (95% CI)	19–64 APR (95% CI)	65+ APR (95% CI)	60+ APR (95% CI)	19–26 female APR (95% CI)
Number of doctor visits in past year								
0	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
1	1.21 (1.09, 1.35)	1.27 (1.09, 1.47)	1.24 (0.94, 1.62)	1.26 (1.06, 1.50)	1.11 (1.06, 1.15)	1.31 (1.12, 1.52)	1.97 (1.44, 2.68)	1.21 (0.91, 1.62)
2–3	1.56 (1.43, 1.71)	1.46 (1.27, 1.69)	1.56 (1.25, 1.95)	1.41 (1.21, 1.65)	1.17 (1.12, 1.22)	1.32 (1.14, 1.52)	2.17 (1.61, 2.92)	1.35 (1.05, 1.74)
4–9	1.77 (1.61, 1.94)	1.55 (1.34, 1.79)	1.58 (1.27, 1.97)	1.57 (1.35, 1.83)	1.22 (1.17, 1.28)	1.44 (1.24, 1.66)	2.29 (1.70, 3.09)	1.47 (1.12, 1.93)
≥ 10	1.91 (1.73, 2.11)	1.60 (1.37, 1.85)	2.19 (1.74, 2.76)	1.67 (1.43, 1.95)	1.33 (1.27, 1.39)	1.63 (1.41, 1.89)	2.54 (1.85, 3.49)	1.44 (1.06, 1.94)
Usual source of health care								
Yes	1.59 (1.45, 1.75)	1.82 (1.42, 2.32)	1.30 (1.08, 1.56)	1.98 (1.50, 2.60)	1.10 (1.06, 1.14)	1.16 (0.96, 1.39)	1.39 (0.93, 2.09)	1.11 (0.89, 1.39)
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Self-reported health status								
Excellent/very good	0.89 (0.77, 1.03)	1.11 (0.99, 1.24)	0.56 (0.46, 0.69)	0.95 (0.84, 1.08)	1.05 (0.97, 1.15)	1.08 (0.95, 1.23)	1.79 (1.35, 2.37)	0.79 (0.38, 1.62)
Good	0.92 (0.79, 1.06)	1.12 (1.00, 1.27)	0.70 (0.58, 0.84)	1.01 (0.90, 1.14)	1.04 (0.96, 1.13)	1.01 (0.89, 1.16)	1.48 (1.10, 1.98)	0.63 (0.30, 1.34)
Fair	0.92 (0.80, 1.06)	1.08 (0.95, 1.22)	0.95 (0.79, 1.15)	0.97 (0.86, 1.11)	1.05 (0.97, 1.14)	1.00 (0.88, 1.14)	1.21 (0.87, 1.68)	0.60 (0.25, 1.44)
Poor	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Duration of U.S. residence								
U.S. born	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
In U.S. <10 years	1.09 (0.96, 1.25)	0.84 (0.59, 1.21)	0.86 (0.53, 1.38)	1.00 (0.72, 1.39)	0.96 (0.90, 1.03)	1.13 (0.86, 1.48)	0.88 (0.39, 1.97)	0.52 (0.28, 0.98)
In U.S. ≥ 10 years	1.00 (0.92, 1.07)	0.89 (0.80, 0.98)	0.87 (0.70, 1.09)	0.74 (0.66, 0.83)	0.89 (0.84, 0.93)	0.81 (0.72, 0.91)	0.74 (0.57, 0.97)	0.71 (0.50, 0.99)
Region of residence								
Northeast	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref

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Table 4. Adult Vaccination and Multivariable Logistic Regression Analysis Among Adults Aged ≥ 18 Years in the U.S., by Demographic and Access-to-Care Characteristics—NHIS 2012 (continued)

	Influenza vaccination (past 12 months)		Pneumococcal vaccination (ever received)		Tetanus vaccination (past 10 years)		Shingles vaccination (ever received)		Human papillomavirus vaccination (≥ 1 dose)	
	19-64 APR ^a (95% CI)	65+ APR (95% CI)	19-64 HR APR (95% CI)	65+ APR (95% CI)	19-64 APR (95% CI)	65+ APR (95% CI)	60+ APR (95% CI)	19-26 female APR (95% CI)		
Midwest	1.02 (0.94, 1.10)	0.94 (0.88, 1.01)	1.03 (0.88, 1.20)	1.07 (0.98, 1.16)	1.07 (1.03, 1.11)	1.12 (1.02, 1.23)	1.10 (0.94, 1.29)	0.59 (0.48, 0.73)		
South	1.01 (0.93, 1.09)	0.97 (0.91, 1.03)	1.02 (0.88, 1.18)	1.03 (0.95, 1.12)	1.03 (0.99, 1.07)	1.02 (0.93, 1.11)	1.07 (0.92, 1.23)	0.70 (0.58, 0.84)		
West	0.95 (0.88, 1.03)	0.97 (0.89, 1.04)	1.06 (0.90, 1.25)	1.04 (0.95, 1.13)	1.08 (1.04, 1.12)	1.17 (1.07, 1.27)	1.33 (1.14, 1.56)	0.77 (0.63, 0.95)		

Note: Boldface indicates statistical significance ($p < 0.05$ comparing to reference group).

^aAdjusted prevalence ratios, adjusted for all variables included in the table.

APR, adjusted prevalence ratios; HR, high risk; NHIS, National Health Interview Survey.

Multiple factors contribute to racial and ethnic differences in adult vaccination, including differences in attitudes toward vaccination and preventive care, propensity to seek and accept vaccination, variations in the likelihood that providers recommend vaccination, differences in quality of care received by racial and ethnic populations, and differences in concerns about vaccination, including vaccine safety.^{9,14-23} Additionally, non-Hispanic black and Hispanic adults are more likely to be uninsured. In one study in 2011, uninsured prevalence was higher among non-Hispanic blacks (19.5%) and Hispanics (30.1%) compared with non-Hispanic whites (11.1%).³¹ This study showed that health insurance had a positive impact on adult vaccination coverage. Lack of medical insurance has been an important predictor of low adult vaccination uptake.^{20-23,32,33} The Affordable Care Act and other healthcare reform holds the promise of reducing the number of uninsured adults and related barriers to care and reducing missed opportunities for vaccination related to health insurance coverage and access to care.^{34,35} The data suggest, however, that health insurance, although beneficial in improving access to healthcare services, might not be sufficient in itself to achieve optimal adult vaccination. Additional effort will be needed to increase rates and close gaps in adult vaccination coverage.

Previous research has indicated a variety of possible causes for the continued racial and ethnic disparities in adult influenza and pneumococcal vaccination rates, including patient, provider, and system factors.^{14,15,17,19} African American older adults report more negative attitudes toward influenza vaccination than older white adults^{15,24}; however, studies of standardized offering of influenza and pneumococcal vaccines have demonstrated reductions in racial and ethnic coverage disparities.^{25,36} Standardized offering of vaccination by healthcare providers to all eligible patients may work in part by addressing the fact that older African American adults are less likely than older whites to actively seek influenza vaccination.^{37,38} In another study, vaccination disparities were reduced among older adults using an intensive combination of patient tracking, vaccination reminders for providers and patients, and patient outreach and assistance.³⁹ Incorporating the standards of practice for adult immunizations—which include routinely assessing vaccination needs during clinical encounters, providing a strong recommendation for vaccination to patients in need of vaccines, and then offering vaccination at the visit—can have a significant impact on coverage and reduce disparities.⁴⁰

Shingles and HPV vaccination have been recommended for adults since 2006–2007.^{6,41} Gaps in early uptake of these vaccines by race and ethnicity 1–2 years after new ACIP recommendations were small and not statistically significant.^{32,33,42} Racial and ethnic gaps in vaccination

might not be apparent during the first few years following ACIP recommendations. This study showed that, in 2012, shingles and HPV vaccination coverage were generally significantly lower among non-Hispanic blacks and Hispanics compared with non-Hispanic whites. One of the reasons that might contribute to lower coverage is differential awareness of those two newer vaccines. Studies have shown that awareness of shingles and HPV vaccines was significantly lower among racial and ethnic minorities compared with non-Hispanic whites.^{32,33,42}

Studies have shown that healthcare provider recommendations for vaccination are strongly associated with vaccination coverage.^{20-23,42-45} The number of physician visits in the past 12 months was independently associated with all adult vaccinations assessed in this study. This finding was consistent with previous studies²⁰⁻²³ and suggests that physician contact might have facilitated a discussion about indicated vaccines and a recommendation and decision to vaccinate.

Limitations

The findings in this report are subject to limitations. First, adult vaccination coverage was self-reported and therefore might be subject to recall bias. However, self-reported influenza (previous 12 months), pneumococcal polysaccharide (ever received), hepatitis A (ever received), hepatitis B (ever received), shingles (received since 2006) and HPV vaccination status (received since 2005) among adults has been shown to be sensitive and specific.⁴⁶⁻⁵⁰ In one study, self-reported tetanus vaccination (received in last 10 years) was sensitive but not specific.⁵⁰ Additional study is needed for accuracy of recall by young adults of vaccinations they may have received as children or adolescents (HPV, tetanus, diphtheria, and pertussis [Tdap], or hepatitis B). The findings for HPV vaccination among younger women aged 18–26 years should be viewed with caution, based on comparison with estimates from provider-reported vaccinations in the National Immunization Survey (NIS)-Teen.⁵¹ HPV vaccination for younger adults was lower among Hispanics based on NHIS, but NIS-Teen estimates indicate that among girls aged 17 years in 2008–2010 (aged 19–21 years in 2012), Hispanics had higher HPV vaccination initiation coverage than non-Hispanic whites. Second, other factors associated with vaccination disparities were not measured by the NHIS and could not be ascertained in this analysis. Finally, it might be more difficult to identify disparities with low vaccination rates (e.g., shingles vaccination rate was <30%).

Conclusions

Adult vaccination coverage remains suboptimal, particularly among racial and ethnic minority groups. Substantial improvement in vaccination of recommended groups is

needed to maximally reduce the health impact of vaccine-preventable diseases. To improve coverage and eliminate disparities in adult vaccination, greater implementation of evidence-based interventions is needed, including the use of reminder/recall systems, standing orders for vaccination, regular assessments of vaccination coverage levels among provider practices, vaccination registries, and improving public and provider awareness of the importance of vaccinations for adults.^{9,21-23,25,36,40,52,53} Broad use of interventions to remove barriers to access and routinely offering adult vaccines in healthcare and other settings are important components of efforts to reduce adult vaccination disparities (e.g., influenza vaccine has been available in multiple settings for many years, and gaps in vaccination coverage among non-Hispanic blacks and Asians were slightly reduced compared to non-Hispanic whites from 2007 to 2012).^{21,23,53} Multi-sector collaborations, including culturally relevant communications to reach specific target populations and implementation of effective interventions, are important for reducing vaccination and other health disparities in the U.S.^{54,55} Routine monitoring and reporting of vaccine coverage by race, ethnicity, and other sociodemographic factors might also help reduce racial and ethnic disparities.⁵⁶ Identifying other factors associated with vaccination that are not currently measured by health surveys like the NHIS is also needed.

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