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Racial and ethnic disparities in vaccination coverage among adult populations

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Abstract

Background—Reducing racial/ethnic disparities in immunization rates is a compelling public health goal. Disparities in childhood vaccination rates have been absent in recent years for most vaccines.

Purpose—The objective of this study is to assess adult vaccination by race/ethnicity in the United States.

Methods—The 2012 National Health Interview Survey (NHIS) was analyzed in 2014 to assess adult vaccination by race/ethnicity for six vaccines routinely recommended for adults: The vaccines are: influenza, Tetanus, pneumococcal, human papilloma virus, and zoster vaccines. A 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 vaccines examined. 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 associated with vaccination disparities were not measured by the NHIS and could also contribute to the differences in coverage. Additional efforts including systems changes to ensure routine assessment and recommendations for needed vaccination among adults for all racial/ethnic groups are essential for improving vaccine coverage.

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Keywords

Adult vaccination; vaccination coverage; race/ethnicity; disparities; National Health Interview Survey (NHIS)

Introduction

Every year thousands of adults in the United States suffer serious health problems, are hospitalized, and even die due to diseases for which vaccines are available.[1] For example, an annual average of 226,000 people may be hospitalized due to influenza and 75% of the influenza hospitalizations are among patients 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. Due to the widespread use of pneumococcal conjugate vaccine (PCV7) in children and the dramatic reductions of invasive pneumococcal disease (IPD) in children, by 2012, approximately 32,000 cases of IPD occur, about 90% of which are among adults,[1, 4] and among those cases, as many as 3,300 die, with more than 95% of these deaths occurring among adults.[1, 4] As many as 8,300 adults die annually from 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 preventing 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 health-care services for adults in various settings. Adult vaccination coverage, however, remains low for most routinely recommended vaccines 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 to non-Hispanic white populations. [9, 12–25]

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

Methods

The 2012 NHIS were analyzed in 2014. The NHIS is an annual household survey conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention, 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]

Vaccination coverage for influenza, pneumococcal, Td, shingles, and HPV vaccination from coded survey questions on receipt of these vaccines 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 is considered receiving influenza vaccination. Racial/ethnic groups were defined as non-Hispanic white only, non-Hispanic black only, non-Hispanic Asian only, and other race. Other race includes American Indian/Alaska Native and persons reporting multiple races.

Selected adult vaccination coverage (influenza, pneumococcal, Td, shingles, HPV) was stratified by race and ethnicity. Persons with high-risk conditions for pneumococcal vaccination include 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.

SUDAAN statistical software (Research Triangle Institute, Research Triangle Park, NC) was used to calculate point estimates and 95% confidence intervals (CIs) of vaccination coverage.[27] Data are weighted by age, sex, and race/ethnicity to reflect the adult civilian population of the United States. T tests were used to check for associations with the significance level set at $\alpha<0.05$. 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 stratified samples by age were conducted to assess adjusted vaccination coverage and prevalence ratio adjusted for age group (19–64: 19–49, 50–64; 65+: 65–74, 75–84, 85+; 60+: 60–64, 65–74,75–84, 85+; 19–26: 19–21, 22–26), sex (male/female), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, and 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 or more), 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 the United States (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 variables listed were also included in multivariable models. Predictive marginal model is a multivariable analysis that could generate prevalence estimates adjusted for all variables in a multivariable logistic model using a direct standardization procedure. The NHIS was approved by Research Ethics Review Board (the ERB number is 2009–16) of the National Center for Health Statistics, Centers for Disease Control and Prevention.

Results

A total of 34,218 adults ≥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 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 ≥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 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 ≥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. Tetanus vaccination coverage among adults 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. Tetanus vaccination coverage among adults ≥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 ≥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 female adults 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 persons 19–64 years with high-risk conditions (Table 2). Hispanics had significantly lower vaccination coverage compared with non-Hispanic whites for all the vaccines examined (Table 2). Except for influenza vaccination among persons 19–64 years, non-Hispanic Asians had significantly lower vaccination coverage compared with non-Hispanic whites for all the vaccines (Table 2). Persons of other race had coverage similar to non-Hispanic whites except for pneumococcal vaccination among adults ≥ 65 years (Table 2). Vaccination coverage was similar among Hispanics compared with non-Hispanic blacks, except for pneumococcal vaccination among persons 19–64 years with high-risk conditions and HPV vaccination among females 19–26 years (Table 2). Other multiple comparisons are showed in Table 2.

For influenza and pneumococcal vaccination, smaller racial and ethnic disparities in the 19–64 year age group were observed compared with adults ≥ 65 years of age (Table 2). Differences in vaccination compared with non-Hispanic whites among adults 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 ≥65 years of age 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). Persons of other race had adjusted vaccination coverage similar to non-Hispanic whites except for pneumococcal vaccination among adults ≥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 socio-demographic and access to care factors into account (Table 3). Other multiple comparisons are showed in Table 3.

Factors that were independently associated with each vaccination 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 vaccines examined (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 females (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 socio-demographic 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 most of the vaccinations, 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 herpes zoster) vaccination coverage in all race and ethnic groups was well below the respective target levels of 70% for influenza vaccination among adults ≥18 years, 60% for pneumococcal vaccination among adults 18–64 years with high-risk conditions, 90% for pneumococcal vaccination among adults ≥65 years, and 30% for shingles vaccination among adults ≥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, 28] 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 (VFC) 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.[29–31] 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%).[32] Our 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, 33–34] 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.[35, 36] Our data suggest, however, that health insurance, although beneficial in improving access to health care 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 white adults;[15, 24] however, studies of standardized offering of influenza and pneumococcal vaccines have demonstrated reductions in racial and ethnic coverage disparities.[25, 37] Standardized offering of vaccination by healthcare provider to all eligible patients may work in part by addressing the fact that older African-American adults are less likely than whites to actively seek influenza vaccination.[38–39] 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.[40] 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.[41]

Shingles and HPV vaccination have been recommended for adults since 2006–2007.[42–43] Gaps in early uptake of these vaccines by race and ethnicity after 1–2 years following ACIP recommendations were small and not statistically significant.[33, 34, 44] Racial and ethnic gaps in vaccination might not be apparent during the first few years following ACIP recommendations. Our 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 three 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.[33, 34, 44]

Studies have shown that healthcare provider recommendations for vaccination are strongly associated with vaccination coverage.[20–23, 44–47] In this report, 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 studies[20–23] and suggests that physician contact might have facilitated a discussion about vaccines that were indicated and a recommendation and decision to vaccinate.

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 have been shown to be sensitive and specific.[48–52] In one study, self-reported tetanus vaccination (received last 10 years) was sensitive but not specific.[52] Additional study is needed for accuracy of recall by young adults of vaccinations they may have been received as children or adolescents (HPV, Tdap, HepB). The findings for HPV vaccination among younger females 18–26 years should be viewed with caution, based on comparison with estimates based on provider-reported vaccinations from the NIS-Teen.[53] While from NHIS we observed a large disparity with lower coverage among Hispanics, NIS-Teen estimates indicate that among girls age 17 years in 2008–2010 (ages 19–21 in 2012), Hispanic girls had higher HPV vaccination initiation coverage than non-Hispanic white girls. 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%).

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 are 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, 37, 41, 54–55] Broad use of interventions to remove barriers to access and to make offering of adult vaccines in health care and other settings a routine practice 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 white from 2007 to 2012).[21, 23, 55] 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 United States.[56, 57] Routine monitoring and reporting of vaccine coverage by race and ethnicity and other socio-demographic factors might also help reduce racial and ethnic disparities.[58] Identifying other factors associated with vaccination that are not currently measured by health surveys like the NHIS is also needed.

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Table 1

Demographic and access to care characteristics of study population, National Health Interview Survey, 2012

	19–64 years (N=26,836)					≥65 years (N=7,382)				
Characteristic	**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	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
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

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 %
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 yrs	0.8	2.9	12.8	23.0	1.9	0.0	0.4	1.6	5.5	0.7
In U.S. ≥10 yrs	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 significance.

[a] Weighted percentage.

* $p < 0.05$ by chi-square test.

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Table 2

Unadjusted adult vaccination coverage by race and ethnicity[a], National Health Interview Survey - 2012, United States

	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 significance.

Abbreviations: CI=Confidence interval.

[a]Persons of Hispanic or Latino origin may be of any race or combination of races. “Others” included American Indian/Alaska Native, and multiple race.

[b]Influenza 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 through June 2013 and vaccinations received from July 2012 through May 2013) published on FluVaxView (http://www.cdc.gov/flu/fluvaxview/nhis-flu-vax.htm).

[c] Adults 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 nonmelanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; or they 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.

[*] $p < 0.05$ 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).

Table 3

Adjusted[a] adult vaccination coverage by race and ethnicity[b], National Health Interview Survey - 2012, United States

	Non-Hispanic white % (95% CI)	Non-Hispanic black % (95% CI)	Hispanic % (95% CI)	Non-Hispanic Asian % (95% CI)	Other % (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 significance.

Abbreviations: CI=Confidence interval.

[a] Adjusted 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.

[b] Persons of Hispanic or Latino origin may be of any race or combination of races. “Others” included American Indian/Alaska Native, and multiple race.

[c] Influenza 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 through June 2013 and vaccinations received from July 2012 through May 2013) published on FluVaxView (http://www.cdc.gov/flu/fluvaxview/nhis-flu-vax.htm).

[d] Adults 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 nonmelanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; or they 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.

* $p < 0.05$ 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).

Table 4

Adult vaccination and multivariable logistic regression analysis among adults ≥18 years in the United States, 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	65+	19–64 HR	65+	19–64	65+	60+	19–26 female
	APR[a] (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)
Race/ethnicity								
Non-Hispanic white	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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								
19–49	Reference	NA	Reference	NA	Reference	NA	NA	NA
50–64	**1.36 (1.30, 1.44)** *	NA	**1.72 (1.53, 1.94)** *	NA	**0.94 (0.91, 0.97)** *	NA	NA	NA
65–74	NA	Reference	NA	Reference	NA	Reference	NA	NA
75–84	NA	**1.10 (1.05, 1.16)** *	NA	**1.16 (1.10, 1.22)** *	NA	**0.84 (0.79, 0.89)** *	NA	NA
85+	NA	**1.19 (1.14, 1.26)** *	NA	1.08 (0.99, 1.18)	NA	**0.72 (0.64, 0.81)** *	NA	NA
60–64	NA	NA	NA	NA	NA	NA	Reference	NA
65–74	NA	NA	NA	NA	NA	NA	**1.58 (1.35, 1.84)** *	NA
75–84	NA	NA	NA	NA	NA	NA	**1.63 (1.37, 1.94)** *	NA
85+	NA	NA	NA	NA	NA	NA	**1.45 (1.16, 1.82)** *	NA
19–21	NA	NA	NA	NA	NA	NA	NA	Reference
22–26	NA	NA	NA	NA	NA	NA	NA	**0.71 (0.62, 0.82)** *
Sex								
Male	Reference	Reference	Reference	Reference	Reference	Reference	Reference	NA
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)** *	NA

	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	65+	19–64 HR	65+	19–64	65+	60+	19–26 female
	APR[a] (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)
Marital status								
Married	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Number of doctor visits in past year								
0	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference

	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	65+	19–64 HR	65+	19–64	65+	60+	19–26 female
	APR[a] (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)	APR (95% CI)
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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Duration of U.S. residence								
U.S. born	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
In U.S. <10 yrs	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 yrs	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	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
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 significance.

Abbreviations: CI=Confidence interval; NA=Not applicable.

[a]Adjusted prevalence ratios, adjusted for all variables included in the table.

*$p < 0.05$ comparing to reference group.