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Trends in racial/ethnic disparities in influenza vaccination coverage among adults during the 2007-08 through 2011-12 seasons

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Abstract

Background—Annual influenza vaccination is recommended for all persons ≥6 months. The objective of this study is to assess trends in racial/ethnic disparities in influenza vaccination coverage among adults in the United States.

Methods—We analyzed data from the 2007-2012 National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS) using the Kaplan-Meier survival analysis procedure to assess influenza vaccination coverage by age, presence of medical conditions, and racial/ethnic groups during the 2007-08 through 2011-12 seasons.

Results—During the 2011-12 season, influenza vaccination coverage was significantly lower among non-Hispanic blacks and Hispanics compared with non-Hispanic whites among most of the adult sub-groups, with smaller disparities observed for adults 18-49 years compared to other age groups. Vaccination coverage for non-Hispanic white, non-Hispanic black, and Hispanic adults increased significantly from the 2007-08 through the 2011-12 season for most of the adult sub-groups based on NHIS (test for trend: $p<0.05$). Coverage gaps between racial/ethnic minorities and non-Hispanic white persisted at similar levels from the 2007-08 through the 2011-12 season, with similar results from NHIS and BRFSS.

Conclusions—Influenza vaccination coverage among most racial/ethnic groups increased from the 2007-08 through the 2011-12 seasons, but substantial racial and ethnic disparities remained in most age groups. Targeted efforts are needed to improve coverage and reduce disparities.

Keywords

influenza vaccination; vaccination coverage; high-risk conditions; racial disparities

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Introduction

Annual influenza epidemics typically occur during the late fall through early spring in the United States. Influenza is a major cause of morbidity and mortality among adults in the United States (1-6). Between the 1976–77 season and 2006–07 season, estimated annual deaths attributable to influenza ranged from 3,000 to 49,000 each season (2). The economic impact of influenza illness is substantial. One national study estimated the annual economic burden of seasonal influenza in the United States to be $87.1 billion, including $10.4 billion in direct medical costs (7).

Since the 2010-11 influenza season, the Advisory Committee on Immunization Practices (ACIP) has recommended annual influenza vaccination for all persons 6 months of age and older. Prior to 2010, adult groups recommended for annual vaccination included persons 50 years and older, pregnant women, persons 18-49 years with medical conditions associated with higher risk of complications from influenza infection, health care personnel, and close contacts of high risk persons (8). Healthy adults 18-49 years who were not close contacts of persons at high risk were added to those recommended for annual vaccination beginning in the 2010-11 season (3).

Mortality and morbidity associated with influenza are substantial, particularly among the elderly and those with chronic conditions who are most at risk for secondary infections. Annual vaccination is the most effective strategy for preventing influenza (3, 5-23). Vaccination coverage has been suboptimal, and racial/ ethnic disparities in influenza vaccination coverage have been documented (3, 24-31). To assess the level and trend of racial and ethnic disparities in influenza vaccination of adults, we analyzed 2007-2012 National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS) data.

Methods

The BRFSS and NHIS are two primary data sources used to monitor influenza vaccination coverage among adults (25-32), with NHIS providing national estimates used to monitor progress toward national Healthy People 2020 objectives (33), and BRFSS for more timely national and state-specific estimates (34). BRFSS has larger sample size and thus provides a more detailed examination of racial/ethnic groups. These surveys differ in their sampling design, mode of administration, response rates and other methodological aspects. We examine racial/ethnic disparities using both data sources and provide a synthesis of evidence on disparities using both data sources.

We estimated influenza vaccination coverage among adults using 2007-2012 NHIS data and 2007-2012 BRFSS data. We did not use the annual BRFSS public release data, but monthly or quarterly weighted files created by CDC for more timely estimates of season-specific influenza vaccination coverage. The NHIS is a national cross-sectional household survey conducted annually by the Centers for Disease Control and Prevention (CDC) to provide estimates of health indicators, health care utilization and access, and health-related behaviors (30, 35). The survey samples civilian, non-institutionalized populations living in the United

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States at the time of the survey. Multistage probability samples of households are selected weekly throughout the year, and face-to-face interviews are conducted. Weights are based on design, ratio, non-response, and post-stratification adjustments (sex, age, race/ethnicity). The BRFSS is a continuous, population-based telephone survey conducted by state health departments in collaboration with the CDC to collect uniform, state-specific data on self-reported preventive health practices and risk behaviors that are linked to preventable infectious diseases, chronic diseases, and injuries. Non-institutionalized adults ≥18 years are randomly selected using a multistage cluster design. Data are collected monthly in all 50 states and D.C. and are weighted by age, sex, and, in some states, race/ethnicity, to reflect each area's estimated adult population (36). Beginning in 2011, surveys included landline and cellular telephone households and used a new method for weighting (37).

For NHIS survey, respondents were asked "During the past 12 months, have you had a flu shot?" and "During what month and year did you receive your most recent seasonal flu shot?" "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?" and "During what month and year did you receive your most recent seasonal flu vaccine that was sprayed in your nose?" For BRFSS, prior to 2011, influenza vaccination questions were worded similarly as for NHIS; starting from 2011, BRFSS respondents were asked "During the past 12 months, have you had either a seasonal flu shot or a seasonal flu vaccine that was sprayed in your nose?" and "During what month and year did you receive your most recent flu shot injected into your arm or flu vaccine that was sprayed in your nose?"

Compared to BRFSS, the NHIS collects more information regarding high-risk conditions to enable categorization of adults who had health conditions that put them at high risk for complications from influenza (34). For respondents included in the NHIS samples, we defined high-risk persons as individuals who self-reported one or more of the following: ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack or other heart condition; being diagnosed with cancer in the past 12 months (excluding non-melanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia or blood cancer; during the past 12 months, being told by a physician they have chronic bronchitis or weak or failing kidneys; or reporting an asthma episode or attack in the past 12 months. For respondents included in the BRFSS samples, we defined high-risk persons as individuals who self-reported they had diabetes, asthma, myocardial infarction, and coronary heart disease, the relevant medical conditions collected by BRFSS.

We assessed influenza vaccination among adult populations and stratified by race/ethnicity. To better assess influenza vaccination coverage for each season, we reported coverage restricted to individuals interviewed during September through June, and vaccinated during August through May, using the Kaplan-Meier survival analysis procedure (34). For example, for the 2010-11 season, interviews during September 2010 through June 2011 were analyzed to estimate influenza vaccination received during August 2010 through May 2011. For the 2007-08 season, 2008 BRFSS interviews from January-June 2008 were used since month and year of vaccination was first added to BRFSS in the 2008 BRFSS data. For the 2009-10 season, interviews from October 2009 through June 2010 were used. Vaccination month was used to define the "event" variable and interview date to define the "censoring" variable of

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the Kaplan Meier procedure. Tests for linear trend were performed using a weighted linear regression on the season-specific estimates using season number as the independent variable and weights as the inverse of the estimated variance of the estimated vaccination coverage. Racial/ethnic differences within each group were assessed with t-tests. All analyses were weighted to reflect the age, sex, and race/ethnicity of the U.S. non-institutionalized, civilian population. Vaccination month and year were imputed for individuals who did not report their month and year of vaccination (range by season was 3.0-5.0% for NHIS and 3.5-7.3% for BRFSS). All tests were 2-tailed with the significance level set at $\alpha<0.05$. SAS and SUDAAN (Software for the statistical analysis of correlated data, Research Triangle Institute, Research Triangle Park, NC, version 10.01) were used to calculate point estimates and 95% confidence intervals (CIs).

Results

Overall, among adults ≥18 years, influenza vaccination coverage in the 2011-12 season based on NHIS was 42.4% for non-Hispanic whites, 34.0% for non-Hispanic blacks, 28.3% for Hispanics, 42.3% for American Indian and Alaska Natives (AIAN), 42.0% for Asians, and 34.2% for other or multiple races; based on BRFSS, coverage was 41.9% for non-Hispanic whites, 32.7% for non-Hispanic blacks, 29.4% for Hispanics, 37.3% for AIAN, 42.6% for Asians, and 33.9% for other or multiple races (Table 1).

During the 2011-12 season, overall among adults ≥18 years, the gap in influenza vaccination coverage between racial/ethnic minorities and non-Hispanic whites (minorities minus non-Hispanic whites) ranged from −14.1 to −0.1 percentage points based on NHIS, and −12.5 to 0.7 percentage points based on BRFSS (Table 2).

During the 2011-12 season, vaccination coverage was significantly lower among non-Hispanic blacks and Hispanics compared with non-Hispanic whites as measured by NHIS and BRFSS for most age groups (NHIS: ≥18 years, 18–64 years, 18-64 years without high-risk conditions, 50-64 years, and ≥65 years for non-Hispanic blacks, all age groups for Hispanics (Table 1-2, Figure 1); BRFSS: all age groups for non-Hispanic blacks, all age groups for Hispanics except for ≥65 years) (Table 1-2). Vaccination coverage was similar for AIAN, Asians, and other or multiple races compared with non-Hispanic whites as measured by NHIS and BRFSS for most age groups (NHIS: all age groups for AIAN, all age groups except for 18-49 years, and 18-64 years without high-risk conditions for Asians, all age groups except for ≥18 years for other or multiple race; BRFSS: all age groups except for 18-49 years and ≥18 years for AIAN, all age groups except for 18-49 years for Asians, all age groups except for ≥18 years, 18-64 years, and 18-64 years without high-risk conditions for other or multiple race) (Table 1-2).

Overall, among adults ≥18 years, during the 2011-12 season, the BRFSS estimate was similar to the NHIS estimate, with a percentage point difference of (BRFSS minus NHIS) −0.4%. Percentage point differences between BRFSS and NHIS estimates among all adults ≥18 years by racial/ethnic groups ranged from −5.0% to 1.1%. Percentage point differences between BRFSS and NHIS among other adult age groups by racial/ethnic groups ranged from −14.5% to 8.8% (Table 1). Among age and high-risk groups, percentage point

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differences between BRFSS and NHIS estimates were statistically significant for adults aged 18-49 years (percentage point difference: 1.5%, $p<0.05$), and ≥65 years (percentage point difference: −5.2%%, $p<0.05$) (Table 1). Among racial/ethnic groups, percentage point differences between BRFSS and NHIS estimates were statistically significant for non-Hispanic white adults aged 18-49 years (percentage point difference: 2.0%, %, $p<0.05$), 50-64 years (percentage point difference: −2.4%%, $p<0.05$), and ≥65 years (percentage point difference: −6.1%%, $p<0.05$) (Table 1). Percentage point differences between BRFSS and NHIS estimates were not statistically significant for non-Hispanic blacks, Hispanics, AIAN, Asians, and other or multiple races (Table 1).

As measured by NHIS, vaccination coverage for non-Hispanic white, non-Hispanic blacks, and Hispanic adults significantly increased by a per season average of 1-2 percentage points from the 2007-08 through the 2011-12 seasons for most age groups aged <65 years (test for trend: $p<0.05$) (all age groups except for ≥65 years and 18-64 years with high-risk conditions for non-Hispanic whites; ≥18 years, 18-64 years, 18-49 years, and 18-64 years without high-risk conditions for non-Hispanic blacks; ≥18 years, 18-64 years, 18-49 years, and 18-64 years without high-risk conditions for Hispanics) (Table 3, Figure 1). Vaccination coverage for Asian adults significantly increased by a per season average of about 3 percentage points increases from the 2007-08 through the 2011-12 seasons for adults aged 18-49 years, and 18-64 years without high-risk conditions (test for trend: $p<0.05$) (Table 3). As measured by BRFSS, test for trends by race/ethnicity were not statistically significant except for a 2.5% average per season decrease among non-Hispanic white adults aged ≥65 years and 1.3% average season increase among Asians aged 18-64 years without high-risk conditions (Table 3).

During the 2007-08 through the 2011-12 seasons, coverage gaps between racial/ethnic minorities and non-Hispanic whites did not significantly change as measured by NHIS and BRFSS for most age groups (test for trend: $p>0.05$) (NHIS: all age groups for non-Hispanic blacks, Hispanics, and other or multiple races, all age groups for Asians except for 18-49 years; BRFSS: test for trends by gaps between racial/ethnic minorities and non-Hispanic white were not significant except for those 50-64 years for Hispanics) (Table 4).

Discussion

Our findings showed that, by the 2011-12 season, racial/ethnic disparities in influenza vaccination among adult populations remained although vaccination coverage among non-Hispanic white, non-Hispanic black, and Hispanics significantly increased during the 2007-08 season through 2011-12 season for most age groups. Among most adult sub-groups examined, smaller disparities in the 18-49 year age group were observed compared to other age groups. Compared with non-Hispanic whites, vaccination coverage is particularly lower among non-Hispanic blacks and Hispanics. Coverage for the 2011-12 season was higher compared to non-Hispanic whites for several racial/ethnic and age subgroups (Asians 18-49 years based on NHIS and BRFSS, Asians 18-64 years without high risk conditions from NHIS, and American Indian and Alaskan Natives 18-49 years from BRFSS). Among each racial/ethnic group, vaccination coverage varied by age group and high-risk conditions status in a consistent manner.

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Overall, coverage among all racial/ethnic groups remains suboptimal. By the 2011-12 season, influenza vaccination coverage among all adults ≥18 years by racial/ethnic groups was 28-42% based on NHIS, and 29-43% based on BRFSS, which were substantially below *Healthy People 2020* goals of 70% for adults aged ≥18 years (33). The universal vaccination recommendation eliminates the need to determine whether each person has one or more specific indications for vaccination and emphasizes the importance of preventing influenza among persons of all ages (3). Monitoring of annual influenza vaccination coverage among adults ≥18 years by race/ethnicity is important to assess the impact of the vaccination program and to focus efforts on groups with lagging coverage.

Previous research shows significant racial/ethnic disparities in influenza vaccination coverage among adults (25, 27-30, 38). We found that vaccination coverage among most adult sub-groups that were analyzed was significantly higher among non-Hispanic whites compared with non-Hispanic blacks and Hispanics. Gaps in coverage are long-standing and likely result from a combination of factors, including differences in: socio-demographic characteristics, patients and provider attitudes toward vaccination, awareness of recommendations, systems used in clinics serving different patient populations, preventive care, propensity to seek and accept vaccination, and quality of care received by racial/ethnic populations (3, 28, 29, 39-43). Broad use of interventions to remove barriers to access and to make offering of vaccination in health care and other settings a routine practice are important components of efforts to reduce these disparities (43, 44). Efforts to reduce disparities may be most important for older adults given smaller disparities in adults 18-49 years.

The CDC publishes influenza vaccination coverage estimates among adults from several data sources, including NHIS and BRFSS (32, 34). For adults, BRFSS estimates provide timely national and state-specific estimates that are available by the time the next influenza vaccination campaigns begin. The National Health Interview Survey (NHIS) provides national estimates used for monitoring *Healthy People 2020* objectives (33) but is less timely than BRFSS. The NHIS is a national household survey conducted mostly by face-to-face interviews with higher response rates (60-70%) than the BRFSS, a telephone survey with lower response rates (50-60%) (35, 36). The NHIS provides a more complete set of high-risk conditions and has provided season-specific estimates using self-reported month and year of most recent influenza vaccination since 2005, while BRFSS has provided these estimates since 2008.

There were few statistically significant differences in estimated influenza vaccination coverage between NHIS and BRFSS among the racial/ethnic, age and risk groups examined, although 95% confidence intervals for differences were wide for some racial/ethnic and age/risk combinations, particularly for AIAN, Asians and Multiple race/others. However, a very similar level and pattern of differences in influenza vaccination coverage between racial/ethnic groups compared to non-Hispanic whites was observed based on both BRFSS and NHIS. The NHIS provides a means to assess the potential validity of estimates from more timely data sources. BRFSS estimates among age groups often followed the NHIS pattern, except for adults ≥ 65 years in recent seasons, where BRFSS estimates were lower. While NHIS estimates for adults ≥65 years appear stable in recent seasons aside from a dip during

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2009-10, BRFSS estimates for this age group indicate a possible decline, with estimates of 74% for 2008-09, 67% for 2010-11, and 65% for 2011-12 (32). However, both data sources indicate coverage in older adults is 65-70% with much room for improvement. Ongoing comparisons of NHIS and other sources of influenza vaccination coverage over several seasons are needed. These comparisons will provide a better assessment of the validity of signals in trends and disparities identified from other data sources. Factors that may contribute to the differences in estimated coverage between NHIS and other data sources include a more representative sample frame and higher response rates for NHIS, survey mode (in-person for NHIS, telephone or internet for others), and differences in survey operations and weighting procedures. Starting in 2008, BRFSS began sampling persons in households with only cellular telephone service in each state to the landline telephone sampling frame (34, 45). Beginning in 2011, BRFSS included both landline and cellular telephone households in final data sets. The 2011-12 estimates from BRFSS in this report were based on data from this dual frame design, and thus may affect coverage estimates (34, 45).

Our study is subject to several limitations. First, influenza vaccination status and high-risk conditions were self-reported and were not validated with medical records. Second, for the 2009-10 season when both seasonal vaccine and monovalent pH1N1 vaccines were available, it is possible that some persons may have confused receipt of pH1N1 vaccination and seasonal influenza vaccination, with potential for over- or under-estimation of coverage for seasonal vaccine in 2009-10. Third, information was not available for some high-risk conditions in BRFSS identified by ACIP. Finally, our study is not further stratified or adjusted in multivariable analysis for the racial/ethnic disparities by socio-demographic variables.

Vaccination coverage in all groups recommended for vaccination remains suboptimal. Substantial improvement in annual influenza vaccination of recommended groups is needed to maximally reduce the health impact of influenza. It is important to continue to monitor vaccination coverage levels and racial/ethnic disparities over subsequent influenza seasons.

To improve coverage and eliminate disparities in adult influenza vaccination, 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, improving public and provider awareness of the importance of vaccinations for adults, public financing of recommended vaccines, and most importantly, identifying where vaccination coverage levels are low and using the information to target interventions (3, 46).

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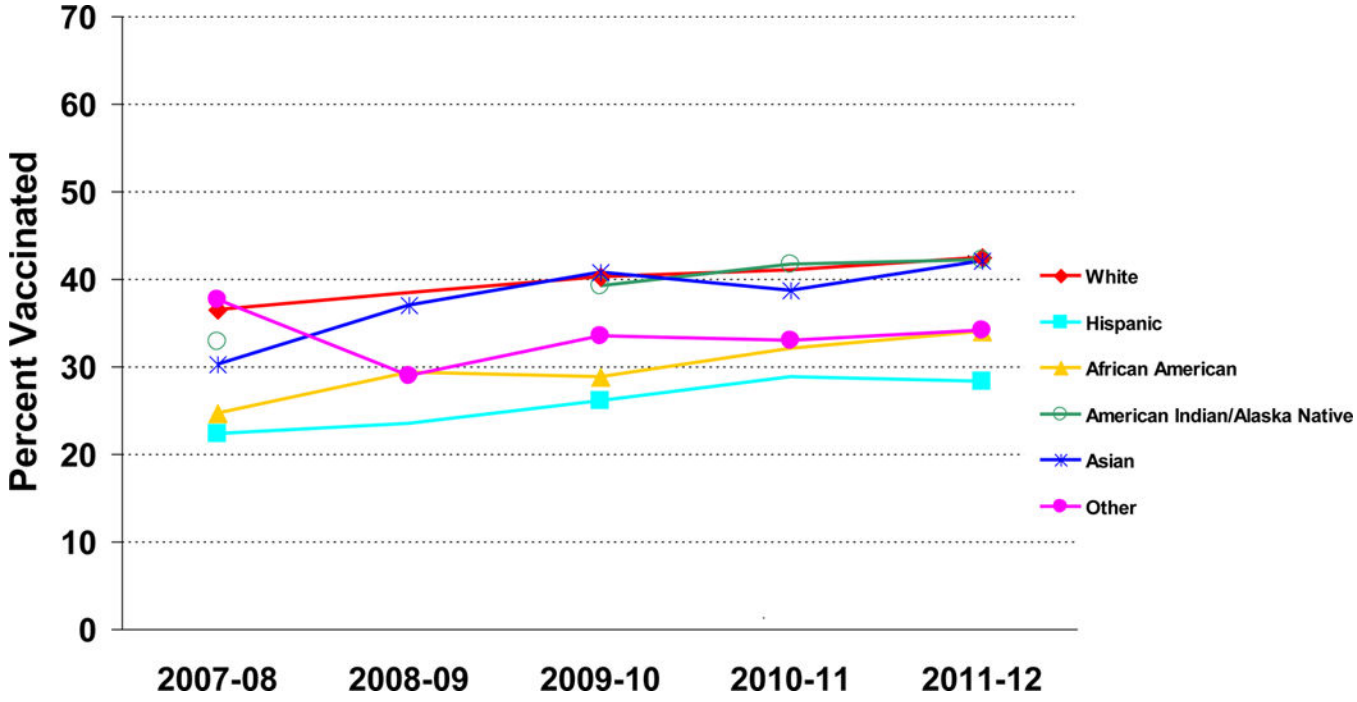

Figure 1. Influenza Vaccination Coverage, U.S., Persons Aged ≥ 18 Years, by Race/Ethnicity
(Source: National Health Interview Survey, the 2007-08 to 2011-12 seasons)

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Table 1

Influenza vaccination coverage[*] among adults ≥18 years by age, high-risk status[†], race/ethnicity[§] and data sources, 2011-12 influenza season, United States

	All	Non-Hispanic white	Non-Hispanic black	Hispanic	AIAN	Asian	Multiple race/other
	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI
Percent Vaccinated, NHIS							
Age and high-risk group	N=26,947	N=16,032	N=3,961	N=4,756	N=133	N=1,637	N=428
≥18	39.2 (38.3, 40.2)	42.4 (41.2, 43.6)	34.0 (31.8, 36.4)	28.3 (26.0, 30.7)	42.3 (31.8, 54.5)	42.0 (38.6, 45.7)	34.2 (28.1, 41.1)
18–64	32.6 (31.6, 33.6)	34.5 (33.2, 35.8)	30.5 (28.1, 33.0)	25.1 (22.7, 27.7)	36.5 (25.6, 50.1)	37.6 (33.9, 41.6)	30.7 (24.0, 38.7)
18–49	27.1 (26.0, 28.2)	28.1 (26.6, 29.7)	26.3 (23.6, 29.2)	22.1 (19.8, 24.5)	33.0 (20.9, 49.5)	34.8 (30.5, 39.5)	25.3 (18.3, 34.4)
50–64	44.7 (42.8, 46.6)	46.1 (44.0, 48.4)	40.6 (36.4, 45.0)	36.9 (30.7, 43.9)	42.4 (22.6, 69.7)	46.3 (37.3, 56.3)	46.6 (32.8, 62.7)
≥65	70.1 (68.2, 72.0)	72.3 (70.2, 74.4)	58.2 (52.5, 63.9)	60.4 (54.2, 66.8)	¶	70.7 (61.8, 79.2)	69.5 (48.1, 88.4)
Persons 18–64 with high-risk conditions	44.9 (42.5, 47.3)	45.2 (42.1, 48.4)	48.3 (43.1, 53.9)	37.2 (30.4, 44.9)	62.5 (40.2, 84.5)	46.9 (35.4, 59.9)	46.2 (29.2, 67.2)
Persons 18–64 without high-risk conditions	29.7 (28.7, 30.8)	31.8 (30.4, 33.3)	25.2 (22.6, 27.9)	23.1 (20.6, 25.8)	25.9 (14.8, 42.8)	36.4 (32.7, 40.4)	26.0 (19.5, 34.3)
Percent Vaccinated, BRFSS							
Age and high-risk group	N= 367,500	N= 289,490	N=30,617	N=22,412	N=6,521	N=4,801	N=9,783
≥18	38.8 (38.4, 39.2)	41.9 (41.4, 42.4)	32.7 (31.2, 34.2)	29.4 (27.8, 31.0)	37.3 (33.9, 40.9)	42.6 (37.8, 47.7)	33.9 (31.2, 36.8)
18–64	33.1 (32.5, 33.7)	35.0 (34.5, 35.6)	29.8 (28.2, 31.4)	26.9 (25.3, 28.5)	35.8 (32.3, 39.6)	39.6 (34.4, 45.3)	30.6 (27.8, 33.7)
18–49	28.6 (28.0, 29.2)	30.1 (29.4, 30.9)	25.5 (23.6, 27.5)	24.6 (22.9, 26.5)	34.4 (30.5, 38.7)	36.9 (30.8, 43.9)	26.9 (23.7, 30.5)
50–64	42.7 (41.9, 43.5)	43.7 (42.9, 44.5)	40.7 (38.0, 43.5)	37.2 (33.8, 40.9)	42.1 (34.6, 50.5)	46.4 (36.9, 57.1)	42.4 (37.6, 47.6)
≥65	64.9 (64.1, 65.7)	66.2 (65.5, 67.0)	54.4 (51.4, 57.6)	63.1 (58.1, 68.1)	59.7 (50.6, 69.1)	61.4 (51.2, 71.6)	59.6 (52.8, 66.5)
Persons 18–64 with high-risk conditions	45.2 (44.0, 46.5)	47.6 (46.2, 49.0)	42.7 (39.3, 46.3)	38.9 (34.8, 43.3)	48.0 (38.1, 59.0)	44.1 (34.8, 54.7)	42.3 (34.7, 50.7)
Persons 18–64 without high-risk conditions	30.4 (29.9, 31.0)	32.4 (31.8, 33.1)	26.1 (24.4, 27.9)	24.3 (22.6, 26.1)	34.7 (30.9, 38.7)	37.7 (31.8, 44.4)	27.1 (24.3, 30.1)
Difference in Percent Vaccinated, BRFSS - NHIS							
Age and high-risk group							
≥18	−0.4 (−1.4, 0.6)	−0.5 (−1.8, 0.8)	−1.3 (−4.0, 1.4)	1.1 (−1.7, 3.9)	−5.0 (−16.9, 6.9)	0.6 (−5.5, 6.7)	−0.3 (−7.4, 6.8)
18–64	0.5 (−0.7, 1.7)	0.5 (−0.9, 1.9)	−0.7 (−3.6, 2.2)	1.8 (−1.2, 4.8)	−0.7 (−13.5, 12.1)	2.0 (−4.7, 8.7)	−0.1 (−8.0, 7.8)
18–49	1.5 (0.2, 2.8) **	2.0 (0.3, 3.7) **	−0.8 (−4.2, 2.6)	2.5 (−0.5, 5.5)	1.4 (−13.5, 16.3)	2.1 (−5.8, 10.0)	1.6 (−7.1, 10.3)
50–64	−2.0 (−4.1, 0.1)	−2.4 (−4.7, −0.1) **	0.1 (−5.0, 5.2)	0.3 (−7.2, 7.8)	−0.3 (−25.2, 24.6)	0.1 (−13.8, 14.0)	−4.2 (−20.0, 11.6)

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	All	Non-Hispanic white	Non-Hispanic black	Hispanic	AIAN	Asian	Multiple race/other
	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI
≥65	−5.2 (−7.3, −3.1) **	−6.1 (−8.3, −3.9) **	−3.8 (−10.3, 2.7)	2.7 (−5.3, 10.7)	¶	−9.3 (−22.7, 4.1)	−9.9 (−31.2, 11.4)
Persons 18–64 with high-risk conditions	0.3 (−2.4, 3.0)	2.4 (−1.0, 5.8)	−5.6 (−12.0, 0.8)	1.7 (−6.7, 10.1)	−14.5 (−39.0, 10.0)	−2.8 (−18.6, 13.0)	−3.9 (−24.5, 16.7)
Persons 18–64 without high-risk conditions	0.7 (−0.5, 1.9)	0.6 (−1.0, 2.2)	0.9 (−2.3, 4.1)	1.2 (−1.9, 4.3)	8.8 (−5.7, 23.3)	1.3 (−6.1, 8.7)	1.1 (−6.8, 9.0)

* Estimates are based on interviews conducted during September 2011 through June 2012, and vaccination received during August 2011 through May 2012.

† High-risk definition based on NHIS is that adults categorized as being at high risk for influenza-related complications self-reported one or more of the following: 1) ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack, or other heart condition; 2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer during the previous 12 months; 3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or 4) reporting an asthma episode or attack during the preceding 12 months. High-risk definition based on BRFSS includes adults who had diabetes, asthma, myocardial infarction, and coronary heart disease.

§ Adults who were Hispanic might be of any race. Adults who were white, black, Asian, or American Indian/Alaska Native (AIAN) all were considered non-Hispanic. For NHIS, persons of multiple races or persons where race was not “releasable” due to respondent confidentiality or other reasons were categorized as “other.” For BRFSS, adults who were native Hawaiian or other Pacific Islander, who were “other” race, or who reported multiple race were categorized as “other”.

¶ Estimate may not be reliable due to relative standard error >30% or sample size < 30.

** $p<0.05$ by t test for comparisons between BRFSS and NHIS.

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Table 2

Difference in influenza vaccination coverage compared to non-Hispanic whites among adults ≥18 years, by age, high-risk status*, race/ethnicity†, and data sources, 2011-12 influenza season, United States

	Non−Hispanic black	Hispanic	AIAN	Asian	Multiple race/other
	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI
Percent Vaccinated, NHIS					
Age and high-risk group					
≥18	−8.4 (−11.0, −5.8)§	−14.1 (−16.7, −11.5)§	−0.1 (−11.5, 11.3)	−0.4 (−4.1, 3.3)	−8.2 (−14.8, −1.6)§
18–64	−4.0 (−6.8, −1.2)§	−9.4 (−12.2, −6.6)§	2.0 (−10.3, 14.3)	3.1 (−1.0, 7.2)	−3.8 (−11.3, 3.7)
18–49	−1.8 (−5.0, 1.4)	−6.0 (−8.8, −3.2)§	4.9 (−9.5, 19.3)	6.7 (1.9, 11.5)§	−2.8 (−11.0, 5.4)
50–64	−5.5 (−10.3, −0.7)§	−9.2 (−16.2, −2.2)§	−3.7 (−27.4, 20.0)	0.2 (−9.6, 10.0)	0.5 (−14.6, 15.6)
≥65	−14.1 (−20.2, −8.0)§	−11.9 (−18.5, −5.3)§	−8.9 (−32.9, 15.1)	−1.6 (−10.5, 7.3)	−2.8 (−23.1, 17.5)
Persons 18–64 with high-risk conditions	3.1 (−3.2, 9.4)	−8.0 (−15.9, −0.1)§	17.3 (−5.1, 39.7)	1.7 (−10.9, 14.3)	1.0 (−18.3, 20.3)
Persons 18–64 without high-risk conditions	−6.6 (−9.6, −3.6)§	−8.7 (−11.7, −5.7)§	−5.9 (−20.0, 8.2)	4.6 (0.5, 8.7)§	−5.8 (−13.3, 1.7)
Percent Vaccinated, BRFSS					
Age and high-risk group					
≥18	−9.2 (−10.8, −7.6)§	−12.5 (−14.2, −10.8)§	−4.6 (−8.1, −1.1)§	0.7 (−4.3, 5.7)	−8.0 (−10.8, −5.2)§
18–64	−5.2 (−6.9, −3.5)§	−8.1 (−9.8, −6.4)§	0.8 (−2.9, 4.5)	4.6 (−0.9, 10.1)	−4.4 (−7.4, −1.4)§
18–49	−4.6 (−6.7, −2.5)§	−5.5 (−7.5, −3.6)§	4.3 (0.1, 8.5)§	6.8 (0.2, 13.4)§	−3.2 (−6.7, 0.3)
50–64	−3.0 (−5.9, −0.1)§	−6.5 (−10.1, −2.9)§	−1.6 (−9.6, 6.4)	2.7 (−7.4, 12.8)	−1.3 (−6.4, 3.8)
≥65	−11.8 (−15.0, −8.6)§	−3.1 (−8.2, 2.0)	−6.5 (−15.8, 2.8)	−4.8 (−15.0, 5.4)	−6.6 (−13.5, 0.3)
Persons 18–64 with high-risk conditions	−4.9 (−8.7, −1.1)§	−8.7 (−13.2, −4.2)§	0.4 (−10.1, 10.9)	−3.5 (−13.5, 6.5)	−5.3 (−13.4, 2.8)
Persons 18–64 without high-risk conditions	−6.3 (−8.2, −4.4)§	−8.1 (−10.0, −6.2)§	2.3 (−1.7, 6.3)	5.3 (−1.0, 11.6)	−5.3 (−8.3, −2.3)§

*High-risk definition based on NHIS is that adults categorized as being at high risk for influenza-related complications self-reported one or more of the following: 1) ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack, or other heart condition; 2) having a diagnosis of cancer during the preceding 12 months (excluding nonmelanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer during the previous 12 months; 3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or 4) reporting an asthma episode or attack during the preceding 12 months. High-risk definition based on BRFSS includes adults who had diabetes, asthma, myocardial infarction, and coronary heart disease.

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[†]Adults who were Hispanic might be of any race. Adults who were white, black, Asian, or American Indian/Alaska Native (AIAN) all were considered non-Hispanic. For NHIS, persons of multiple races or persons where race was not “releasable” due to respondent confidentiality or other reasons were categorized as “other.” For BRFSS, adults who were native Hawaiian or other Pacific Islander, who were “other” race, or who reported multiple race were categorized as “other”.

[§]$p<0.05$ by t test for comparisons between racial/ethnic groups with non-Hispanic white as the reference group.

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Table 3

Trend by season in influenza vaccination coverage, adults ≥18 years by age, high-risk status*, race/ethnicity†, and data sources, 2007-08 through 2011-12 seasons, United States

		Average per-Season Change in Influenza Vaccination Coverage§					
		Non-Hispanic white	Non-Hispanic black	Hispanic	AIAN	Asian	Multiple Race/other
		% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI
Age and high-risk group	Data Source						
≥18	NHIS	1.5 (1.0, 1.9)¶	2.2 (1.0, 3.4)¶	1.8 (0.7, 2.8)¶	**	2.2 (−0.3, 5.1)	−0.1 (−3.0, 2.8)
	BRFSS††	0.1 (−1.1, 1.4)	−0.0 (−1.5, 1.5)	1.1 (−0.6, 2.6)	0.0 (−3.3, 3.8)	0.0 (−0.9, 1.4)	0.0 (−1.6, 2.5)
18-64	NHIS	1.6 (0.7, 2.5)¶	2.3 (0.7, 3.9)¶	1.8 (0.9, 2.8)¶	**	2.2 (−0.1, 5.9)	0.0 (−4.1, 5.5)
	BRFSS	0.0 (−0.7, 1.7)	0.0 (−0.8, 1.4)	1.1 (−0.3, 2.7)	0.0 (−3.0, 4.8)	0.0 (−0.5, 1.3)	0.0 (−1.8, 3.6)
18-49	NHIS	1.9 (0.4, 3.4)¶	2.4 (0.7, 4.1)¶	1.9 (0.5, 3.4)¶	**	3.3 (1.2, 5.4)¶	−0.1 (−3.7, 3.6)
	BRFSS	0.0 (−0.5, 1.9)	0.0 (−1.0, 1.5)	1.1 (−0.2, 2.8)	1.1 (−2.7, 5.3)	0.0 (−0.2, 1.6)	1.1 (−2.0, 3.9)
50-64	NHIS	0.8 (0.3, 1.3)¶	1.1 (−2.0, 4.6)	0.0 (−0.6, 1.8)	**	1.1 (−5.4, 8.7)	**
	BRFSS	−0.5 (−1.9, 0.9)	0.0 (−1.8, 1.9)	1.1 (−1.0, 3.2)	−0.7 (−6.4, 4.9)	−0.8 (−5.8, 4.3)	0.0 (−1.9, 3.5)
≥65	NHIS	0.0 (−1.5, 1.9)	1.1 (−1.3, 3.8)	0.0 (−3.1, 4.9)	**	−0.5 (−6.4, 5.5)	**
	BRFSS	−2.5 (−4.4, −0.7)¶	−2.0 (−5.6, 1.6)	0.0 (−8.8, 10.2)	−2.0 (−8.1, 4.1)	0.0 (−6.8, 7.8)	−1.4 (−3.0, 0.1)
Persons 18-64 with high-risk conditions	NHIS	0.0 (−0.8, 2.7)	2.2 (−0.4, 5.3)	−0.4 (−3.8, 3.0)	**	2.2 (−1.9, 6.7)	**
	BRFSS	−0.0 (−0.8, 0.8)	−0.3 (−4.5, 3.9)	0.0 (−3.8, 5.7)	−0.5 (−3.9, 2.9)	−2.2 (−5.3, 0.9)	0.0 (−1.9, 2.1)
Persons 18-64 without high-risk conditions	NHIS	1.8 (1.1, 2.5)¶	2.1 (0.3, 3.9)¶	2.2 (1.3, 3.2)¶	**	2.9 (0.0, 5.8)¶	0.0 (−3.0, 3.1)
	BRFSS	0.0 (−0.7, 1.7)	0.0 (−0.3, 1.1)	1.1 (−0.0, 2.3)	1.1 (−3.3, 5.3)	1.3 (0.2, 2.4)¶	0.0 (−2.5, 4.4)

*High-risk definition based on NHIS is that adults categorized as being at high risk for influenza-related complications self-reported one or more of the following: 1) ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack, or other heart condition; 2) having a diagnosis of cancer during the preceding 12 months (excluding non-melanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer during the previous 12 months; 3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or 4) reporting an asthma episode or attack during the preceding 12 months. High-risk definition based on BRFSS includes adults who had diabetes, asthma, myocardial infarction, and coronary heart disease.

†Adults who were Hispanic might be of any race. Adults who were white, black, Asian, or American Indian/Alaska Native (AIAN) all were considered non-Hispanic. For NHIS, persons of multiple races or persons where race was not “releasable” due to respondent confidentiality or other reasons were categorized as “other.” For BRFSS, adults who were native Hawaiian or other Pacific Islander, who were “other” race, or who reported multiple races were categorized as “other”.

§Estimated slope from weighted linear regression of influenza vaccination coverage on influenza season.

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¶ $p < 0.05$ (test for linear trend).

** Not able to run weighted linear regression because some estimates may not be reliable due to relative standard error >30% or sample size < 30.

†† Beginning in 2011, BRFSS included landline and cellular telephone households and used a new method for weighting, so estimates for 2011-12 are not strictly comparable to estimates from prior seasons.

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Table 4

Trend by season in racial/ethnic disparities in influenza vaccination coverage compared to non-Hispanic whites, adults ≥18 years by age, high-risk status*, race/ethnicity†, and data sources, 2007-08 through 2011-12 seasons, United States

		Average per-Season Change in Percentage Point Difference in Influenza Vaccination Coverage Compared to Non-Hispanic Whites§				
		Non-Hispanic black	Hispanic	AIAN	Asian	Multiple Race/other
		% 95% CI	% 95% CI	% 95% CI	% 95% CI	% 95% CI
Age and high-risk group	Data Source					
≥18	NHIS	−0.7 (−2.0, 0.6)	−0.3 (−1.4, 0.8)	¶	−1.0 (−3.3, 1.3)	1.1 (−1.7, 4.7)
	BRFSS**	0.0 (−1.2, 1.5)	−0.9 (−2.4, 0.6)	0.0 (−3.2, 3.3)	−0.0 (−1.5, 1.5)	−0.4 (−2.3, 1.6)
18-64	NHIS	−0.7 (−2.7, 1.4)	−0.2 (−1.1, 0.7)	¶	−1.4 (−3.6, 0.9)	0.0 (−4.0, 5.6)
	BRFSS	0.0 (−0.9, 1.1)	−0.8 (−1.8, 0.2)	−0.3 (−4.1, 3.4)	0.0 (−1.1, 1.3)	−0.4 (−3.0, 2.1)
18-49	NHIS	−0.6 (−3.4, 2.2)	−0.1 (−1.8, 1.5)	¶	−1.5 (−2.6, −0.3)††	1.1 (−2.5, 6.0)
	BRFSS	0.0 (−0.9, 1.7)	−0.6 (−1.7, 0.5)	−0.5 (−4.4, 3.4)	0.0 (−0.3, 0.4)	−0.3 (−3.3, 2.7)
50-64	NHIS	−0.5 (−4.3, 3.3)	0.0 (−1.4, 1.9)	¶	−0.8 (−8.2, 6.5)	¶
	BRFSS	−0.6 (−2.4, 1.2)	−1.6 (−2.8, −0.3)††	0.0 (−4.4, 4.8)	0.0 (−4.5, 5.0)	−1.4 (−3.5, 0.8)
≥65	NHIS	−1.1 (−3.9, 1.8)	−0.6 (−4.1, 2.9)	¶	0.0 (−4.5, 5.7)	¶
	BRFSS	−0.5 (−3.2, 2.2)	−3.4 (−13.0, 6.2)	−0.5 (−6.1, 5.2)	−3.1 (−10.2, 4.0)	−1.2 (−3.9, 1.4)
Persons 18-64 with high-risk conditions	NHIS	−1.5 (−5.9, 2.9)	1.1 (−2.8, 5.6)	¶	−1.7 (−5.3, 2.0)	¶
	BRFSS	0.0 (−3.3, 4.0)	−1.0 (−5.2, 3.2)	0.0 (−2.4, 3.4)	2.2 (−0.3, 4.7)	−0.0 (−2.3, 2.2)
Persons 18-64 without high-risk conditions	NHIS	−0.3 (−2.0, 1.4)	−0.4 (−1.0, 0.2)	¶	−1.1 (−3.4, 1.2)	1.1 (−1.7, 5.1)
	BRFSS	0.0 (−0.9, 1.0)	−0.7 (−1.9, 0.5)	−0.4 (−4.7, 3.9)	−0.8 (−1.8, 0.3)	−0.6 (−3.3, 2.2)

*High-risk definition based on NHIS is that adults categorized as being at high risk for influenza-related complications self-reported one or more of the following: 1) ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack, or other heart condition; 2) having a diagnosis of cancer during the preceding 12 months (excluding non-melanoma skin cancer) or ever being told by a physician they have lymphoma, leukemia, or blood cancer during the previous 12 months; 3) being told by a physician they have chronic bronchitis or weak or failing kidneys; or 4) reporting an asthma episode or attack during the preceding 12 months. High-risk definition based on BRFSS includes adults who had diabetes, asthma, myocardial infarction, and coronary heart disease.

†Adults who were Hispanic might be of any race. Adults who were white, black, Asian, or American Indian/Alaska Native (AIAN) all were considered non-Hispanic. For NHIS, persons of multiple races or persons where race was not “releasable” due to respondent confidentiality or other reasons were categorized as “other.” For BRFSS, adults who were native Hawaiian or other Pacific Islander, who were “other” race, or who reported multiple race were categorized as “other”.

§Estimated slope from weighted linear regression of percentage point difference in influenza vaccination coverage between a racial/ethnic group and non-Hispanic whites on influenza season.

¶Not able to run weighted linear regression because some estimates may not be reliable due to relative standard error >30% or sample size < 30.

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** Beginning in 2011, BRFSS included landline and cellular telephone households and used a new method for weighting, so estimates for 2011-12 are not strictly comparable to estimates from prior seasons.

†† $p < 0.05$ (test for linear trend).