



## Major article

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



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## Key Words:

Immunization  
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**Background:** Annual influenza vaccination is recommended for all persons aged  $\geq 6$  months. The objective of this study was 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 Kaplan-Meier survival analysis 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 subgroups, with smaller disparities observed for adults age 18-49 years compared with 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 subgroups based on the NHIS (test for trend,  $P < .05$ ). Coverage gaps between racial/ethnic minorities and non-Hispanic whites persisted at similar levels from the 2007-08 through the 2011-12 seasons, with similar results from the 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 these disparities.

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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 in US adults.<sup>1-6</sup> Between the 1976-77 and 2006-07 influenza seasons, estimated annual deaths attributable to influenza ranged from 3,000 to 49,000.<sup>2</sup> The economic impact of influenza illness is substantial. One US national study

estimated the annual economic burden of seasonal influenza as \$87.1 billion, including \$10.4 billion in direct medical costs.<sup>7</sup>

Since the 2010-11 influenza season, the Advisory Committee on Immunization Practices (ACIP) has recommended annual influenza vaccination for all individuals age  $\geq 6$  months. Before 2010, annual vaccination was recommended in adults age  $\geq 50$  years, pregnant women, adults age 18-49 years with medical conditions associated with increased risk of complications from influenza infection, health care personnel, and close contacts of high-risk persons.<sup>8</sup> Healthy adults 18-49 years who were not close contacts of persons at high risk were added to this list beginning in the 2010-11 season.<sup>3</sup>

Significant morbidity and mortality are associated with influenza, particularly in elderly adults and those with chronic conditions at increased risk for secondary infections. Annual vaccination is the most effective strategy for preventing influenza.<sup>3,5-23</sup> Vaccination

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coverage has been suboptimal, however, and racial/ethnic disparities in influenza vaccination coverage have been documented.<sup>3,24-31</sup> To assess the level of and trends in 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 2 primary data sources used to monitor influenza vaccination coverage among adults<sup>25-32</sup> with the NHIS providing national estimates used to monitor progress toward national Healthy People 2020 objectives,<sup>33</sup> and the BRFSS providing more timely national and state-specific estimates.<sup>34</sup> The BRFSS has a 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 have examined racial/ethnic disparities using both data sources and here 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 used not the annual BRFSS public release data, but rather monthly or quarterly weighted files created by the Centers for Disease Control and Prevention (CDC) for more timely estimates of season-specific influenza vaccination coverage. The NHIS is a national cross-sectional household survey conducted annually by the CDC to provide estimates of health indicators, health care utilization and access, and health-related behaviors.<sup>30,35</sup> The survey samples civilian, noninstitutionalized populations living in the United 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, nonresponse, and poststratification adjustments (ie, sex, age, and 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. Noninstitutionalized adults age  $\geq 18$  years are selected at random using a multistage cluster design. Data are collected monthly in all 50 states and the District of Columbia and are weighted by age, sex, and, in some states, race/ethnicity, to reflect each area's estimated adult population.<sup>36</sup> Beginning in 2011, surveys included landline and cellular telephone households and used a new method for weighting.<sup>37</sup>

For NHIS survey, respondents were asked the following questions: "During the past 12 months, have you had a flu shot?"; "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 the BRFSS, before 2011, influenza vaccination questions were worded similarly as for the NHIS; starting in 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 with the BRFSS, the NHIS collects more information regarding high-risk conditions to enable categorization of adults with health conditions that put them at high risk for complications from influenza.<sup>34</sup> For respondents included in the NHIS samples, we defined high-risk persons as those who self-reported 1 or more

of the following: ever being told by a physician they had diabetes, emphysema, coronary heart disease, angina, heart attack, or another heart condition; being diagnosed with cancer (excluding nonmelanoma skin cancer) in the previous 12 months; ever being told by a physician they have lymphoma, leukemia, blood cancer; being told by a physician they have chronic bronchitis or weak or failing kidneys during the previous 12 months; or experiencing an asthma episode or attack in the previous 12 months. For respondents included in the BRFSS samples, we defined high-risk persons as individuals who self-reported having diabetes, asthma, myocardial infarction, and coronary heart disease, the relevant medical conditions collected by the 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 between September and June and vaccinated between August and May, using Kaplan-Meier survival analysis.<sup>34</sup> For example, for the 2010-11 season, interviews conducted between September 2010 and June 2011 were analyzed to estimate influenza vaccination received between August 2010 and May 2011. For the 2007-08 season, 2008 BRFSS interviews from January to June 2008 were used, because 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 was used to define the "censoring" variable of the Kaplan-Meier procedure. Tests for linear trend were performed using weighted linear regression on the season-specific estimates, with 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 US noninstitutionalized civilian population. Vaccination month and year were imputed for individuals who did not report their month and year of vaccination (range by season, 3.0%-5.0% for the NHIS and 3.5%-7.3% for the BRFSS). All tests were 2-tailed, with the significance level set at  $\alpha < 0.05$ . SAS version 9.3 (SAS Institute, Cary, NC) and SUDAAN version 10.01 (Research Triangle Institute, Research Triangle Park, NC) were used to calculate point estimates and 95% confidence intervals (CIs).

## RESULTS

Overall, among adults age  $\geq 18$  years, influenza vaccination coverage in the 2011-12 season based on the 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 the 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 age  $\geq 18$  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 the NHIS, and from -12.5 to 0.7 percentage points based on the 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 the NHIS and BRFSS for most age groups (NHIS:  $\geq 18$  years, 18-64 years, 18-64 years without high-risk conditions, 50-64 years, and  $\geq 65$  years for non-Hispanic blacks, all age groups for Hispanics (Tables 1 and 2; Fig 1); BRFSS: all age groups for non-Hispanic blacks, all age groups for Hispanics

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