BMC Public Health

Research article

Racial differences in influenza vaccination among older americans 1996–2000: longitudinal analysis of the Health and Retirement Study (HRS) and the Asset and Health Dynamics Among the Oldest Old (AHEAD) survey

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Published: 16 December 2003

BMC Public Health 2003, **3**:41

Received: 31 July 2003
Accepted: 16 December 2003

This article is available from: http://www.biomedcentral.com/1471-2458/3/41

Abstract

Background: Influenza is a common and serious public health problem among the elderly. The influenza vaccine is safe and effective.

Methods: The purpose of the study was to determine whether frequencies of receipt vary by race, age group, gender, and time (progress from 1995/1996 to 2000), and whether any racial differences remain in age groups covered by Medicare. Subjects were selected from the Health and Retirement Study (HRS) (12,652 Americans 50–61 years of age (1992–2000)) and the Asset and Health Dynamics Among the Oldest Old (AHEAD) survey (8,124 community-dwelling seniors aged 70+ years (1993–2000)). Using multivariate logistic regression, adjusting for potential confounders, we estimated the relationship between race, age group, gender, time and the main outcome measure, receipt of influenza vaccination in the last 2 years.

Results: There has been a clear increase in the unadjusted rates of receipt of influenza vaccination for all groups from 1995/1996 to 2000. However, the proportions immunized are 10–20% higher among White than among Black elderly, with no obvious narrowing of the racial gap from 1995/1996 to 2000. There is an increase in rates from age 50 to age 65. After age 70, the rate appears to plateau. In multivariate analyses, the racial difference remains after adjusting for a series of socioeconomic, health, and health care related variables. (HRS: OR = 0.63 (0.55–0.72), AHEAD: OR = 0.55 (0.44–0.66))

Conclusions: There is much work left if the *Healthy People 2010* goal of 90% of the elderly immunized against influenza *annually* is to be achieved. Close coordination between public health programs and clinical prevention efforts in primary care is necessary, but to be truly effective, these services must be culturally appropriate.

Background

Influenza frequently causes several days of incapacitating malaise for otherwise healthy individuals. In the elderly and persons with chronic medical conditions, it increases risk for serious complications and death. Twenty to 40 thousand deaths are attributed to influenza each year, with 90 percent of these in patients over age 65. [1] Influenza also has a large economic impact, in the United States estimated to exceed $12 billion annually.[2]

Immunization, using inactivated virus, is cheap, safe, and effective. [3-6] Most clinical guidelines recommend annual vaccination of the elderly.[1,7] The U.S. Preventive Services Task Force advises vaccination for anyone over age 65 as well as for patients with chronic diseases such as cardiopulmonary disorders, metabolic diseases, and immuno-suppression.[1] The American College of Preventive Medicine recommends influenza vaccination for everyone over the age of 18 for whom it is not contraindicated.[7]

Since 1993, Medicare has provided Part B coverage for the influenza vaccine and its administration [8], and although immunization rates have steadily increased since then [9], Medicare's specific contribution to this increase is not clear.

Healthy People 2000 established a goal of 60% immunization among elderly aged 65 and above and high risk persons [10], a goal that was surpassed in most states, especially among Whites. [11] Among non-institutionalized high-risk persons 50–64, only 40% received the influenza vaccine in 1997. *Healthy People 2010* set the goal for influenza vaccination to 90% for persons aged 65 and above.[12] A recent Institute of Medicine report also targets increased influenza vaccination as one of 20 key areas to improve US health care [13], and that special efforts should be made among African American and Hispanic adults and nursing home residents.

Earlier studies have shown persistent racial disparities, not only for influenza morbidity [6], but also for immunization coverage. [14,15] In 1998, the influenza vaccination rate was 46% among non-Hispanic Black elderly.[6] Under age 65, such racial discrepancy may be due to health insurance differences, but health insurance differences should not play a central role after Medicare becomes available to all groups at age 65.

The objective of these analyses is to evaluate the determinants of influenza vaccination among the elderly, based on 2 large, national studies of middle aged and old Americans. We investigate whether the reported frequencies of receipt vary by age group, gender and race. In addition, we document whether any racial differences persist in age groups covered by Medicare insurance, and evaluate the cohorts' recent progress, from 1996 to 2000, towards the goals of *Healthy People 2010*. In multivariate analyses, we investigate the importance of demographic, socioeconomic, health status and health care factors as predictors of influenza vaccination.

Methods

Data

Data The Health and Retirement Study (HRS) is a national cohort study with an initial sample of over 12,600 persons.[16] The survey contains information about health behaviors, ill health and disability, medical care usage, and other topics. The baseline survey (1992) was an in-home, face-to-face interview for the 1931–41 birth cohort (and their spouses, regardless of age). A question module relating to receipt of clinical preventive services, including influenza vaccination, was included in wave 3 (1996) and wave 5 (2000).

The Asset and Health Dynamics Among the Oldest Old (AHEAD) database is a companion national panel study designed to monitor similar topics in an older age group.[17] The initial sample (wave 1: 1993) consisted of 7,447 respondents aged 70 and over (and their spouses, regardless of age) who lived in the community. If the subject was unable to participate in the interview, a proxy respondent was identified and interviewed in stead. Persons aged 80+ were over-sampled to allow for more precise estimates in this group. The follow-up interviews were conducted by telephone (wave 2: 1995; wave 3: 1998; wave 4: 2000). As in HRS, people of Hispanic origin, African-Americans and Florida residents were over-sampled (100%). The question pertaining to influenza vaccination was included in wave 2 and wave 4.

Dependent variable

The question measuring influenza vaccination in both HRS and AHEAD was as follows: "Since we talked to you last .... [i.e. 2 years ago]" or [if the respondent had not completed the survey 2 years earlier]: "*In the last 2 years, have you had any of the following medical tests or procedures:*" *"A flu shot"? (etc.)* Therefore, the annual prevalence of influenza immunization is unavailable, but a 2-year prevalence can be determined, i.e. the proportion of persons who received an influenza immunization at least once over that period.

Explanatory variables

Receipt of influenza vaccination reported in 2000 (with the corresponding independent variables measured in 1998 – please see below) was contrasted with receipt reported in 1995/1996 (with the independent variables measured in 1993). Age was grouped in 5-year intervals. Independent variables included sex, race (White or Black),

Table 1: Uptake of Influenza Vaccine by Survey, Wave and Gender in Selected Subgroups (weighted percentages).

Variables	HRS*1996		HRS 2000		AHEAD*1995		AHEAD 2000	
	Female n = 4375	Male n = 3676	Female n = 4859	Male n = 4030	Female n = 3840	Male n = 2386	Female n = 3049	Male n = 1526
Demographic								
Age 50–54	35	29	43	41				
Age 55–59	38	35	52	46				
Age 60–64	46	41	58	53				
Age 70–74					67	71	77	81
Age 75–79					67	74	75	82
Age 80–84					68	69	76	80
Age 85–89					65	61	76	81
White	41	36	58	58	69	72	77	82
Black	28	32	45	50	51	51	60	68
Socioeconomic								
Completed high school	41	37	58	59	71	73	78	82
Not completed high school	36	31	52	53	62	66	71	78
Born in the US	40	36	57	58	68	71	76	81
Born abroad	35	31	47	46	61	61	77	73
Married	42	36	59	59	71	72	80	82
Not married	35	34	52	50	65	66	73	77
Income category [a] 1	37	36	53	54	61	60	70	69
Income category 2	38	29	58	64	67	68	77	81
Income category 3	42	37	57	57	67	72	76	82
Income category 4	43	38	58	54	76	77	80	84
Health								
Smokers	36	30	49	45	57	56	64	70
Non smokers	41	38	58	60	68	72	77	82
Less physical activity			57	57			74	79
Vigorous exercise			57	57			79	83
Health excellent, v. good, good	38	35	55	55	66	70	75	81
Health poor or fair	46	42	60	64	68	71	77	80
Cognitively normal					68	71	77	82
Cognitively impaired					54	56	62	67
Subj. life expectation [b] 0–33	37	34	60	62	67	71	75	80
Subj. life expectation 34–66	41	39	58	53	68	74	78	83
Subj. life expectation 67–100	40	35	53	52	67	65	75	79
Health Care								
Uninsured	30	23	38	27				
Insured	41	37	58	59				
No additional private insurance					56	57	76	81
Additional private insurance					70	74	64	80
Not in hospital last year	39	34	55	55	66	70	75	79
Hospitalized in the last year	47	46	66	67	71	74	78	84
0–2 doctor visits last year	29	26	43	40	59	61	58	67
3–5 doctor visits last year	38	39	55	60	72	76	75	81
6+ doctor visits last year	49	46	64	67	72	79	80	84
Not admitted to nursing home					67	71	76	81
Admitted to nursing home					67	77		

* HRS – Health and Retirement Study AHEAD – Asset and Health Dynamics Among Oldest Old Survey a. Household income categories (in $): HRS 1996: 1. less than or equal to 13,000 2. 13,001–31,600 3. 31,600–58,269 4. more than 58,269 HRS 2000: 1. less than or equal to 8,295 2. 8,296–20,420 3. 20,421–49,504 4. more than 49,504 AHEAD 1995: 1. less than or equal to 10,560 2. 10,561–18,000 3. 18,001–30,000 4. more than 30,000 AHEAD 2000: 1. less than or equal to 8,400 2. 8,401–12,000 3. 12,001–18,840 4. more than 18,840 b. Subjective life expectation: HRS: "(What is the percent chance) that you will live to be 75 or more?". AHEAD: "(Using a number from 0 to 100), what do you think are the chances that you will live another 5 years?"

born in the US or abroad, married or not, and whether high school had been completed. Household income was categorized into 4 groups (by quartiles for each of the 2 surveys – please see footnote to Table 1).

Current smokers were compared to current non-smokers and those who reported engaging in vigorous exercise compared to those who did not report exercising vigorously. Those who reported their health as being fair or poor were contrasted with those who reported their health as being excellent, very good or good, and (in AHEAD only) those with cognitive impairment were contrasted with those who were cognitively normal [18]. A question relating to subjective life expectation was also included (please see footnote to Table 1).

In HRS' pre-Medicare population, subjects without health insurance were compared to those with any type of health insurance. In AHEAD, where nearly all subjects were covered by Medicare, those with additional, private insurance were compared to those without additional insurance. Three categories were constructed based on the number of outpatient physician visits in the last year (0–2, 3–5, 6 or more) (indicating amount of 'exposure' to the health care system).

Analysis The weighted proportions of respondents in both HRS and AHEAD who had received influenza vaccination since the previous wave were evaluated by race, age group, sex and wave (1995/1996; 2000). Since no sample weights were available for the respondents to the year 2000 questionnaires (and for consistency with the multivariate analyses: please see below), weights from the *previous* wave were utilized (i.e. sample weights from 1993/1994 were applied to data from 1995/1996; sample weights from 1998 were applied to data from 2000.)

Analysis

In bivariate analyses, parallel data elements from the 2 surveys were used to relate a set of explanatory factors to influenza vaccination. To indicate time trends by race, age group and gender, report of influenza vaccination from the 1995/1996 and 2000 waves were first estimated. Available sample weights were used in this analysis. Beyond simple compensation for unequal selection probabilities, weighting factors were also used to adjust for geographic and race group differences in response rates in Wave 1. [19] In subsequent waves, the weights were consistently adjusted for sample attrition and mortality.[20] Based on those respondents who had completed the influenza question in 1995/1996 or 2000, the weighted proportions who reported receipt were tabulated by category of the explanatory variables (explanatory variables measured in the wave *preceding* the report of receipt).

The respondents who completed the influenza question in 1995/1996 and/ or 2000 (i.e. the outcome variable) (HRS 1996: n = 10,754, AHEAD 1995: n = 6,936, HRS 2000: n = 9,606, AHEAD 2000: n = 4,845) were eligible for the multivariate analyses. Since receipt of influenza vaccination referred to the interval between the current and the previous wave ("In the last 2 years..." or "...since we spoke to you last."), the values of the explanatory variables from the wave *preceding* the value of the outcome variable were selected (i.e. predictors 1993/1994 -> outcome 1995/1996; predictors 1998 -> outcome 2000.)

Using multivariate logistic regression, models were first developed separately for the 1993/1994–1995/1996 waves and for the 1998–2000 waves (results not shown). Subsequently, observations for each respondent were stacked (most respondents provided 2 outcome values and 2 sets of explanatory values). In the latter models, because the observations for the same person in different waves were not independent of one another, clustering of observations at the individual level was adjusted for by obtaining Huber-White corrected standard errors. [21,22] Odds ratios and 95% confidence intervals are reported. Models were estimated separately for HRS and AHEAD using very similar variables from both surveys. In addition to simple models including only year (wave) and demographic variables, more comprehensive models were also developed with predictor variables from the following groups: demographic, socioeconomic, health related, health care related. In the stacked models, a variable indicating interaction between race and wave was also included (indicating whether the difference in receipt of influenza vaccination between the races was increasing or decreasing from 1995/1996 to 2000).

SAS (version 8.01) was used for the statistical analyses.

This project was approved by the Duke University Medical Center's Institutional Review Board.

Results

From Figures 1 and 2, it is clear that there has been an increase in the unadjusted influenza vaccination rates for both genders and for all age groups from 1995/1996 to 2000, and that this increase has taken place in both Black and White Americans. There is an increase in rates from age 50 to age 65, with a plateau in older groups. However, Black men and women have consistently lower rates than their white counterparts, with no obvious narrowing of the racial gap (i.e. steeper slopes for Blacks than for Whites) from 1995/1996 to 2000 among either gender.

In bivariate analyses (accounting for sample weights), among persons aged 50–54 in 1995, 35% of females and 29% of males reported receipt of vaccination in the pre-

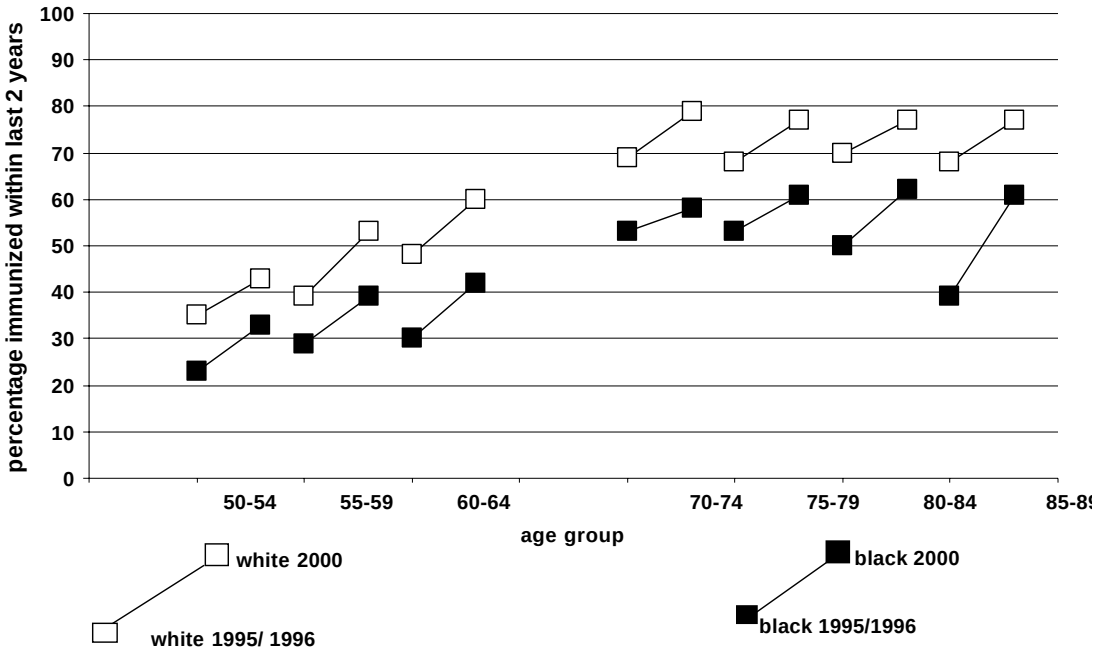

Figure 1
Percentage immunized against influenza by age and year; weighted data. (FEMALES)

ceding 2-year period (Table 1). By comparison, 68% of females and 69% of males who were between the ages of 80 and 84 in 1996 reported receipt, rising to 76% of females and 80% of males in the same age group by the year 2000. The proportion of persons reporting immunization rose for every age group analyzed between 50 and 89 years of age. Several other demographic variables were related to immunization. Those who had completed high school had higher rates of immunization compared to those who did not. Household income was not consistently related to immunization among the HRS sample, but among the older AHEAD respondents those with higher incomes were more likely to have received influenza immunization. Married persons were also more likely to receive immunization compared to those not married in both databases.

Those who did not smoke were more likely to be immunized, and among older persons those who exercised were more likely to have received the immunization. Individuals' subjective beliefs about their current health as well as their subjective expected longevity might theoretically alter patients' receipt of the influenza vaccination. Generally, persons who reported fair or poor health status were more likely to report receipt of the influenza vaccination compared to those who reported that their health was good or excellent. The unadjusted relationship between an individual's subjective belief about his or her likelihood of survival was not as clearly linked to influenza vaccination.

In multivariate analyses (Tables 2 and 3), the major findings of racial disparity in rates of immunization and increasing rates over time persisted, both in simple models controlling for demographic factors, as well as in more

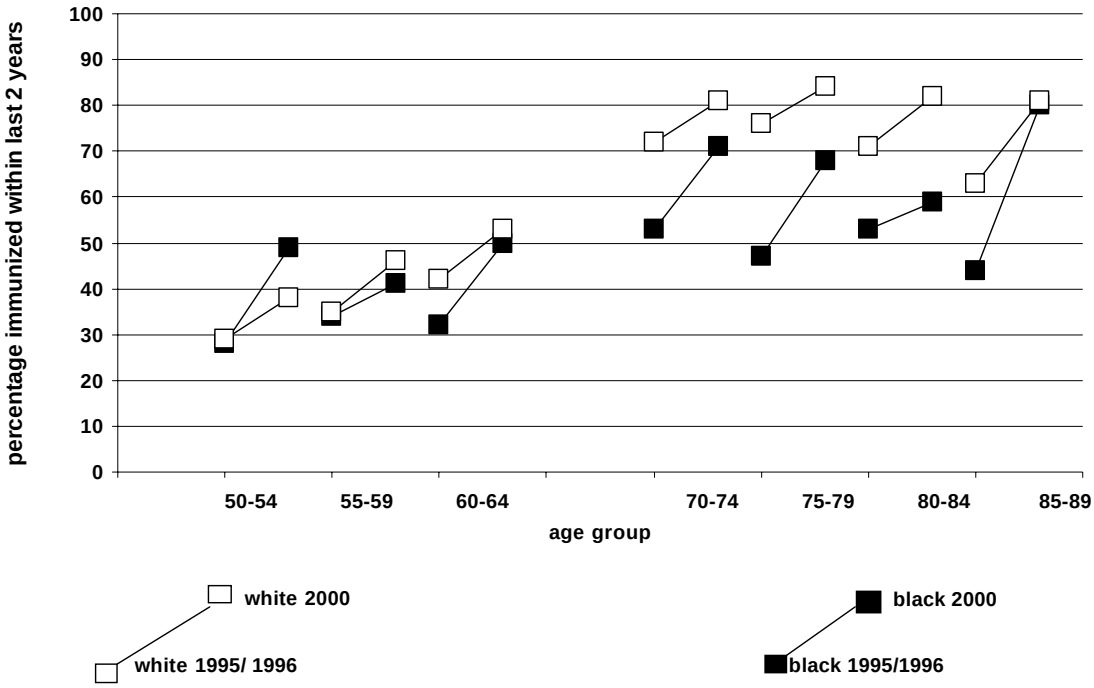

Figure 2
Percentage immunized against influenza by age and year; weighted data. (MALES)

comprehensive models controlling for a series of potential confounding factors, including demographics, health insurance, individual perceptions of health and longevity, socioeconomic status, health and utilization of health care services. The increase from 1995/1996 to 2000 net of the potential confounding variables is significant in all models. The general finding that Blacks have significantly lower rates than Whites is also robust, and found in all our model specifications. The interaction term of race and year was not significant, indicating that the relative odds of vaccination among Blacks relative to Whites did not change during the period, i.e. the rate of change in the increase did not vary significantly between Blacks and Whites. The odds of vaccination among Blacks, relative to Whites, were even lower in AHEAD than in HRS, and these odds do not appear to be reduced after including the potential confounding variables, this in spite of the fact that virtually all persons in AHEAD had Medicare coverage. Furthermore, interaction with the health care system generally, as measured by physician visits and hospitalizations, also increased the likelihood of immunization.

The effect of other demographic factors mirrored the bivariate results. There are significant increases by age group in HRS with higher rates of immunization as people age, but in AHEAD, the effect of age differed across models, and the general finding was that age did not have a large effect within this group. Males and females have similar rates in HRS, but in AHEAD males have higher rates. Completing higher education, being born in the USA and being married remain significantly associated with higher rates of immunization in all models. Household income is not a significant predictor in the HRS sample, but is in the AHEAD models – those with lower incomes being less likely to be immunized.

Table 2: Adjusted relative odds of influenza immunization: HRS: multivariate models

Variables	Simple Model	Comprehensive Model
	OR (95% CI)	OR (95% CI)
Demographic		
Year 2000 [a]	2.04 (1.92, 2.17)	1.86 (1.74, 1.99)
Age 55–59.9 [b]	0.79 (0.74, 0.85)	0.86 (0.80, 0.93)
Age 60–64.9 [b]	0.99 (0.93, 1.07)	1.07 (0.99, 1.15)
Male [c]	1.06 (1.00, 1.12)	1.03 (0.96, 1.10)
Black [d]	0.65 (0.58, 0.73)	0.63 (0.55, 0.72)
Black * year 2000	1.02 (0.87, 1.20)	1.01 (0.85, 1.20)
Socioeconomic		
Completed high school [e]		1.23 (1.14, 1.33)
Born in the US [f]		1.52 (1.36, 1.69)
Married [g]		1.13 (1.04, 1.22)
Income category 1 [h]		1.02 (0.93, 1.13)
Income category 2 [h]		1.06 (0.97, 1.16)
Income category 3 [h]		1.00 (0.92, 1.09)
Health		
Smoking [i]		0.73 (0.67, 0.78)
Vigorous exercise [j]		1.09 (1.03, 1.16)
Poor or fair health [k]		1.25 (1.15, 1.36)
Subj. life expectation 34–66[l]		0.87 (0.79, 0.94)
Subj. life expectation 67–100[l]		0.80 (0.74, 0.87)
Health Care		
Uninsured [m]		0.56 (0.50, 0.63)
In hospital in last year [n]		1.35 (1.23, 1.47)
3–5 doctor visits in the last year [o]		1.66 (1.53, 1.80)
6+ doctor visits in the last year [o]		2.31 (2.13, 2.49)

Reference categories: a. Year 1996. b. Age 50–54.9 c. Female d. White e. Not completed high school f. Born abroad g. Not married h. (Household) income category 4 (see details in footnote to table 1) i. Not smoking j. Less physical activity k. Excellent, very good or good health l. Subjective life expectation 0–33 (see details in footnote to table 1) m. Some health insurance n. Not in hospital last year o. 0–2 doctor visits last year

Those with a healthier risk factor profile are the persons most likely to receive the influenza immunization. Smokers were less likely, while persons reporting a higher level of physical activity were more likely to have been immunized. Conversely, persons with more positive subjective views of their current health and their future longevity were less likely to receive immunization. Those reporting fair or poor health had a higher rate of receipt, suggesting that those who view themselves as healthy do not perceive a strong risk reduction benefit of being immunized. Furthermore, persons with a higher value of their subjective life expectation (which approximates a probability of survival to age 75 in HRS; and for 10 more years in AHEAD) were less likely to be immunized in HRS, but there was no significant effect in AHEAD. Elderly with cognitive impairment (AHEAD only) were much less likely to have received an influenza vaccination than those with normal cognition.

Discussion

Two overall trends stand out when considering rates of influenza immunization among persons over age 50 in the United States. The proportion of persons who are immunized has risen since the mid 1990's. However, persistent disparities in the immunization rates between Blacks and Whites remain, with Whites having higher rates regardless of age group or year of survey. These general findings are remarkably robust, particularly the racial difference, even with the addition of many potential confounding variables. Despite increasing rates of influenza immunization, more work must to be done to reach the *Healthy People 2010* goal of 90% immunization *annually* since the proportion of persons immunized over a *2-year* period is never higher than 80% among Whites in any age group, and peaks among Blacks at less than 70%.

Possible reasons for the increase in influenza vaccination levels among elderly over age 65 years include greater acceptance of preventive medical services by practitioners and patients, increased delivery and administration of vaccination, and new information regarding influenza vaccine cost-effectiveness and safety.[23,24] Continued monitoring is needed to determine if vaccination coverage among persons over age 65 years has plateaued. It is clear

Table 3: Adjusted relative odds of influenza immunization: AHEAD: multivariate models

Variables	Simple Model	Comprehensive Model
	OR (95% CI)	OR (95% CI)
Demographic		
Year 2000 [a]	1.62 (1.47, 1.77)	1.70 (1.45, 2.00)
Age 75–79.9 [b]	1.05 (0.95, 1.16)	1.09 (0.97, 1.22)
Age 80–84.9 [b]	1.03 (0.92, 1.15)	1.09 (0.96, 1.25)
Age 85–89.9 [b]	0.96 (0.83, 1.11)	1.13 (0.94, 1.35)
Male [c]	1.22 (1.12, 1.33)	1.16 (1.04, 1.29)
Black [d]	0.44 (0.38, 0.50)	0.55 (0.45, 0.66)
Black * year 2000	1.08 (0.86, 1.36)	0.97 (0.74, 1.27)
Socioeconomic		
Completed high school [e]		1.19 (1.07, 1.32)
Born in the US [f]		1.21 (1.03, 1.43)
Married [g]		1.15 (1.04, 1.28)
Income category 1 [h]		0.68 (0.59, 0.79)
Income category 2 [h]		0.79 (0.69, 0.90)
Income category 3 [h]		0.79 (0.69, 0.90)
Health		
Smoking [i]		0.62 (0.53, 0.72)
Vigorous exercise [j]		1.20 (1.08, 1.33)
Poor or fair health [k]		1.07 (0.96, 1.19)
Cognitive impairment [l]		0.71 (0.60, 0.84)
Subjective life expectation 34–66 [m]		1.08 (0.96, 1.21)
Subjective life expectation 67–100[m]		0.92 (0.82, 1.03)
Health Care		
Other private insurance [n]		1.48 (1.28, 1.72)
In hospital in last year [o]		1.08 (0.96, 1.22)
3–5 doctor visits in the last year [p]		1.81 (1.61, 2.04)
6+ doctor visits in the last year [p]		2.15 (1.90, 2.43)
Admitted to nursing home [q]		1.52 (1.19, 1.94)

Reference categories: a. Year 1995 b. Age 70–74.9 c. Female d. White e. Not completed high school f. Born abroad g. Not married h. Income category 4 (see details in footnote to table 1) i. Not smoking j. Less physical activity k. Excellent, very good or good health l. cognitively normal m. Subjective life expectation 0–33 (see details in footnote to table 1) n. No other private insurance o. Not in hospital last year p. 0–2 doctor visits last year q. Not admitted to nursing home last year

that health insurance coverage, while a significant predictor of influenza immunization, is not a panacea that can lead to the near-universal level of immunization called for in *Healthy People 2010*. It is notable that racial disparities are larger in our study among persons over age 65, virtually all of whom have Medicare coverage.

Our findings concur with earlier work which showed that Blacks are less likely to receive influenza immunization compared to Whites, even after controlling for health and certain socioeconomic variables. [6,25] Furthermore, racial disparities in receipt of health care services in general are common in the United States, and this is a priority area for public health. In 1998, the influenza vaccination rate among persons over age 65 was 66% among non-Hispanic Whites, 46% among non-Hispanic Blacks, and 50% among Hispanics. [11] In a study from Louisiana, the rate for Medicare African American beneficiaries was approximately one-half that of Caucasian beneficiaries.[15] There are likely a set of reasons for the differences in immunization by race that were not measured in our study. These reasons may be cultural and/or are related to attributes of the health beliefs as represented in the Health Belief Model. [26] For example, past work has found that in addition to limited knowledge about the disease and the vaccine [27], in a low-income urban population, concern about undisclosed vaccine contents exists and appears to impede acceptance of influenza immunization among both African-Americans and Caucasians.[28] Misconceptions of the vaccine may even be common among health care providers, and it is possible that African Americans are offered the vaccine less. [29] Although shortages of influenza vaccine have been reported during the 2000–2001 influenza season [30], it is unlikely that this would lead to differential use among African Americans and Caucasians.

Strengths of our study include the large, nationally representative sample, over-sampling of Black Americans, long-term follow-up of individuals with information on risk factors as well as immunization status at more than one point in time. The overall rates of immunization are broadly consistent with other national surveys of immunization rates.[6,14] However, since the wording of the questionnaires refers to the period "within the last two years", the proportions reporting having been immunized, as reported in Table 1, are higher than annual rates. Since it is possible that individuals might have been immunized one or more times in the last two years, we cannot simply divide the reported rates by two to get the annual rates, i.e. the corresponding annual rates lie somewhere between our reported rates and half of these rates.

Although the information about influenza vaccination is based on self-report, similar questions relating to influenza vaccination have been validated.[31] A limitation of the study is the lack of measures related to detailed health beliefs and cultural views about medical and preventive services in HRS and AHEAD, factors which likely pose persistent barriers to achieving the *Healthy People 2010* goals. It would also be interesting to investigate whether African Americans are offered the vaccine less frequently or less convincingly.

Influenza was chosen as an indicator for *Healthy People 2010* because of its high incidence and serious health and economic consequences. [32] Few, if any, other preventive or therapeutic interventions for adults match or exceed the clear benefits of influenza immunization.[2]

Interventions raised immunization rates even before Medicare covered influenza immunization [33], and simple systems such as annual mailings, computerized reminders in the doctor's office [34] and standing orders for nurses, and pre-printed documentation. [35,36] increase vaccination rates. However, identifying and addressing cultural and health belief barriers, and possibly also subtle provider behavior, effectively, are likely key to developing interventions that are effective in increasing influenza immunization further.

To successfully develop and implement influenza vaccination strategies to reach the Healthy People 2010 national objective of 90% influenza vaccination among the elderly, additional resources will be needed. Close coordination between public health programs and clinical prevention in managed and primary care is necessary, but to be truly effective, these services must be culturally appropriate.

Conclusion

The proportion of Americans who are immunized against influenza has risen since the mid 1990's. However, persistent disparities in the immunization rates between Blacks and Whites remain, with Whites having higher rates regardless of age group or year of survey. These general findings are remarkably robust, particularly the racial difference, even with the addition of a series of potential confounding variables.

Abbreviations

HRS – The Health and Retirement Study

AHEAD – The Asset and Health Dynamics Among the Oldest Old survey

Competing interests

None declared.

Authors' contributions

TO, DT and GG developed the idea. TO and DT designed and oversaw the statistical analyses. TO and AML completed the literature review. All authors contributed to the interpretation of the data and the writing and editing of the manuscript.

Acknowledgements

This work was funded by grants from the National Institute of Aging (1R01-AG15868 and 1R01-AG16816). The authors would like to thank Tara Hackney and Jaspreet Chowdhary for editing the manuscript.

References

1. United States Preventive Services Task Force: **Immunizations and chemoprophylaxis.** In: *Guide to Clinical Preventive Services* Secondth edition. *Baltimore, MD: Williams & Wilkins*; 1996.
2. Nichol KL, Margolis KL, Wouremna J *et al.*: **Effectiveness of influenza vaccine in the elderly.** *Gerontology* 1996, **42(5):**274-279.
3. Liddle BJ, Jennings R: **Influenza vaccination in old age.** *Age Ageing* 2001, **30:**385-389.
4. Gross PA, Hermogenes AW, Sacks HS *et al.*: **Efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature.** *Ann Intern Med* 1995, **123:**518-527.
5. Mullooly JP, Bennett MD, Hornbrook MC *et al.*: **Influenza vaccination programs for elderly persons: cost-effectiveness in a health maintenance organization.** *Ann Intern Med* 1994, **121:**947-952.
6. CDC: **Influenza and pneumococcal vaccination levels among persons aged greater than or equal to 65 years – United States, 1999.** *MMWR Morb Mortal Wkly Rep* 2001, **50(25):**532-537.
7. Fingar A, Francis B: **Adult immunizations. American college of preventive medicine practice policy statement.** *Am J Prev Med* 1998, **14(2):**156-158.
8. Medicare: **Screening and immunizations.** [http://www.rimedicare.org/beneficiary/screenings_immunizations.html]. Last accessed September 22, 2003
9. Health Care Financing Administration: **Quality of care-national campaign. Influenza/pneumoccocal campaign.** . Last accessed September 22, 2003
10. US Department of Health and Human Services, Public Health Service: *Healthy people 2000: national health promotion and disease prevention objectives – full report, with commentary Washington, DC: US Department of Health and Human Services, Public Health Service*; 1991.
11. Singleton JA, Lu PJ: **Influenza vaccination levels in the United States, 1998.** In: *Abstracts of the 35th National Immunization Conference Atlanta, GA: CDC*; 2001 in press.
12. US Department of Health and Human Services: *Healthy People 2010 Washington, DC: US Department of Health and Human Services*; 2000.

13. Karen Adams K, Corrigan JM, eds: **Priority Areas for National Action: Transforming Health Care Quality.** *Washington, DC: The National Academies Press*; 2003.
14. Schneider E, Cleary P, Zaslavsky A *et al.*: **Racial disparity in influenza vaccination.** *JAMA* 2001, **286(12):**1455-1460.
15. Kumar S, Scheffler S, Singleton S *et al.*: **Influenza rates for Louisiana Medicare beneficiaries (1933–1995): a need for interventions.** *J La State Med Soc* 1996, **148(10):**423-429.
16. Juster F, Suzman R: **An Overview of the Health and Retirement Study.** *J Hum Resour* 1995, **30(5):**S7-S56.
17. Myers GC, Juster FT, Suzman RM: **Asset and health dynamics among the oldest old (AHEAD): initial results from the longitudinal study. Introduction.** *J Gerontol B Psychol Sci Soc Sci* 1997, **52 Spec No:**v-viii.
18. Herzog AR, Wallace RB: **Measures of cognitive functioning in the AHEAD study.** *J Gerontol B Psychol Sci Soc Sci* 1997:37-48.
19. Anonymous: **Weights for Wave 1 Data Analysis.** In: *Codebook: Assets and Health ynamics Among the Oldest Old (AHEAD)* [http://hrsonline.isr.umich.edu/meta/1993/core/codebook/ahintro.htm#weights]. Last accessed September 22, 2003
20. Anonymous: **Sampling Weights Revised for Tracker 2.0 and Beyond.** [http://hrsonline.isr.umich.edu/meta/tracker/desc/wghtdoc.pdf]. Last accessed September 22, 2003
21. Huber PJ: **The behavior of maximum likelihood estimates under non-standard conditions.** In *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability Berkeley CA: University of California Press*; 1967:221-233.
22. White H: **A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity.** *Econometrica* 1980, **48:**817-830.
23. Office of Technology Assessment: *Cost effectiveness of influenza vaccination Washington, DC: US Congress, Office of Technology Assessment*; 1981.
24. Singleton JA, Greby SM, Wooten KG *et al.*: **Influenza, pneumococcal, and tetanus toxoid vaccination of adults-United States, 1993–1997.** *MMWR CDC Surveill Summ* 2000, **49(9):**39-62.
25. Fiscella K, Franks P, Doescher MP *et al.*: **Disparities in health care by race, ethnicity, and language among the insured: findings from a national sample.** *Med Care* 2002, **40(1):**52-59.
26. Rosenstock IM, Strecher VJ, Becker MH: **Social learning theory and the health belief model.** *Health Educ Q* 1988, **15(2):**175-183.
27. Cornford CS, Morgan M: **Elderly people's beliefs about influenza vaccination.** *Br J Gen Pract* 1999, **49:**281-284.
28. Armstrong K, Berlin M, Schwartz JS *et al.*: **Barriers to influenza immunization in a low-income urban population.** *Am J Prev Med* 2001, **20(1):**21-25.
29. Heimberger T, Chang HG, Shaikh M *et al.*: **Knowledge and attitudes of healthcare workers about influenza: why are they not getting vaccinated?** *Infect Control Hosp Epidemiol* 1995, **16(7):**412-415.
30. CDC: **Notice to readers: Delayed supply of influenza vaccine and adjunct ACIP influenza vaccine recommendations for the 2000–2001 influenza season.** *MMWR* 2000, **49(27):**619-622.
31. Mac Donald R, Baken L, Nelson A *et al.*: **Validation of self-report of influenza and pneumococcal vaccination status in elderly outpatients.** *Am J Prev Med* 1999, **16(3):**173-177.
32. Nichol KL, Wuorenma J, von Sternberg T: **Benefits of influenza vaccination for low-, intermediate and high-risk senior citizens.** *Arch Intern Med* 1998, **158(16):**1769-1776.
33. Ohmit SE, Furumoto-Dawson A, Monto AS *et al.*: **Influenza vaccine use among an elderly population in a community intervention.** *Am J Prev Med* 1995, **11(4):**271-276.
34. Hutchison BG: **Effect of computer-generated nurse/ physician reminders on influenza immunization among seniors.** *Fam Med* 1989, **21(6):**433-437.
35. Baker AM, McCarthy B, Gurley VF *et al.*: **Influenza immunization in a managed care organization.** *J Gen Intern Med* 1998, **13:**469-475.
36. Nichol KL: **Ten-year durability and success of an organized program to increase influenza and pneumococcal vaccination rates among high-risk adults.** *Am J Med* 1998, **105:**385-392.

Pre-publication history

The pre-publication history for this paper can be accessed here:

http://www.biomedcentral.com/1471-2458/3/41/prepub