Racial/Ethnic Differences in Adult Vaccination Among Individuals With Diabetes

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Objectives. This study examined whether differences in access to health care, health coverage, and socioeconomic status (SES) explained racial differences in influenza and pneumococcal vaccination rates in individuals with diabetes.

Methods. We analyzed data on 1906 individuals from the 1998 National Health Interview Survey. We used multiple logistic regression to adjust for race/ethnicity, age, access to care, health insurance, and SES, and used SUDAAN for statistical analyses to yield national estimates.

Results. Whites had higher vaccination rates than did African Americans or Hispanics. After adjustment for covariates, race/ethnicity predicted receipt of both vaccines independent of age, access to care, health care coverage, and SES.

Conclusions. Racial disparity in vaccination rates for adults with diabetes is independent of access to care, health care coverage, and SES. (*Am J Public Health.* 2003;93:324–329)

Diabetes mellitus is a chronic debilitating illness that affects about 16 million people in the United States.[1] Diabetes is more prevalent in minority populations, and complication and death rates from diabetes are higher in African Americans and Hispanics than in Whites.[1] Individuals with diabetes are susceptible to influenza and pneumonia,[2,3] and they have higher death rates during episodes of influenza epidemics compared with people without diabetes.[4,5]

Influenza and pneumococcal vaccines are efficacious[6,7] and cost-effective,[8–10] and current guidelines recommend influenza and pneumococcal vaccination for people with diabetes.[11–13] Also, *Healthy People 2010* has set target vaccination rates for adults with diabetes at 65% for individuals younger than 65 years and 90% for those 65 years and older.[14] Regrettably, vaccination rates for people with diabetes are a long way from this objective, notably in African Americans and Hispanic.[15,16] Socioeconomic status (SES) and unequal access to health care[15] are thought to contribute to disparities in vaccination rates. Debate on this topic parallels the debate in the larger field of racial/ethnic disparity research about the contribution of differential access to care and SES to racial inequities in health outcomes in the United States.[17–19]

We examined data from the 1998 National Health Interview Survey to determine whether differences in access to care, health care coverage, and SES explained racial/ethnic differences in immunization rates. Our hypothesis was that differences in access to care, health care coverage, and SES would explain racial disparities in influenza and pneumococcal vaccination rates in adults with diabetes.

METHODS

We performed our analysis on data from 1906 individuals aged 18 years or older with diabetes, excluding women with a diagnosis of gestational diabetes. We used the National Health Interview Survey, which is a national household survey of nonmilitary and noninstitutionalized adults aged 18 years or older in the United States sponsored by the National Center for Health Statistics of the Centers for Disease Control and Prevention.[20] A complex sampling design that involved stratification, clustering, and multistage sampling was used to select a representative sample of US adults. The final survey response was 73.9%, and final survey weights were designed to allow generalization to nonmilitary and noninstitutionalized adults with diabetes. Details about the survey methodology are available on-line.[20,21]

Clinical Variables

A label of diabetes was based on self-report, and influenza vaccination was based on receipt of an influenza shot in the previous 12 months. A label of pneumococcal vaccination was based on ever having had a pneumococcal vaccination. Health status was based on a comparison of a person's present health with what it was the year before and classified as worse than last year or better/same as last year.

Adjustment for Comorbidity

We adjusted for 10 other conditions because we assumed that guideline recommendations[12,13] were likely to cause primary care providers to preferentially vaccinate individuals with these comorbid conditions. Selected conditions were cardiac conditions (coronary heart disease, angina, heart attack, other heart condition), chronic pulmonary condition (emphysema, chronic bronchitis), asthma, chronic renal failure, chronic liver disease, and cancer. We created 3 categories: people with diabetes, people with diabetes and 1 other condition, and people with diabetes and 2 or more other conditions.

Utilization Variable

Four commonly used measures of access to primary care are having a usual source of care, having a regular health care provider, probability of a visit to a physician, and level of emergency room use.[22] We used having a primary care visit in the past 12 months as a measure of access because having a visit to a physician is a predictor of immunization.[23] We created 3 health insurance categories: private, public, and uninsured.

Demographic Variables

We created 3 categories for age (65 years or older, 50 to 64 years, 18 to 49 years). There were 4 racial/ethnic categories (non-Hispanic White, non-Hispanic Black, Hispanic, Other), 3 categories for education (less than a high school education, high school graduate, more than a high school education), 2 categories for household income ($20,000 or more, less than $20,000), and 2 categories for marital status (married, not married). We defined employment as working for pay in the previous year, and we included the 4 census regions (Northeast, Midwest, South, West). In addition, we included a variable that indicated whether the respondent was born within or outside the 50 United States.

Statistical Analyses

We used SAS[24] for statistical analyses and SUDAAN[25] to generate population estimates and to account for the complex sampling design of the National Health Interview Survey. We compared demographic, clinical, and utilization variables in persons with diabetes by influenza and pneumococcal vaccination status. We then used multiple logistic regression to develop models for influenza and pneumococcal vaccination in people with diabetes by race/ethnicity, access to a primary care physician, and SES. In the base model (model 1), we entered age, gender, marital status, health care coverage, general health status, census region, place of birth (US-born or not), and number of comorbid conditions as independent variables and influenza and pneumococcal vaccination status as dependent variables. In subsequent models, we kept influenza and pneumococcal vaccination status as dependent variables, and we entered race/ethnicity (model 2), access to primary care (model 3), and SES—education, household income, and employment—(model 4) sequentially as independent variables to the base model.

Overall, we created 4 models: the base model, base model plus race/ethnicity, base model plus race/ethnicity and access to care, and base model plus race/ethnicity, access to care, and SES. All tests were 2-tailed with the significance level set at $\alpha < .05$.

RESULTS

Sample Characteristics

Of the 32 440 adults surveyed in 1998, 1906 persons (5.8%) had diabetes. Table 1 shows the baseline characteristics of individuals with diabetes in 1998.

TABLE 1—Sample Characteristics of People With Diabetes in 1998 (n = 1906)

	Percentage
Age, y	
≥65	40.8
50–64	34.7
18–49	24.4
Sex	
Men	46.8
Women	53.2
Race/ethnicity	
Non-Hispanic White	68.3
Non-Hispanic Black	16.1
Hispanic	12.0
Other	3.6
Income, $	
≥ 20 000	65.0
< 20 000	35.0
Education	
> High school	35.0
High school graduate	32.2
< High school	32.8
Employment status	
Employed	42.0
Not employed	58.0
Marital status	
Married	61.6
Not married	38.4
General health status	
Better/same	79.5
Worse	20.5
Health insurance	
Private insurance	64.7
Public insurance	26.3
Uninsured	9.0
Access to care	
Yes	85.4
No	14.6
No. of comorbid conditions	
≥ 2	19.8
1	36.1
0	44.1
Census region	
Northeast	19.3
Midwest	22.6
South	41.5
West	16.6
US-born	
Yes	88.3
No	11.7

Baseline Differences in Vaccination Rates

Table 2 shows baseline differences in receipt of influenza and pneumococcal vaccines. Of the adults with diabetes, 51% and 33% received influenza and pneumococcal vaccines, respectively. Influenza and pneumococcal vaccination rates were highest in Whites, individuals older than 65 years, those with a household income under $20,000, and those who were employed. US-born persons and persons with health care coverage, access to a primary care physician, or comorbid conditions also had higher influenza and pneumococcal vaccination rates. There were no significant differences by gender, education, marital status, general health status, or census region.

Multiple Logistic Regression Analyses

Table 3 shows the odds ratios for the 4 logistic regression models for influenza vaccination. In the base model (model 1), age, having health coverage, and having comorbid conditions were independent predictors of vaccination. With the addition of race/ethnicity (model 2), age, health coverage, comorbidity, and race/ethnicity were independent predictors of vaccination. With the addition of access to care (model 3), race/ethnicity remained an independent predictor. Finally, the addition of SES variables (model 4) indicated that age, health care coverage, and health status were independently associated with influenza vaccination along with race/ethnicity, access to care, education, and employment.

Similar results were obtained for pneumococcal vaccination (Table 4). In the base model, age, health coverage, birth in the United States, and comorbidity independently predicted pneumococcal vaccination. The addition of race/ethnicity, access to care, and SES showed a pattern similar to that for influenza vaccination. In the final model, age, birth in the United States, comorbidity, race/ethnicity, education, and employment were independent predictors of pneumococcal vaccination.

These results suggest that race/ethnicity is an important predictor of influenza and pneumococcal vaccination independent of access to care, health coverage, and SES.

TABLE 2—Baseline Characteristics of Persons With Diabetes by Vaccination Status in 1998

	Vaccinated (Influenza), %	P	Vaccinated, % (Pneumococcal)	P
Age, y				
≥ 65	65	<.0001[a]	50	<.0001[a]
50–64	47		24	
18–49	31		15	
Sex				
Men	49	.1032	30	.0929
Women	53		35	
Race/ethnicity				
Non-Hispanic White	55	<.005[b]	38	<.005[b]
Non-Hispanic Black	39		22	
Hispanic	42		17	
Other	50		36	
Income, $				
≥ 20 000	49	.0477	31	.0396
< 20 000	55		36	
Education				
> High school	50	.8591[c]	31	.5545[c]
High school graduate	52		34	
< High school	51		32	
Employment status				
Employed	59	<.0001	42	<.0001
Not employed	39		20	
Marital status				
Married	51	.7591	32	.8216
Not married	50		33	
General health status				
Better/same	52	.1523	33	.6541
Worse	47		32	
Health insurance				
Private insurance	53	<.0001	34	<.0001
Public insurance	54		36	
Uninsured	24		11	
Access to care				
Yes	54	<.0001	34	.0012
No	35		23	
No. of comorbid conditions				
≥ 2	59	<.0001[d]	48	<.0001[d]
1	56		36	
0	43		23	
Census region				
Northeast	49	.1432[e]	32	.3501[e]
Midwest	55		36	
South	47		29	
West	56		37	
US-born				
Yes	52	.0321	35	<.0001
No	43		18	

[a] $P < .0001$ for all comparisons.
[b] $P < .005$ for White vs Hispanic, White vs non-Hispanic Black comparisons. All other comparisons nonsignificant at $P < .05$ except Hispanic vs Other ($P = .03$ [pneumococcal vaccination]).
[c] All comparisons nonsignificant at $P < .05$.
[d] $P < .0001$ for ≥ 2 vs 0 and 1 vs 0 comorbidities; $P = .3195$ for ≥ 2 vs 1 (influenza) and $P = .003$ for ≥ 2 vs 1 (pneumonia).
[e] All comparisons not significant at $P < .05$ except West vs South and Midwest vs South comparisons.

DISCUSSION

This study documents the persistence of racial/ethnic disparities in influenza and pneumococcal vaccination rates in adults with diabetes despite adjustment for access to care, health care coverage, and SES.

Our results are similar to those of previous studies[15,16] with a few notable differences. First, we used 4 racial/ethnic categories instead of the 2 categories that were used in previous studies. This approach showed that the disparities in vaccination rates between Whites and non-Whites with diabetes were due largely to differences between Whites and Blacks. Second, we adjusted for access to care, health insurance coverage, and SES. Lack of adjustment for these variables has been identified as a flaw in previous studies on racial/ethnic disparities in health care.[17,26,27] Finally, we included the respondent's place of birth in our analysis because of data that suggest that beliefs, behavior, and physical functioning differ significantly between individuals born and raised in the United States and those born and raised outside this country.[28]

The results of this study have 3 major implications. First, the findings suggest that there are "missed opportunities" for vaccination of individuals with diabetes in primary care settings, particularly minority individuals. Only 54% of people with diabetes who had contact with a primary care physician received the influenza vaccine despite evidence that when a physician recommends vaccination, the likelihood of a patient's accepting it increases significantly.[23] Because primary care providers treat the majority of people with diabetes[29] and because pneumonia is one of the 10 leading causes of death in the United States,[30] there is a need to improve vaccination coverage in primary care settings. Several effective vaccination strategies that can be easily implemented in primary care settings have been documented.[12,13] Therefore, collective efforts at all levels need to be directed at ensuring vaccination of all individuals with diabetes at primary care encounters.

The second implication of this study is that race/ethnicity appears to be a proxy for a variable that is either currently unmeasured

TABLE 3—Logistic Regression Models of Influenza Vaccination by Race/Ethnicity, Access to Care, and Socioeconomic Status Among Persons With Diabetes in 1998

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Age, y				
≥65	3.5 (2.5, 4.7)***	3.4 (2.4, 4.7)***	3.3 (2.4, 4.6)***	2.8 (1.9, 3.9)***
50–64	1.8 (1.3, 2.5)**	1.8 (1.3, 2.5)***	1.7 (1.3, 2.4)**	1.7 (1.2, 2.3)**
18–39 (reference)				
Sex				
Men	0.9 (0.7, 1.2)	0.9 (0.7, 1.2)	0.9 (0.7, 1.2)	0.9 (0.7, 1.2)
Women (reference)				
Marital status				
Married	1.1 (0.9, 1.5)	1.1 (0.8, 1.4)	1.1 (0.8, 1.4)	1.1 (0.8, 1.5)
Not married (reference)				
Health insurance				
Private insurance	2.1 (1.3, 3.6)***	2.1 (1.3, 3.4)***	2.0 (1.2, 3.4)***	2.2 (1.3, 3.7)***
Public insurance	1.9 (1.1, 3.4)**	2.0 (1.2, 3.4)**	1.9 (1.1, 3.3)**	1.7 (1.1, 3.0)**
Uninsured (reference)				
General health status				
Worse	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)	0.7 (0.5, 1.0)	0.7 (0.5, 0.9)*
Better/same (reference)				
Census region				
West	1.3 (0.9, 2.0)	1.3 (0.9, 2.1)	1.3 (0.9, 2.1)	1.3 (0.9, 2.1)
South	1.0 (0.7, 1.5)	1.1 (0.8, 1.5)	1.1 (0.8, 1.6)	1.1 (0.8, 1.6)
Midwest	1.3 (0.9, 1.8)	1.2 (0.9, 1.9)	1.3 (0.9, 1.9)	1.3 (0.9, 1.9)
Northeast (reference)				
US-born				
Yes	1.4 (0.9, 2.0)	1.4 (0.9, 2.1)	1.3 (0.9, 2.1)	1.4 (0.9, 2.1)
No (reference)				
No. of comorbid conditions				
≥2	1.6 (1.1, 2.2)*	1.5 (1.1, 2.2)*	1.5 (1.1, 2.1)*	1.4 (1.0, 2.0)
1	1.4 (1.1, 1.8)*	1.4 (1.1, 1.8)*	1.4 (1.1, 1.8)*	1.3 (1.0, 1.7)
0 (reference)				
Base model + race/ethnicity (model 2)				
Race/ethnicity				
White vs non-Hispanic Black		1.6 (1.1, 2.3)**	1.7 (1.2, 2.4)**	1.7 (1.2, 2.4)**
White vs Hispanic		1.1 (0.8, 1.7)	1.1 (0.7, 1.6)	1.0 (0.7, 1.5)
White vs Other		1.1 (0.6, 2.0)	1.0 (0.5, 1.9)	1.0 (0.5, 2.0)
Non-Hispanic Black vs Hispanic		0.7 (0.4, 1.1)	0.6 (0.4, 1.0)	0.6 (0.4, 0.9)*
Non-Hispanic Black vs Other		0.7 (0.3, 1.4)	0.6 (0.3, 1.3)	0.6 (0.3, 1.3)
Hispanic vs Other		0.9 (0.5, 1.9)	0.9 (0.5, 1.9)	1.0 (0.5, 2.1)
Base model + race/ethnicity + access to care (model 3)				
Access to care				
Yes			2.1 (1.5, 2.9)***	2.2 (1.5, 3.0)***
No (reference)				
Base model + race/ethnicity + access to care + SES (model 4)				
Education				
>High school				1.5 (1.1, 2.2)**
High school graduate				1.2 (0.9, 1.7)
<High school (reference)				
Income, $				
≥20 000				0.7 (0.5, 1.0)
<20 000 (reference)				
Employment status				
Employed				1.6 (1.2, 2.3)**
Not employed (reference)				
Regression model statistics				
No.	1860[a]	1860[a]	1860[a]	1860[a]
(−2) Log likelihood (model)	2387.4	2373.7	2345.9	2325.5
Chi square	190.7	202.0	227.1	247.4

Note. SES = socioeconomic status; OR = odds ratio; CI = confidence interval.
[a]Sample size less than total of 1906 because of missing values.
*$P<.05$; **$P<.005$; ***$P<.0005$.

or unidentified, because the current thinking is that race/ethnicity is a social construct that has little or no biological significance.[31] Therefore, although we have shown that race/ethnicity is an independent predictor of influenza and pneumococcal vaccination in adults with diabetes, there is still a need to tease out what race/ethnicity truly represents. To accomplish this, there is continuing need to collect data on race/ethnicity, but more importantly, additional data are needed on social and cultural factors that may influence health outcomes across racial/ethnic groups.

The third implication is the need to devote research efforts toward identifying the true reasons for the observed racial/ethnic disparities in vaccination rates for people with diabetes. An editorial in *Morbidity and Mortality Weekly Report* suggested that unequal access to preventive care, social or cultural values that result in differential acceptance of vaccination by people with diabetes, and differential recommendation of vaccination by physicians were responsible for disparities in vaccination coverage.[15] This study has shown that disparities in vaccination rates in people with diabetes appear to be independent of access to care, health insurance coverage, and SES. This independence leaves the alternative explanation that cultural values that result in differential acceptance of vaccination by patients and differential recommendation of vaccination by physicians may be responsible.

The concept of culture as distinct from race/ethnicity has been proposed as a better explanation for differences in health behavior and health outcomes.[32] *Culture* in this context has been defined as "unique shared values, beliefs, and practices that are directly associated with a health-related behavior, indirectly associated with a behavior, or influence acceptance and adoption of the health education message."[33] Although the concept of culture seems plausible, more research is needed to provide support for this hypothesis. Future studies on the relationship between culture and health outcomes need to do more than merely demonstrate an association between cultural differences and health outcomes; they must provide a causal pathway for any such association. Of particular importance will be a better understanding of how differences in the cultural beliefs and values of health

TABLE 4—Logistic Regression Models of Pneumococcal Vaccination by Race/Ethnicity, Access to Care, and Socioeconomic Status in 1998 Among Persons With Diabetes

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Base model (model 1)				
Age, y				
≥65	4.3 (2.9, 6.4)***	4.2 (2.8, 6.3)***	4.2 (2.8, 6.2)***	3.3 (2.1, 5.2)***
50–64	1.6 (1.1, 2.3)*	1.6 (1.1, 2.3)*	1.5 (1.1, 2.3)*	1.5 (1.0, 2.2)
18–39 (reference)				
Gender				
Men	1.0 (0.8, 1.3)	1.0 (0.8, 1.3)	1.0 (0.8, 1.3)	1.0 (0.8, 1.3)
Women (reference)				
Marital status				
Married	1.1 (0.8, 1.4)	1.0 (0.8, 1.3)	1.0 (0.8, 1.3)	1.0 (0.8, 1.3)
Not married (reference)				
Health insurance				
Private insurance	2.0 (1.1, 3.8)*	1.8 (0.9, 3.5)	1.8 (0.9, 3.5)	1.9 (1.0, 3.8)
Public insurance	1.8 (0.9, 3.5)	1.8 (0.9, 3.5)	1.8 (0.9, 3.4)	1.6 (0.8, 3.1)
Uninsured (reference)				
General health status				
Worse	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)
Better/same (reference)				
Census region				
West	1.2 (0.7, 1.9)	1.2 (0.7, 1.9)	1.2 (0.7, 1.9)	1.2 (0.7, 1.9)
South	0.9 (0.6, 1.3)	0.9 (0.6, 1.4)	0.9 (0.6, 1.4)	1.0 (0.6, 1.4)
Midwest	1.0 (0.6, 1.5)	1.0 (0.7, 1.6)	1.0 (0.7, 1.6)	1.0 (0.7, 1.6)
Northeast (reference)				
US-born				
Yes	2.4 (1.5, 3.7)***	2.2 (1.3, 3.6)**	2.1 (1.3, 3.6)**	2.2 (1.3, 3.7)**
No (reference)				
No. of comorbid conditions				
≥2	2.5 (1.8, 3.7)***	2.4 (1.6, 3.4)***	2.4 (1.6, 3.4)***	2.2 (1.5, 3.2)***
1	1.5 (1.1, 2.0)*	1.4 (1.1, 1.9)*	1.4 (1.1, 1.9)*	1.4 (1.1, 1.8)*
0 (reference)				
Base model + race/ethnicity (model 2)				
Race/ethnicity				
White vs non-Hispanic Black		1.8 (1.2, 2.5)***	1.8 (1.2, 2.6)***	1.7 (1.2, 2.5)**
White vs Hispanic		1.6 (1.1, 2.5)*	1.6 (1.1, 2.4)*	1.5 (0.9, 2.3)
White vs Other		0.7 (0.3, 1.7)	0.7 (0.3, 1.7)	0.7 (0.3, 1.6)
Non-Hispanic Black vs Hispanic		0.9 (0.6, 1.5)	0.9 (0.5, 1.4)	0.9 (0.5, 1.4)
Non-Hispanic Black vs Other		0.4 (0.2, 1.0)	0.4 (0.2, 0.9)*	0.4 (0.2, 0.9)*
Hispanic vs Other		0.4 (0.2, 1.1)	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)
Base model + race/ethnicity + access to care (model 3)				
Access to care				
Yes			0.7 (0.5, 1.1)	0.7 (0.5, 1.1)
No (reference)				
Base model + race/ethnicity + access to care + SES (model 4)				
Education				
>High school				1.6 (1.1, 2.2)*
High school graduate				1.3 (0.9, 1.8)
<High school (reference)				
Income, $				
≥20 000				0.9 (0.6, 1.3)
<20 000 (reference)				
Employment status				
Employed				1.8 (1.3, 2.6)**
Not employed (reference)				
Regression model statistics				
No.	1809[a]	1809[a]	1809[a]	1809[a]
(−2) Log likelihood (model)	2009.2	1988.1	1980.9	1959.7
Chi square	273.4	294.5	298.0	320.9

Note. SES = socioeconomic status; OR (95% CI) = odds ratio with 95% confidence interval around estimates.
[a]Sample size less than total of 1906 because of missing values.
**P* < .05; ***P* < .005; ****P* < .0005.

care providers and patients influence recommendation of services by providers and acceptance of health services by patients.

There are limitations to observe in interpreting the results of this study. Recall of diabetes and vaccination status may be problematic; however, previous studies have established the reliability of diabetes and influenza vaccination information collected by self-report.[34,35] On the other hand, self-report of pneumococcal vaccination may be less reliable; therefore, conclusions about pneumococcal vaccination rates in people with diabetes should be interpreted with caution. Another limitation is the small sample size of individuals of "Other" race/ethnicity. Estimates of vaccination coverage in these individuals may be unstable and should be interpreted with caution. Finally, because our sample was limited to nonpregnant and noninstitutionalized civilian adults, generalization should not be made beyond this population. ■

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This article was accepted April 7, 2002.

Note. *The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Health Care Research and Quality or the Centers for Disease Control and Prevention.*

Contributors

Both authors planned the study, performed the statistical analyses, and wrote the article.

Acknowledgments

Leonard E. Egede was supported in part by grant 1K08HS11418 from the Agency for Health Care Research and Quality, Rockville, MD.

Leonard E. Egede and Deyi Zheng were supported in part by grant U50/CCU417281-02 from the Centers for Disease Control and Prevention, Atlanta, Ga.

We gratefully acknowledge John Colwell, MD, PhD, for reviewing the manuscript and for his helpful comments.

Human Participant Protection

The institutional review board of the Medical University of South Carolina approved this study.

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