Race, Ethnicity, Socioeconomic Position, and Quality of Care for Adults With Diabetes Enrolled in Managed Care

The Translating Research Into Action for Diabetes (TRIAD) study

ARLEEN F. BROWN, MD, PHD[1]
EDWARD W. GREGG, PHD[2]
MARK R. STEVENS, MSPH, MA[2]
ANDREW J. KARTER, PHD[3]
MORRIS WEINBERGER, PHD[4,5]
MONIKA M. SAFFORD, MD[6]
TIFFANY L. GARY, PHD[7]
DOROTHY A. CAPUTO, APRN, BC-ADM[8]
BETH WAITZFELDER, PHD[9]
CATHERINE KIM, MD, MPH[10]
GLORIA L. BECKLES, MD, MSC[2]

OBJECTIVE — To examine racial/ethnic and socioeconomic variation in diabetes care in managed-care settings.

RESEARCH DESIGN AND METHODS — We studied 7,456 adults enrolled in health plans participating in the Translating Research Into Action for Diabetes study, a six-center cohort study of diabetes in managed care. Cross-sectional analyses using hierarchical regression models assessed processes of care (HbA_{1c} [A1C], lipid, and proteinuria assessment; foot and dilated eye examinations; use or advice to use aspirin; and influenza vaccination) and intermediate health outcomes (A1C, LDL, and blood pressure control).

RESULTS — Most quality indicators and intermediate outcomes were comparable across race/ethnicity and socioeconomic position (SEP). Latinos and Asians/Pacific Islanders had similar or better processes and intermediate outcomes than whites with the exception of slightly higher A1C levels. Compared with whites, African Americans had lower rates of A1C and LDL measurement and influenza vaccination, higher rates of foot and dilated eye examinations, and the poorest blood pressure and lipid control. The main SEP difference was lower rates of dilated eye examinations among poorer and less educated individuals. In almost all instances, racial/ethnic minorities or low SEP participants with poor glycemic, blood pressure, and lipid control received similar or more appropriate intensification of therapy relative to whites or those with higher SEP.

CONCLUSIONS — In these managed-care settings, minority race/ethnicity was not consistently associated with worse processes or outcomes, and not all differences favored whites. The only notable SEP disparity was in rates of dilated eye examinations. Social disparities in health may be reduced in managed-care settings.

Diabetes Care 28:2864–2870, 2005

Population-based studies suggest that racial and ethnic minorities (1–6) and people of lower socioeconomic position (SEP) (2) experience worse long-term outcomes for diabetes than whites and people of higher SEP. However, it is unclear why these differences persist even among individuals with health insurance. Understanding the relationship of race/ethnicity and SEP to processes and outcomes of diabetes care in insured populations is critical to reducing health disparities.

Previous research found poorer processes of diabetes care (e.g., performance of dilated eye examinations and foot examinations at regular intervals) and intermediate health outcomes (e.g., control of glycemia, blood pressure, or lipid levels) among racial and ethnic minorities and individuals of lower income or education (2,3,7–14). As racial and ethnic minorities and poorer people with diabetes are less adequately insured than whites or wealthier people (15,16), differential access to care may contribute to these findings. Research from managed-care settings (17,18) and the Veterans Health Administration (19,20) suggests that racial and ethnic disparities in diabetes processes and outcomes may be reduced in settings offering more uniform access to care. These studies were conducted in single systems of care, however, and it is not known whether similar reductions in health disparities can be achieved in managed-care settings that are more clinically and geographically heterogeneous. Additionally, the studies of insured populations did not explicitly evaluate the impact of SEP, separate from race/ethnicity, and did not examine whether disparities in intermediate outcomes were

From the [1]Division of General Internal Medicine and Health Services Research, Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, California; the [2]Centers for Disease Control and Prevention, Atlanta, Georgia; the [3]Division of Research, Kaiser Permanente, Oakland, California; the [4]Department of Health Policy and Administration, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; the [5]Center for Health Services Research in Primary Care, Durham VAMC, Durham, North Carolina; the [6]Deep South Center on Effectiveness at Birmingham VA Medical Center and Department of Preventive Medicine University of Alabama at Birmingham, Birmingham, Alabama; [7]Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland; the [8]University of Medicine and Dentistry of New Jersey Continuing and Outreach Education, New Brunswick, New Jersey; the [9]Pacific Health Research Institute, Honolulu, Hawaii; and the [10]Departments of Medicine and Obstetrics-Gynecology, University of Michigan, Ann Arbor, Michigan.

Address correspondence and reprint requests to Arleen F. Brown, MD, PhD, Division of General Internal Medicine and Health Services Research, Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA 90095-1736. E-mail: abrown@mednet.ucla.edu.

Received for publication 19 May 2005 and accepted in revised form 1 September 2005.

Abbreviations: CHD, coronary heart disease; DBP, diastolic blood pressure; MCS-12, Mental Component Summary; PCS-12, Physical Component Summary; SBP, systolic blood pressure; SEP, socioeconomic position; TRIAD, Translating Research Into Action for Diabetes.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

attributable to differential intensity of management.

Translating Research into Action for Diabetes (TRIAD) is a multicenter study of quality of care for adults with diabetes enrolled in managed-care health plans. This large study of an insured population, in which access barriers should be reduced, allows us to examine racial/ethnic and socioeconomic variation in the quality of diabetes care provided in six managed-care markets and to determine whether effects of race/ethnicity vary by income or education and whether differences in intermediate outcomes were due to differences in management intensity.

RESEARCH DESIGN AND METHODS

The design of TRIAD, a longitudinal study of diabetes care in managed-care settings, has been published elsewhere (21). The 10 TRIAD health plans contract with 68 provider groups, serve ~180,000 individuals with diabetes, and are geographically and ethnically diverse, with patients in California, Hawaii, Indiana, Michigan, New Jersey, Pennsylvania, and Texas. The proportion of patients with diabetes in these plans ranged from 5 to 10%. Between July 2000 and August 2001, we surveyed a random sample of individuals with diabetes from these plans using a combination of computer-assisted telephone interviews and mailed surveys and reviewed their medical records. Individuals eligible to be included in the TRIAD study had diabetes, were ≥18 years old, were continuously enrolled in a participating health plan for ≥18 months with at least one claim for health care in that time, reported receiving the majority of their diabetes care through the health plan, and spoke English or Spanish. The TRIAD study excluded nursing home residents, pregnant women, and those who could not provide informed consent. Multiple reviewers abstracted the medical records from the participants' primary care providers for the 18 months before the interview date, with 5% of records reviewed in a "blind-double" fashion, i.e., they were not aware of which subjects were selected for double abstraction. Interrater reliability (κ) for the main quality measures derived from medical record data ranged from 0.86 to 0.94.

Only people in the TRIAD study for whom we had both survey and medical record data were eligible for these analyses. We also excluded individuals missing data on our primary predictors: race/ethnicity, education, or income. As in prior studies of socioeconomic position and health (22), because we wanted to ensure that most participants had completed their education, we excluded individuals <25 years of age ($n = 37$).

The TRIAD study protocol was reviewed and approved by the Centers for Disease Control and Prevention Institutional Review Board and the institutional review boards at all six translational research centers.

Variables

Race/ethnicity was identified using questions derived from the 2000 U.S. Census (www.census.gov). Based on self-identified race and ethnicity, participants were categorized as non-Hispanic white ("white"), African American or non-Hispanic black ("African American"), Latino or Hispanic ("Latino"), Asian/Pacific Islander ("Asians/Pacific Islanders"), and other race or multiracial ("other"). SEP was measured using self-reported education and income. The education categories were did not graduate from high school (<high school), high school graduate but no higher education (high school graduate), and education beyond high school (>high school). The categories of annual household income were <$15,000, $15,000 to <$39,999, $40,000 to <$74,999, and ≥$75,000.

We determined whether seven processes of care had been performed over the previous year: measurement of HbA_{1c} (A1C), a lipid profile (or triglyceride level >400), assessment of nephropathy, a dilated eye examination, a foot examination at most or all visits, advice to take aspirin or aspirin use, and receipt of influenza vaccination. Influenza vaccination was self-reported. Lipid profile, A1C measurement, and nephropathy screening were obtained from the medical record. Other process measures (dilated eye examination, foot examination, and aspirin advice or use) were obtained from either self-report or the medical chart.

As intermediate outcomes (23), we used the most recent result from the medical record for blood pressure (percentage with systolic blood pressure [SBP] ≥140 mmHg or diastolic blood pressure [DBP] ≥90 mmHg), A1C, and LDL, measures for which there is strong experimental and epidemiologic evidence that improvements can lead to better long-term health outcomes. To assess whether differences in intermediate outcomes were due to differences in intensity of treatment, we also evaluated whether there was racial/ethnic or SEP variations in medication management for subjects with suboptimal blood glucose, lipid, or blood pressure control. If A1C was ≥8%, we assessed use of either insulin or two or more oral antidiabetic agents; for those with LDL ≥130 mg/dl, we evaluated use of lipid-lowering agents; and among subjects who had SBP ≥140 or DBP ≥90 mmHg, we assessed use of two or more antihypertensive agents.

Covariates in multivariate models included age, sex, duration of diabetes, health status using the Physical Component Summary (PCS-12) and the Mental Component Summary (MCS-12) scores from the SF-12 (24), the Charlson comorbidity index (25), and the type of diabetes treatment (insulin only, insulin and oral medications, oral medications only, or no medications). To account for differences in the A1C assays used at different sites, models for A1C were adjusted for the upper limit of a normal value for the test. The model for intensity of management of A1C did not include type of diabetes treatment.

Statistical methods

Bivariate tests of association were used to compare processes of care and intermediate health outcomes among the racial/ethnic groups and by education and income. Hierarchical regression models were constructed to adjust for the clustering of patients within health plans. For continuous dependent variables, we present estimates of the least-squares means by race/ethnicity and levels of income and education adjusted for the other covariates. For dichotomous outcomes, because odds ratios are poor estimates of relative risk when outcomes are common, we report the adjusted estimated conditional probabilities for each category of race/ethnicity, income, and education. We evaluated separate models for each of the three main predictors and a full model that included all three predictors. Because there was little difference between these sets of models, we report the results of the full models. Models were also tested for interactions between race/ethnicity and either education or income. All analyses were performed using the SAS PROC MIXED procedure and the SAS GLIMMIX Macro (26).

Missing values for covariates other than the primary predictors of race/ethnicity, income, and education and the dependent variables were imputed using

Table 1—*Sociodemographic and clinical characteristics of TRIAD participants by race/ethnicity*

	Total	White	African American	Latino	Asian/Pacific Islander	Other	*P**
n	7,456	3,293	1,234	1,207	1,075	647	
Age (years)	60.4 ± 12.6	61.8 ± 12.5	59.4 ± 12.5	60.9 ± 12.7	57.6 ± 12.1	59.0 ± 12.7	<0.0001
Women (%)	53	49	65	53	47	53	<0.0001
Education (%)							
<High school	22	15	31	42	10	19	<0.0001
High school graduate	29	29	32	26	28	32	
>High school graduate	49	56	37	32	62	49	
Annual income (%)							
<$15,000	30	25	51	36	15	29	<0.0001
$15,000–39,999	31	31	26	37	32	30	
$40,000–74,999	24	26	16	20	31	27	
>$75,000	15	18	7	7	23	15	
Duration of diabetes (years)	12.2 ± 10.8	12.5 ± 11.0	12.7 ± 11.2	12.3 ± 10.6	10.9 ± 10.5	11.7 ± 10.4	0.0004
Comorbidity score	0.99 ± 0.92	1.05 ± 0.93	0.92 ± 0.96	0.91 ± 0.94	0.99 ± 0.85	0.97 ± 0.87	<0.0001
BMI (kg/m^2)	31.3 ± 7.3	31.6 ± 7.3	33.0 ± 7.8	30.9 ± 6.8	28.5 ± 6.2	31.7 ± 7.4	<0.0001
Smoker (%)	19	17	25	19	16	20	<0.0001
Diabetes medications (%)							
Insulin only	18	21	25	12	9	19	<0.0001
Insulin + oral	13	13	16	12	11	12	
Oral only	61	59	55	70	69	59	
None	8	7	5	7	11	10	
PCS-12	43.2 ± 7.1	43.0 ± 7.3	41.7 ± 7.2	43.4 ± 7.0	45.1 ± 6.1	43.1 ± 7.3	<0.0001
MCS-12	44.9 ± 6.5	44.7 ± 6.3	44.2 ± 6.8	45.2 ± 6.8	45.7 ± 5.9	44.9 ± 6.9	<0.0001

Data are means ± SD unless otherwise indicated. **P* values are for global tests of association across racial/ethnic groups.

single imputation methods generated by the transcan (27) function in S-PLUS (28). Each covariate was predicted as a function of other covariates in the model, including age, sex, duration of diabetes, PCS-12 and MCS-12 scores, type of diabetes treatment, and health plan. The proportion of missing data ranged from 0 (type of diabetes treatment) to 7.8% (PCS-12 and MCS-12 scores). Restricted cubic splines were used to model missing data for continuous variables, and imputed values were constrained to be in the same range as nonimputed values.

We recognize that there are a large number of comparisons included in these analyses, and although we present all single-inference associations for our main predictors (race/ethnicity, income, and education), we emphasize patterns of association in the data rather than individually significant results (29).

RESULTS

Sample description by race/ethnicity and SEP

Data were collected from 11,927 individuals (69% response rate), the original TRIAD sample. Among contacted eligible individuals, 91% responded to the survey. Of the 8,827 TRIAD respondents who had survey and medical record data, 7,456 (84%), our analytic sample, had complete information on race/ethnicity, income, and education and were ≥25 years old.

Income and educational attainment differed by race/ethnicity (Table 1), with the highest levels of education and income among whites and Asians/Pacific Islanders. African Americans had the highest proportion of women, the highest mean BMI, the highest smoking rates, and the lowest mean PCS-12 score, indicating the poorest physical well being (Table 1). Latinos and Asians/Pacific Islanders were more likely to be treated with oral medication for diabetes. Asians/Pacific Islanders, who were the youngest group, had the shortest duration of diabetes, the lowest BMI, the lowest rates of insulin use, the highest PCS-12 scores, and higher MCS-12 scores.

Adjusted results

Race/ethnicity and processes and intermediate outcomes of care. African Americans had lower rates of A1C measurement (77.7 vs. 82.4%, $P = 0.002$), lipid measurement (61 vs. 68%, $P = 0.0003$), and influenza vaccination (58.5 vs. 68.4%, $P < 0.0001$) than whites, but comparable or higher rates for the other processes (Table 2). Compared with whites, Latinos and Asians/Pacific Islanders had similar or higher rates for all process measures.

Mean A1C was higher among Latinos (8.1%, $P < 0.0001$), Asians/Pacific Islanders (8.1%, $P < 0.0001$), and African Americans (7.9%, $P = 0.0009$) than among whites (7.7%) (Table 3). Mean LDL was higher among African Americans than among whites (118 vs. 111 mg/dl, $P < 0.0001$), and African Americans were also more likely than whites to have inadequate blood pressure control, i.e., blood pressure >140/90 (55.5 vs. 44.1%, $P < 0.0001$). Conversely, Latinos were less likely than whites to have poor blood pressure control (38.1 vs. 44.1%, $P = 0.004$).

SEP and processes and intermediate outcomes of care. There were few differences in six of seven process indicators or two of three intermediate outcomes by SEP (Tables 2 and 3). One exception was performance of dilated eye examinations, more commonly reported by the wealthiest (84.6%) than by the poorest participants (74.5%) ($P < 0.0001$) and by individuals with more than a high school education

Table 2—*Processes of care*

	A1C measured	Lipid profile measured or triglycerides >400%	Nephropathy assessed	Dilated eye examination	Foot examination	Aspirin advice or use	Influenza vaccine
Race/ethnicity							
White (reference group)	82.4	68.0	75.5	75.7	83.4	53.5	68.4
African American	77.7 (0.002)	61.0 (<0.0001)	79.7 (0.02)	79.1 (0.03)	88.6 (0.0001)	52.0 (0.43)	58.5 (<0.0001)
Latino	86.3 (0.01)	67.3 (0.72)	77.3 (0.31)	82.7 (<0.0001)	86.4 (0.02)	53.4 (0.98)	67.0 (0.43)
Asian/Pacific Islander	84.7 (0.23)	71.8 (0.09)	76.9 (0.55)	80.6 (0.01)	86.7 (0.03)	52.6 (0.72)	70.5 (0.33)
Other	81.1 (0.49)	65.4 (0.25)	69.6 (0.009)	77.3 (0.41)	83.7 (0.83)	52.6 (0.70)	65.4 (0.17)
Education							
>High school graduate (reference group)	82.2	66.5	76.2	79.8	85.2	53.1	67.7
High school graduate	82.4 (0.82)	67.4 (0.50)	75.3 (0.46)	78.6 (0.30)	84.5 (0.49)	53.4 (0.85)	65.2 (0.08)
<High school graduate	82.1 (0.97)	66.8 (0.87)	77.3 (0.51)	74.7 (0.0006)	85.9 (0.55)	52.4 (0.72)	65.8 (0.27)
Annual income							
>$75,000 (reference group)	84.0	66.9	78.5	84.6	84.1	54.8	68.6
$40,000–75,000	84.2 (0.94)	68.8 (0.34)	76.0 (0.15)	80.5 (0.005)	86.3 (0.09)	55.5 (0.72)	66.9 (0.36)
$15,000–40,000	81.9 (0.18)	67.2 (0.89)	76.4 (0.23)	77.4 (<0.0001)	84.9 (0.59)	51.8 (0.16)	66.8 (0.34)
<$15,000	80.0 (0.04)	65.0 (0.40)	74.7 (0.07)	74.5 (<0.0001)	84.9 (0.65)	51.5 (0.19)	64.8 (0.10)

Data are percentages (*P* values) adjusted for age, sex, duration of diabetes, health status, chronic condition score, and type of diabetes treatment.

(79.8%) than those who had not completed high school (74.7%) ($P = 0.0006$). Poorer individuals also had slightly higher A1C (8.1%) than those with higher income (7.8%) ($P = 0.006$), but there were no differences in glycemic control by education.

Medication management among subjects with inadequate control. In analyses to evaluate the intensity of medication management among subjects with suboptimal control of blood glucose, blood pressure, or LDL, for which most differences were observed, management was more aggressive for poorer, less educated, or minority patients (Table 3). Among those with A1C ≥8%, Asians/Pacific Islanders were less likely to be receiving insulin or two or more antidiabetic agents. Among patients with SBP ≥140, African Americans were the most likely to be receiving two or more antihypertensive agents. For those with LDL ≥130 mg/dl, Asians/Pacific Islanders and subjects with lower income and less education had higher rates of use of lipid-lowering agents.

Interactions between race/ethnicity and SEP

To evaluate whether racial or ethnic differences varied across the range of income or education levels, we examined interactions between race/ethnicity and income and race/ethnicity and education in separate models. We found only one interaction: African Americans had the lowest rates of influenza vaccination at all levels of education, but the disparity decreased slightly at higher levels of education.

CONCLUSIONS

The principal finding of this study is that in this large, diverse cohort of insured patients, there were few racial/ethnic or socioeconomic disparities in diabetes care. Because these subjects benefited from a more uniform access to and quality of care than is typically observed in population-based studies, we avoided much of the confounding of race/ethnicity and SEP with access that complicates and limits the interpretation of population-based studies of quality of care. Additionally, because managed care plays such an important role in health care nationwide, this perspective provides a necessary and important complement to population-based studies. Moreover, this study includes large numbers of Latinos and Asians/Pacific Islanders who have high rates of enrollment in managed care (30) but have been infrequently studied.

The comparable rates of most process indicators across racial/ethnic and socioeconomic categories may be explained in part by characteristics of the health plans. For example, the plans studied all had disease management programs, which may have reduced financial, cultural, and language barriers. Of particular note, the higher rates of dilated eye examinations and foot examinations among African Americans, Latinos, and Asians/Pacific Islanders than among whites (20) may be explained by patient attitudes, provider expectation of higher rates of eye disease and foot disease (31–33) among Latinos and African Americans, and more aggressive evaluation and treatment by the health plans to prevent vision loss and limb loss in these groups.

Although the fact that there were relatively few process or outcome disparities by race/ethnicity and SEP is encouraging, it is useful to examine the possible causes and consequences of the disparities we did find. As in population-based settings (34), African Americans in our study had lower rates of influenza vaccination, which may have important clinical implications (35). In contrast, in the Veterans Health Administration, comparable rates of influenza vaccination among African Americans and whites were achieved through the use of disease management strategies such as patient reminders and

Table 3—*Intermediate outcomes of care and intensity of medication management if inadequate control

	A1C level	For A1C ≥8%, use of insulin or ≥2 oral antidiabetic agents	LDL level (mean mg/dl)	For LDL ≥130 mg/dl, use of lipid-lowering agents	Blood pressure ≥140/90 mmHg	For SBP ≥140 md/dl, use of ≥2 anti-hypertensive agents
Race/ethnicity						
White (reference group)	7.7	77.3	111	51.4	44.1	53.7
African American	7.9 (0.0009)	74.9 (0.37)	118 (<0.0001)	47.1 (0.38)	55.5 (<0.0001)	70.7 (<0.0001)
Latino	8.1 (<0.0001)	77.0 (0.92)	111 (0.89)	57.6 (0.19)	38.1 (0.004)	50.3 (0.30)
Asian/Pacific Islander	8.1 (<0.0001)	69.2 (0.01)	113 (0.28)	61.1 (0.05)	41.3 (0.23)	52.1 (0.67)
Other	8.1 (<0.0001)	76.2 (0.73)	116 (0.007)	46.1 (0.34)	45.7 (0.51)	49.7 (0.29)
Education						
> high school graduate (reference group)	8.0	73.1	114	50.5	43.9	55.6
High school graduate	8.0 (0.12)	76.9 (0.07)	114 (0.55)	52.2 (0.61)	46.2 (0.13)	55.7 (0.98)
< high school	7.9 (0.65)	77.3 (0.11)	113 (0.86)	61.4 (0.02)	44.7 (0.66)	55.4 (0.94)
Annual income						
>$75,000 (reference group)	7.8	78.2	114	47.8	42.8	57.3
$40,000–75,000	7.9 (0.13)	77.1 (0.68)	112 (0.22)	50.8 (0.51)	43.9 (0.62)	53.7 (0.29)
$15,000–40,000	8.1 (0.0006)	73.8 (0.13)	114 (0.91)	56.9 (0.06)	47.7 (0.02)	56.5 (0.81)
<$15,000	8.1 (0.006)	73.3 (0.15)	114 (0.98)	53.3 (0.32)	43.4 (0.81)	55.2 (0.60)

*Data are predicted means and percentages (*P* values) adjusted for age, sex, diabetes duration, health status, chronic condition score, and type of diabetes treatment. Models for A1C level also adjusted for the upper limit of normal for the A1C assay. The model of intensity of A1C management was not adjusted for type of diabetes treatment.

no requirement for a physician visit for vaccinations (36,37), suggesting that adoption of such targeted approaches in the TRIAD health plans could reduce this disparity.

The gradient between rates of dilated eye examinations and both income and education was the main socioeconomic disparity observed. This finding may be explained by the additional requirement of a specialist visit for this service and related barriers, such as copayments. We have shown previously that out-of-pocket costs act as a barrier to eye examination in the TRIAD population (38).

Among the possible causes of the disparities observed in glycemic, lipid, and blood pressure control are racial/ethnic differences in self-care behavior such as nutritional habits or physical activity (39); differential adherence to medication use; biologic variation in blood pressure, A1C, and lipid levels; or psychosocial factors, such as differing levels of trust in providers or the health care system. Although we were unable to examine these specific mechanisms in this analysis, they represent important areas for future research. We were able, however, to indirectly assess the possibility that racial/ethnic minority or lower SEP patients were differentially enrolled in poorer quality plans by analyzing intensity of medication management. We found comparable or higher treatment intensity for African Americans, Asians/Pacific Islanders, and poorer or less educated individuals. Nonetheless, some groups, e.g., African Americans with inadequate blood pressure control, may have needed even more intensive medication management to attain comparable control.

To better understand the clinical implications of these disparities in intermediate outcomes, we used the U.K. Prospective Diabetes Study risk engine (40) to project how the observed differences in A1C and SBP levels would affect the risk of new coronary heart disease (CHD) events over a 10-year period. The 10-year risk of CHD associated with the mean A1C levels observed in our study (7.7% in whites and 8.1% in Asians/Pacific Islanders and Latinos) would rise from 6.6% in whites to ~7.1% in Asians/Pacific Islanders and Latinos, holding constant other clinical and demographic factors for each racial/ethnic group. Similarly, over a 10-year period, the higher mean SBP observed in African Americans (140 mmHg) compared with that in whites (135 mmHg) in our study would increase CHD risk from 7.0 to 7.2%. Thus, the clinical impact of the differences we found may be small, even over a prolonged period. This conclusion should be interpreted cautiously, however, as the effects on a population basis may be much more substantial, and we have not modeled simultaneous changes in the different risk factors.

Some potential limitations to this study should be considered. First, the analyses were cross-sectional. Even so, our requirement that all participants be enrolled in their health plan for at least 18 months should have provided ample follow-up to observe typical care for the indicators studied. Second, we relied exclusively on self-reports for rates of influenza vaccination. If there was differential reporting of these behaviors by SEP or race/ethnicity, the observed rates might be biased. Third, the rates of the process indicators in this study are higher than those in other recent studies (11,41–45). This may be the result of more complete ascertainment due to the use of multiple data sources, temporal trends, or quality initiatives and health plan quality reporting requirements in these managed-care settings. Generalizability to the uninsured or to other settings, such as specialty clin-

ics, may be limited. However, conducting the study in several different health plans and provider groups enhanced our ability to focus the investigation on the largely unexplored relationships of race/ethnicity and SEP among insured individuals. Further, the use of detailed sociodemographic and clinical data also enhance the generalizability of the findings to insured individuals with diabetes in the U.S. Finally, social disparities in health care are experienced over the course of a lifetime, and we only captured the impact of more uniform care for the most recent period. Life course assessments may result in different conclusions.

Our findings may be the result of fewer financial and nonfinancial barriers and the presence of incentives within managed-care organizations to provide care consistent with recommended standards. Further research is needed to identify the specific characteristics of managed-care organizations that may equalize care and to implement clinical strategies that reduce disparities.

Acknowledgments— This study was funded by the Centers for Disease Control and Prevention, Division of Diabetes Translation (Program 04005) and the National Institute of Diabetes and Digestive and Kidney Diseases. A.F.B. was supported by the Robert Wood Johnson Foundation's Minority Medical Faculty Development Program (grant 037214) and the UCLA Center for Health Improvement of Minority Elders/Resource Centers for Minority Aging Research, National Institutes of Health, National Institute of Aging (AG-02-004).

We acknowledge the TRIAD participants, investigators, and staff who made this study possible.

References

1. Lavery LA, van Houtum WH, Armstrong DG, Harkless LB, Ashry HR, Walker SC: Mortality following lower extremity amputation in minorities with diabetes mellitus. *Diabetes Res Clin Pract* 37:41–47, 1997
2. Chin MH, Zhang JX, Merrell K: Diabetes in the African-American Medicare population: morbidity, quality of care, and resource utilization. *Diabetes Care* 29: 1090–1095, 1998
3. Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS: Racial and ethnic differences in glycemic control of adults with type 2 diabetes. *Diabetes Care* 22:403–408, 1999
4. Howard G, Anderson RT, Russell G, Howard VJ, Burke GL: Race, socioeconomic status, and cause-specific mortality. *Ann Epidemiol* 10:214–223, 2000
5. Wong MD, Shapiro MF, Boscardin WJ, Ettner SL: Contribution of major diseases to disparities in mortality. *N Engl J Med* 347:1585–1592, 2002
6. Davis SK, Liu Y, Gibbons GH: Disparities in trends of hospitalization for potentially preventable chronic conditions among African Americans during the 1990s: implications and benchmarks. *Am J Public Health* 93:447–455, 2003
7. Gary TL, McGuire M, McCauley J, Brancati FL: Racial comparisons of health care and glycemic control for African American and white diabetic adults in an urban managed care organization. *Dis Manag* 27:25–34, 2004
8. de Rekeneire N, Rooks RN, Simonsick EM, Shorr RI, Kuller LH, Schwartz AV, Harris TB: Racial differences in glycemic control in a well-functioning older diabetic population. *Diabetes Care* 26:1986–1992, 2003
9. Schneider EC, Zaslavsky AM, Epstein AM: Racial disparities in the quality of care for enrollees in Medicare managed care. *JAMA* 287:1288–1294, 2002
10. Schectman JM, Bovbjerg VE, Voss JD: Predictors of medication-refill adherence in an indigent rural population. *Med Care* 40:1294–1300, 2002
11. Saaddine JB, Engelgau MM, Beckles GL, Gregg EW, Thompson TJ, Narayan KM: A diabetes report card for the United States: quality of care in the 1990s. *Ann Intern Med* 136:565–574, 2002
12. Bonds DE, Zaccaro DJ, Karter AJ, Selby JV, Saad M, Goff D Jr: Ethnic and racial differences in diabetes care: the Insulin Resistance Atherosclerosis Study. *Diabetes Care* 26:1040–1046, 2003
13. Bell RA, Camacho F, Goonan K, Duren-Winfield V, Anderson RT, Konen JC, Goff DC Jr: Quality of diabetes care among low-income patients in North Carolina. *Am J Prev Med* 21:124–131, 2001
14. Harris MI: Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes. *Diabetes Care* 24:454–459, 2001
15. Gary TL, Venkat Narayan KM, Gregg EW, Beckles GLA, Saaddine JB: Racial/ethnic differences in the health care experience (coverage, utilization, and satisfaction) of U.S. adults with diabetes. *Ethn Dis* 13:47–54, 2003
16. Harris MI: Racial and ethnic differences in health insurance coverage for adults with diabetes. *Diabetes Care* 22:1679–1682, 1999
17. Martin TL, Selby JV, Zhang D: Physician and patient prevention practices in NIDDM in a large urban managed-care organization. *Diabetes Care* 18:1124–1132, 1995
18. Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV: Ethnic disparities in diabetic complications in an insured population. *JAMA* 287:2519–2527, 2002
19. Young BA, Maynard C, Boyko EJ: Racial differences in diabetic nephropathy, cardiovascular disease, and mortality in a national population of veterans. *Diabetes Care* 26:2392–2399, 2003
20. Heisler M, Smith DM, Hayward RA, Krein SL, Kerr EA: Racial disparities in diabetes care processes, outcomes, and treatment intensity. *Med Care* 41:1221–1232, 2003
21. The TRIAD Study Group: The Translating Research Into Action for Diabetes (TRIAD) study: a multicenter study of diabetes in managed care. *Diabetes Care* 25: 386–389, 2002
22. Berkman LF, Macintyre S: The measurement of social class in health studies: old measures and new formulations. *IARC Sci Publ* 138:51–64, 1997
23. Kerr EA, Krein SL, Vijan S, Hofer TP, Hayward RA: Avoiding pitfalls in chronic disease quality measurement: a case for the next generation of technical quality measures. *Am J Manag Care* 7:1033–1043, 2001
24. Ware JE, Kosinski M, Keller SD: *How to Score the SF-12 Physical and Mental Health Summary Scale*. Boston, MA, The Health Institute, New England Medical Center, 1995
25. Charlson ME, Pompei P, Ales KL, MacKenzie CR: A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 40:373–383, 1987
26. SAS Institute: *SAS Release 8.02*. Cary, NC, SAS Institute, 2001
27. Harrell F: *Regression Modeling Strategies With Application to Linear Models, Logistic Regression, and Survival Analysis*. New York, Springer-Verlag, 2001
28. *S-plus 6.1*. Seattle, WA, Insightful, 2002
29. Rothman KJ, Greenland S: *Modern Epidemiology*. 2nd ed. Philadelphia, Lippincott Williams & Wilkins, 1998, p. 225–229
30. Collins KS, Hall A, Neuhaus C: *U.S. Minority Health: A Chartbook*. New York, The Commonwealth Fund, 1999
31. Appiah AP, Ganthier R Jr, Watkins N. Delayed diagnosis of diabetic retinopathy in black and Hispanic patients with diabetes mellitus. *Ann Ophthalmol* 23:156–158, 1991
32. Rabb MF, Gagliano DA, Sweeney HE: Diabetic retinopathy in blacks. *Diabetes Care* 13:1202–1206, 1990
33. West SK, Klein R, Rodriguez J, Munoz B, Broman AT, Sanchez R, Snyder R: Diabetes and diabetic retinopathy in a Mexican-American population: Proyecto VER. *Diabetes Care* 24:1204–1209, 2001
34. Egede LE, Zheng D: Racial/ethnic differences in adult vaccination among individuals with diabetes. *Am J Public Health* 93: 324–329, 2003
35. Valdez R, Narayan KM, Geiss LS, Engelgau MM: Impact of diabetes mellitus on

mortality associated wit pneumonia and influenza among non-Hispanic black and white US adults. *Am J Public Health* 89: 1715–1721, 1999
36. Zimmerman RK, Santibanez TA, Janosky JE, Fine MJ, Raymund M, Wilson SA, Bardella IJ, Medsger AR, Nowalk MP: What affects influenza vaccination rates among older patients? An analysis from inner-city, suburban, rural, and Veterans Affairs practices. *Am J Med* 114:31–38, 2003
37. Nicole KL: Long-term success with the national health objective for influenza vaccination: an institution-wide model. *J Gen Intern Med* 7:595–600, 1992
38. Karter AJ, Stevens MR, Herman WH, Ettner S, Safford MM, Engelgau MM, Curb D, Brown AF, the TRIAD Study Group: Out-of-pocket costs and diabetes preventive services: the Translating Research into Action for Diabetes (TRIAD) study. *Diabetes Care* 26:2294–2299, 2003
39. Karter AJ, Ferrara A, Darbinian JA, Ackerson LM, Selby JV: Self-monitoring of blood glucose: language and financial barriers in a managed care population with diabetes. *Diabetes Care* 23:477–483, 2000
40. Stevens RJ, Kothari V, Adler AI, Stratton IM, United Kingdom Prospective Diabetes Study (UKPDS) Group: The UKPDS risk engine: a model for the risk for coronary heart disease in type II diabetes (UKPDS 56). *Clin Sci* (*Lond*) 101:671–679, 2001
41. Blaum CS, Velez L, Hiss RG, Halter JB: Characteristics related to poor glycemic control in NIDDM patients in community practice. *Diabetes Care* 20:7–11, 1997
42. Gaillard TR, Schuster DP, Bossetti BM, Green PA, Osei K: The impact of socioeconomic status on cardiovascular risk factors in African-Americans at high risk for type II diabetes: implications for syndrome X. *Diabetes Care* 20:745–752, 1997
43. Haffner SM, Hazuda HP, Stern MP, Patterson JK, Van Heuven WA, Fong D: Effects of socioeconomic status on hyperglycemia and retinopathy levels in Mexican Americans with NIDDM. *Diabetes Care* 12:128–134, 1989
44. Gregg EW, Geiss LS, Saaddine J, Fagot-Campagna A, Beckles G, Parker C, et al: Use of diabetes preventive care and complications risk in two African-American communities. *Am J Prev Med* 21:197–202, 2001
45. Jencks SF, Huff ED, Cuerdon T: Change in the quality of care delivered to Medicare beneficiaries, 1998–1999 to 2000–2001. *JAMA* 289:305–312, 2003