RACIAL DISPARITIES IN TRENDS FOR CARDIOVASCULAR DISEASE AND PROCEDURES AMONG HOSPITALIZED DIABETIC PATIENTS

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Methods: To determine if racial differences exist for trends in diabetes-related cardiovascular disease (CVD) hospitalization rates, we analyzed data from an inpatient hospital discharge database maintained by the South Carolina Office of Research and Statistics. All hospitalizations involving a diagnosis of diabetes were collected from 1996 through 2003. International Classification of Diseases codes were used to determine diagnosis for diabetes, acute myocardial infraction (AMI), stroke, and other CVD outcomes. Multiple linear regression was performed to model the age-standardized rates during the study period. An interaction parameter for race and discharge year was used in the models to determine if the trend slopes varied between African Americans and Caucasians.

Results: The diabetes-related hospitalization rates for AMI and stroke declined for both race groups. Although the stroke rates for African Americans were consistently higher than those for Caucasians, the African American trend declined more sharply ($P=.027$). AMI rates showed sharper declines among Caucasians ($P<.001$). Rates of CVD procedures (percutaneous transluminal coronary angioplasty and coronary artery bypass graft) were two to three times greater among Caucasians. Cardiomyopathy rates were significantly greater among African Americans and showed a larger increasing trend ($P<.001$), and findings for congestive heart failure trends were similar ($P<.001$).

Conclusions: Diabetes-related CVD rates and trends vary considerably by race. Rates of AMI and stroke declined in African Americans and Caucasians from 1996 through 2003, while other CVD rates increased. Further research is needed to understand the underlying components of these disparities. (*Ethn Dis*. 2008;18:131–135)

Key Words: Racial Disparities, Diabetic Complications, Cardiovascular Disease, Hospitalizations

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INTRODUCTION

Diabetes mellitus represents an increasing public health and clinical challenge in the United States. While all segments of the population are affected by diabetes, the racial, cultural, and geographic disparities are significant and changing at different rates. For example, the prevalence estimates of diabetes for 1996 and 2003 show a 60% increase for the United States (4.5% to 7.2%) as compared to a 72% increase for the state of South Carolina (5.4% to 9.3%).[1] The increased prevalence of diabetes is representative of all regions, socioeconomic levels, age groups, and racial groups in the United States.[2,3] Additionally, the prevalence and incidence of diabetes remains greater among African Americans than among Caucasians.[4–6] Furthermore, persons with diabetes are at considerably increased risk of cardiovascular disease (CVD) compared with nondiabetic persons.[7–9] In addition, mortality rates are increased in diabetic populations, and despite overall decreasing heart disease mortality rates, the decline is less rapid for diabetic individuals.[10,11] Although the diabetes population continues to increase, recent data suggest that acute myocardial infarction (AMI) and stroke rates are beginning a downward trend in both diabetic and nondiabetic populations.[12,13]

While evidence exists that CVD rates are beginning to trend downward among persons with diabetes, whether this effect is as strong in the African American population as in the Caucasian population is unclear. To determine if differences exist between the two race groups, we have conducted a study of South Carolina inpatient hospitalization data. The purpose of this report is to describe the rates of AMI, stroke, and other CVD outcomes among hospitalized African American and Caucasian diabetes patients and to identify racial disparities in these trends.

METHODS

Data Organization

The South Carolina Inpatient Hospitalization Database includes detailed patient-level information on hospital discharges from all South Carolina

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hospitals. The database includes 10 International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes and 10 ICD-9-CM procedure codes and was assessed for African American and Caucasian patients with a diagnosis of diabetes (250.xx) from 1996 through 2003. Outcomes included AMI (410.xx), stroke (431, 434, 436), congestive heart failure (CHF) (428.0), and cardiomyopathy (425.x), as well as procedures: percutaneous transluminal coronary angioplasty (PTCA) (36.0x) and coronary artery bypass graft (CABG) (36.1x). Patient identifiers were not provided in the database; therefore, multiple hospitalizations for the same individual were counted as separate occurrences. Additionally, since 10 diagnoses and 10 procedure codes were available per hospitalization, multiple CVD events could occur within one hospitalization.

Statistical Analysis

The percentage of CVD hospitalizations per study year was determined from the number of hospitalizations for diabetes with the CVD event for which the denominator was the total number of hospitalized diabetic patients for each year. All rates are reported as per 1000 diabetes-related hospitalizations. Furthermore, all hospital rates were age-standardized by race by using the direct standardization method, with the standardized population being the South Carolina diabetic hospitalized population.[14] Multiple linear regression was performed to model the trend of the disease rates with covariates being discharge year, race, and an interaction term between discharge year and race. Significance of the interaction term at a two-sided α level of .05 signified that the trend slopes varied by race group. Race-specific models were run to obtain trend slope parameter estimates separately for African Americans and Caucasians. Also, all models were adjusted for differences in urban status, length of stay, and insurance type. Additional univariate comparisons were performed by using *t* tests for continuous variables and χ^2 tests for categorical variables in which significance between race groups was defined by using a two-sided α level of .05. All statistical analyses were conducted with SAS software version 9.1 (SAS Institute, Inc., Cary, NC).

Table 1. Characteristics of hospitalized diabetes patients in South Carolina, 1996–2003

Characteristic	African American (*n*=240,979)	Caucasian (*n*=368,825)	*P* value
Male (%)	34.7	46.3	<.0001
Age ≥65 years (%)	43.6	56.7	<.0001
Urban status (%)	68.1	76.6	<.0001
Average length of stay (days)	6.4	5.8	<.0001
Commercial insurance (%)	15.7	19.6	<.0001
Medicare (%)	59.9	66.5	<.0001
Medicaid (%)	14.0	5.6	<.0001

RESULTS

During the study period (1996–2003), >600,000 hospitalizations in South Carolina involved diabetes. Forty percent of all diabetes-related hospitalizations were African Americans. Hospitalized African Americans were less likely to be male, were younger, and less frequently lived in urban areas than were Caucasians (Table 1). Additionally, African Americans had a longer average length of hospital stay, were less likely to be covered by Medicare, and were more likely to be covered by Medicaid than were Caucasians.

The trends in diabetes-related CVD hospitalization rates varied considerably (Figure 1). Rates of AMI were consistently higher among Caucasians than among African Americans, and these trends decreased for both groups. The rates of stroke were higher among African Americans, and both groups showed a sharp decline in trend. These findings were confirmed by the results of regression models (Table 2). The corresponding slope parameters translated into a decline in diabetes-related AMI rates for Caucasians compared with African Americans. The same patterns in the racial variations of AMI trends were observed in both men and women. The stroke rates showed a larger decreasing trend in African Americans than in Caucasians. However, when performing the sex-specific models for stroke, the interaction parameter among men failed to reach statistical significance, signifying that the improved trends in stroke rates among African Americans compared with Caucasians is representative of African American women.

The rates of CVD treatment procedures were considerably greater among Caucasians than among African Americans. The 2003 age-standardized rates of PTCA and CABG were two and three times greater among Caucasians than among African Americans (Table 2). PTCA trends increased for all race-sex groups. Caucasian men demonstrated a more significant upward trend than did African American men, and no racial variation in trends was detected for women. However, rates of CABG trends showed a slightly significant decrease without significant racial variation.

In contrast to the decline in CVD outcomes of AMI and stroke, the cardiomyopathy hospitalization rates for persons with diabetes showed increasing trends among African American men and women, while Caucasian rates remained consistent. Trends in CHF rates increased for both African Americans and Caucasians, with a

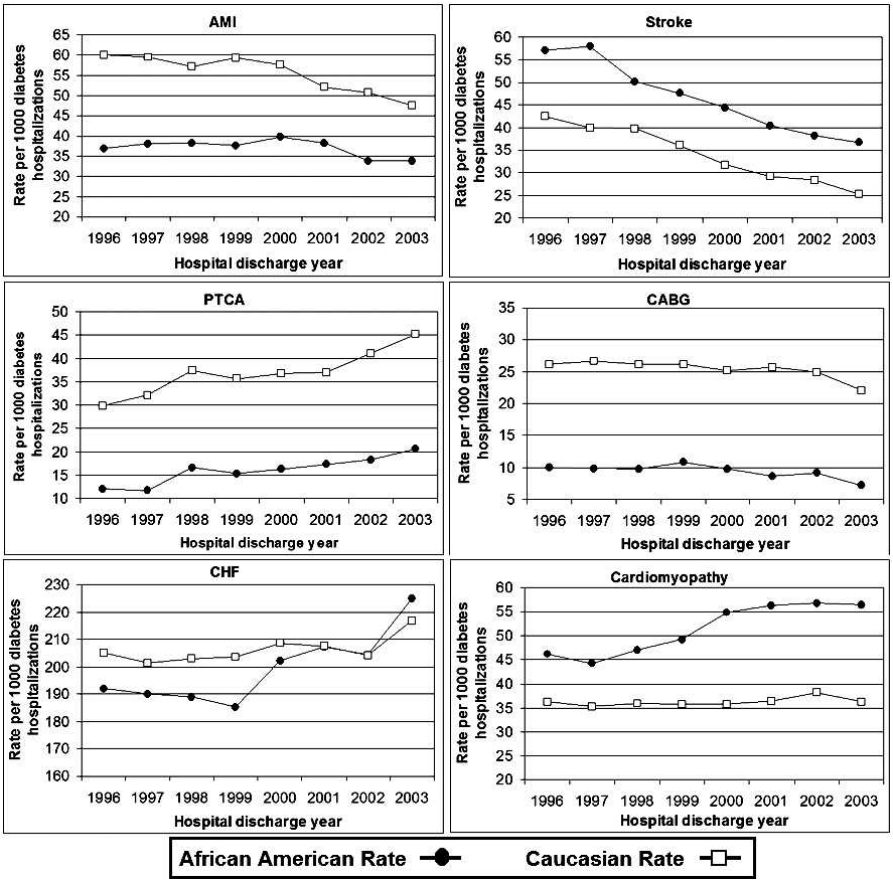

Fig 1. Trends of age-standardized hospital rates among hospitalized diabetic patients. Black circles = African American rates; White squares = Caucasian rates. AMI = acute myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty; CABG = coronary artery bypass graft; CHF = congestive heart failure

sharper rise in African American rates, regardless of sex.

Finally, after adjusting for statistically significant racial variations for differences in urban status, length of hospital stay, and insurance type, all trend slope parameters and interaction parameters were consistent with those presented (data not shown).

DISCUSSION

Our results demonstrate considerable racial variations in the trends of diabetes-related CVD hospitalization rates. As demonstrated with a recent study of diabetic persons in Canada,[12] we observed in our population a significant decline in rates of AMI and stroke for both African Americans and Caucasians. Our analysis also determined racial variations in the declines that showed sharper declines of AMI rates among Caucasians and sharper declines of stroke rates among African Americans.

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AMI rates remained higher among Caucasians, despite the larger downward trend as compared with African Americans. These findings are consistent with other studies, especially those in the Southeast, that reported greater risk of coronary events among Caucasians than among African Americans.[15,16] With regard to our stroke hospital rates, the consistently higher hospitalization rates seen in African Americans is consistent with findings of previous studies assessing racial variation in stroke incidence.[17–19] The excess burden of stroke in the African American population, relative to Caucasians, is well recognized,[20,21] and our data emphasize this fact in a diabetic population. Although African Americans in our study experienced a sharper decline in stroke rates, the disparity between race groups remains. The disparity may relate to unobserved racial variations in migration rates out of South Carolina, where studies show persons born in South Carolina and the Southeast are at increased risk of stroke.[22]

Results identifying that CABG and PTCA procedures are performed more often among Caucasians than African American diabetic patients are consistent with findings from other studies reporting that coronary artery procedures are used less often in minority populations.[23–25] The excess in CVD procedures among Caucasians in our population may be partly explained by the higher rates of AMI observed in Caucasians. However, in 2003, the AMI rate for Caucasians was 1.4 times greater than that of the African Americans, but the rates of PTCA and CABG were 2.2 and 3.1 times greater among Caucasians. Furthermore, the increasing trend of PTCA use is significantly higher among Caucasians than among African Americans, which indicates that racial disparities in use of revascularization procedures continues to grow.

Finally, the diabetes-related hospitalization rates for CHF increased

Table 2. Age-standardized hospitalization rates from 1996 through 2003, trend slope parameters, their *P* values, and interaction *P* values comparing African American slopes to Caucasian slopes for each outcome of interest

Outcome	1996 Hospitalization Rate*		2003 Hospitalization Rate*		Trend Slope Parameter		Interaction *P* value
	African American	Caucasian	African American	Caucasian	African American	Caucasian	
Acute Myocardial Infarction							
Total	36.99	60.15	33.85	47.52	−0.55†	−1.86‡	<.0001
Male	45.49	75.94	38.21	57.10	−1.09†	−2.54‡	.0010
Female	33.53	48.19	31.53	38.81	−0.41†	−1.53‡	<.0001
Stroke							
Total	57.04	42.45	36.68	25.25	−3.22‡	−2.56‡	.0273
Male	60.84	45.11	38.91	25.59	−3.47‡	−2.79‡	.0588
Female	55.55	40.62	36.30	25.75	−3.13‡	−2.38‡	.0080
Percutaneous Transluminal Coronary Angiography							
Total	11.98	29.76	20.52	45.19	1.12‡	1.84‡	.0002
Male	15.34	37.68	23.94	59.31	1.33‡	2.62‡	.0003
Female	10.36	24.26	18.47	32.76	0.99‡	1.01‡	.9448
Coronary Artery Bypass Graft							
Total	9.96	26.16	7.22	22.01	−0.35‡	−0.50‡	.3334
Male	14.52	37.78	9.43	32.27	−0.41†	−0.63†	.4846
Female	8.38	17.21	6.22	14.18	−0.34†	−0.37†	.8719
Cardiomyopathy							
Total	46.17	36.29	56.44	36.30	1.99‡	0.20	<.0001
Male	56.28	43.59	69.33	44.87	2.62‡	0.43†	<.0001
Female	40.96	31.26	49.50	29.51	1.59‡	0.00	<.0001
Congestive Heart Failure							
Total	191.93	205.12	225.02	216.67	4.73‡	1.42‡	<.0001
Male	182.78	199.68	220.41	208.55	5.71‡	1.04†	<.0001
Female	200.72	213.44	228.05	223.09	3.92‡	1.65‡	.0002

* Per 1000 hospital discharges.
† Race-specific trend slope *P* value <.05.
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significantly for both race groups, but the increase was more pronounced among African Americans. The rates of CHF were higher than all other outcomes studied, and with the 2003 rate was >200/1000 for both race groups. Therefore, >20% of all diabetes-related hospitalizations involve CHF. An additional major concern highlighted from our data is that although the cardiomyopathy rates were stable for Caucasians, African Americans saw significant increases in their rates of cardiomyopathy. Improved clinical treatments leading to increased survival may partially explain the increasing trends for hospitalizations involving CHF and cardiomyopathy.[26]

This descriptive study included some limitations, including the inability to assess temporal changes in hospitalization practices and insurance coverage, which could affect hospitalization rates. Furthermore, the racial disparities may be a function of more severe illness among African Americans, which required more frequent hospitalizations and services. However, we could not determine repeated hospital visits for an individual as a mechanism to address this issue. Still, the racial disparities observed in our study are unlikely to be entirely explained by this notion.

In conclusion, diabetes-related CVD hospitalization rates are improving with respect to AMI and strokes among African Americans and Caucasians, but a racial disparity remains for both outcomes. Our data suggest that the racial disparities involving revascularization procedures, CHF, and cardiomyopathy among diabetic patients persist. More work is needed to understand the underlying racial differences associated with the racial disparities in cardiovascular diseases among persons with diabetes.

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