Racial Differences in Diabetic Nephropathy, Cardiovascular Disease, and Mortality in a National Population of Veterans

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OBJECTIVE — To determine racial differences in the prevalence of diabetic nephropathy, cardiovascular disease (CVD), and risk of mortality in a national health care system.

RESEARCH DESIGN AND METHODS — A longitudinal cohort study was conducted in 429,918 veterans with diabetes. Racial minority groups were analyzed for baseline differences in prevalence of early diabetic nephropathy, diabetic end-stage renal disease (ESRD) and CVD, and longitudinal risk of mortality compared with Caucasians.

RESULTS — The 429,918 patients identified with diabetes were of the following racial groups: Caucasian (56.2%), African American (15.3%), Asian (0.5%), Native American (0.4%), and unknown race (21.4%). Minority individuals were, on average, younger and less likely to have CVD but were more likely to have renal disease than Caucasians. After adjustment for age, sex, and economic status, African Americans (adjusted odds ratio [OR] = 1.3, 95% CI 1.2–1.4) and Native Americans (1.5, 1.1–2.1) were more likely to have early diabetic nephropathy than Caucasians. Diabetic ESRD was more likely to be present in African Americans (1.9, 1.9–2.0), Hispanics (1.4, 1.3–1.4), Asians (1.8, 1.5–2.1), and Native Americans (1.9, 1.5–2.3) than Caucasians. Concurrently, the adjusted OR of CVD in racial minority groups was 27–49% less than in Caucasians, whereas the 18-month risk of mortality among people from most racial minority groups was 7–12% lower than in Caucasians.

CONCLUSIONS — We conclude that when access to care is comparable, microvascular complications, macrovascular disease, and subsequent death occur with different frequencies among various racial groups.

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Diabetes is a substantial public health care problem that is estimated to affect over 16 million Americans, approximately half of whom are aware that they have the disease (1,2). Renal disease affects 20–40% of individuals with diabetes (3–5), and diabetic nephropathy is the leading cause of end-stage renal disease (ESRD) or dialysis dependence in the U.S. (6). Compared with Caucasians, racial minority populations are disproportionately affected by diabetes (7,8) and have excessive risk for such complications as ESRD (9) and amputations (10,11). The Multiple Risk Factor Intervention Trial (MRFIT) (12) found that African Americans had a higher risk of diabetic ESRD than Caucasians, whereas Pugh et al. (13) described an excess incidence of diabetic ESRD in African Americans and Hispanics, a finding that was confirmed more recently in the U.S. Renal Data System (USRDS) (9).

Small population studies of diabetes and its complications have been conducted in the U.S., the primary focus of which has been homogeneous groups of patients such as Caucasians in the Midwest (5,14,15) or Pima Indians in the Southwest (12,16–26). Recently, Karter et al. (11) found that among Kaiser Permanente enrollees, African Americans and Hispanics had a higher prevalence of ESRD than Caucasians but lower or similar prevalence of other diabetes complications. However, overall survival and prevalence of non-ESRD conditions were not determined. Other studies have evaluated racial differences in the prevalence and incidence of ESRD (12,16–18), but few data describe racial differences in renal disease and other complications before initiation of dialysis.

We and others have shown that certain microvascular complications occur more frequently in some racial minority groups (10,11), and others have shown that macrovascular complications such as cardiovascular disease (CVD) occur more frequently in Caucasians than in racial minorities (11). Therefore, we hypothesized that in a setting in which access to care is comparable, African Americans and other racial minorities are more likely to develop microvascular complications, such as renal disease, whereas Caucasians, are more likely to develop macro-

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Abbreviations: BIRLS, Beneficiary Identification and Record Locator System; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; ESRD, end-stage renal disease; MRFIT, Multiple Risk Factor Intervention Trial; VA, Veterans Affairs.

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

vascular complications, such as CVD, and that these differences may account for the variation in mortality when access to care is similar. Using administrative databases, this study investigated racial differences in the risk of early diabetic nephropathy, diabetic ESRD, CVD, and mortality in a national setting among veterans where access to health care was comparable among enrollees.

RESEARCH DESIGN AND METHODS

Subjects and settings

We conducted a longitudinal cohort study of subjects with diabetes who received care nationally within the Department of Veterans Affairs (VA) as described previously (10). Inclusion in the study required a diagnosis of diabetes during fiscal year 1998 and three subsequent clinic visits within 1 year. Data were extracted from 1 October 1997 until death or 31 March 1999.

Diabetic subjects were identified through the national Veterans Health Administration (VHA) databases at the Austin Automation Center (Austin, Texas) by the presence of at least one outpatient visit with an ICD-9 (27) diagnosis code of diabetes (250.XX) during fiscal year 1998. Data were extracted from both inpatient (Patient Treatment Files) and outpatient files (Outpatient Care Files by use of ICD-9 codes and Common Procedural Terminology codes) (28) (see online appendix at http://care.diabetesjournals.org). Patient Treatment Files and Outpatient Care Files were merged and duplicate listings were eliminated before analyses. No distinction was made between those with type 1 or type 2 diabetes.

Exposures

Potential risk factors for renal disease were identified a priori and included race, age at beginning of study, sex, and service connection for medical services received. In VA records, race or national origin is extracted from clinical documentation and/or observation of administrative staff and does not take self-report into account. The term "racial minority" will therefore be used to define ethnic minority groups or non-Caucasians for the remainder of this study. Service connection has been used as a proxy for socioeconomic status in the VA setting (10). VA criteria for health care eligibility include a service-connected disability or low financial resources; absence of a service-connected disability is therefore an indicator for low socioeconomic status. Comorbid conditions such as hypertension, stroke, cancer, chronic obstructive pulmonary disease (COPD), and depression were identified by use of ICD-9 codes and were included as potential exposure covariates. Because data on smoking history were not available, a prevalent diagnosis of COPD was used as a proxy for significant smoking history (29). Other extracted covariates of interest included geographic region, diagnosis of diabetic eye disease, total number of clinic visits, and number of hospitalizations.

Outcomes

Diabetic nephropathy was defined by the ICD-9 code 250.4 or the code for diabetes (250.XX) coupled with codes for additional secondary renal conditions such as glomerulonephritis, glomerulonephropathy, or nephropathy (Table 1). Patients diagnosed with diabetes and other renal disease (interstitial nephritis, acute renal failure, cystic disease, or other diseases) were identified separately.

Prevalent coronary artery disease was also identified by ICD-9 code as an outcome of interest. The following conditions were included in the diagnosis: myocardial infarction or ischemic heart disease, angina, coronary atherosclerosis, cardiac dysrhythmias, and heart failure (see online appendix).

Mortality was ascertained prospectively for 18 months using the Beneficiary Identification and Record Locator System (BIRLS) death file, which is a database that contains name, social security number, and dates of death. The BIRLS death file has been shown to have a 94.5% ascertainment of death, which compares favorably with that of the National Death Index (96.7%) (30,31). Dates of death were collected from 1 October 1997 until 31 March 1999.

Statistical analysis

Statistical analyses were conducted to determine frequencies of distribution of covariates and associations of exposures with diabetic renal disease as stratified by race. Data analyses were performed using SPSS statistical software (SPSS, Chicago, IL) (32) and Stata software (Stata, College Station, TX) (33). Statistical significance was determined using the independent Student's t test for continuous data and the χ^2 test for categorical data (34). The associations between exposures and prevalent outcomes such as renal disease, ESRD, and CVD were measured using the odds ratio (OR), and results adjusted for predictor covariates were reported as the adjusted OR (34). These estimates and their 95% CIs were derived using unconditional logistic regression (34).

Cox proportional hazard modeling was used to estimate the relative risk (RR) of death. The hazard, or the instantaneous probability of an event, was modeled as a function of the predictor covariates, which were determined a priori. The main predictors of interest were ethnicity and the presence of renal disease; other potential confounding factors were considered and included in models. The hazard ratio, or RR, was estimated as the proportionate change in the instantaneous probability of death. Results were reported as the adjusted RR. Interactions between race and other predictors of interest were assessed and found to be not significant. Survivors were censored as of the last day of the study period (31 March 1999).

RESULTS — From the national VA databases, we identified 429,918 individuals with diabetes who received primary care within the VA system. Of those patients, 56.2% were Caucasian, 15.3% were African American, 6.2% were Hispanic, 0.5% were Asian, and 0.5% were Native American. At least 21% of individuals could not be categorized by race. Diabetic individuals were generally older (mean age 64.1 ± 11.4 years) and male (97.4%) and represented all geographic areas of the U.S.; southern states accounted for the largest population with diabetes (37.9%) (Table 1). Over half of the veterans identified did not have a service-connected disability. Diabetic veterans had a high prevalence of comorbid conditions, such as hypertension (67.3%) and CVD (40.7%), and a lower prevalence of other important medical conditions, such as COPD (15.2%), depression (12.0%), cancer (11.5%), renal disease (10.4%), and stroke (7.4%).

As shown in Table 1, racial differences in patient characteristics were apparent. On average, African-American veterans were younger, from the southern U.S., and more likely to have been non–service connected for their visits than

Table 1—*Demographic and clinical characteristics of veterans treated for diabetes*

Characteristic	Total (N = 429,918)	Caucasian (n = 241,548; 56.2%)	African American (n = 65,985; 15.3%)	Hispanic (n = 26,544; 6.2%)	Asian (n = 2,046; 0.5%)	Native American (n = 1,747; 0.4%)	Race unknown (n = 92,048; 21.4%)
Age (years)	64.1 ± 11.4	65.3 ± 10.9	6.3 ± 12.4†	63.7 ± 11.1†	63.0 ± 11.6*	60.3 ± 11.6*	63.4 ± 11.7*
Age category (years)							
<40	26,628 (6.2)	10,648 (4.4)	7,248 (11.0)†	1,614 (6.1)	168 (8.2)*	141 (8.1)*	6,809 (7.4)*
40–64	165,624 (38.5)	87,891 (36.6)	28,366 (43.0)	10,726 (40.4)	869 (42.5)	919 (52.6)	36,853 (40.0)
65–74	154,498 (35.9)	91,440 (37.9)	20,372 (30.9)	9,727 (36.6)	586 (28.6)	470 (26.9)	31,903 (34.7)
75+	83,168 (19.3)	51,569 (21.3)	9,999 (15.2)	4,477 (16.9)	423 (20.7)	217 (12.4)	16,483 (17.9)
Male (%)	97.4	97.4	97.5	98.7†	97.7	96.5*	97.1*
Non–service connected	252,946 (58.8)	137,632 (57.0)	40,158 (60.9)†	16,482 (62.1)†	722 (35.3)*	937 (53.6)*	57,015 (61.9)*
Number of service-connected disabilities	2.3 ± 2.3	2.3 ± 2.3	2.0 ± 2.2†	1.8 ± 2.1†	3.3 ± 2.5*	2.3 ± 2.3	2.5 ± 2.3*
Region (%)							
Northeast	21.4	22.6	22.6†	8.0†	6.3*	5.6*	21.8*
South	37.9	35.5	45.0	60.2	6.4	26.0	33.8
Midwest	21.4	23.5	20.8	3.5	4.1	24.0	22.0
West	19.3	18.5	11.5	28.3	83.2	44.2	22.4
Health care delivery							
Hospitalizations (days)	17.1 ± 98.9	16.9 ± 106.9	18.7 ± 93.0*	15.2 ± 27.9†	12.9 ± 25.3	12.9 ± 28.4	11.0 ± 22.3*
Hospitalizations (number)	1.6 ± 1.1	1.6 ± 1.1	1.6 ± 1.1	1.6 ± 1.1†	1.7 ± 1.1	1.7 ± 1.4	1.2 ± 0.6*
Seen by primary care	11.5	57.2 (70.9)	18.7 (67.6)†	5.9 (79.0)†	0.7 (75.9)*	0.5 (74.3)	17.1 (69.7)*
Total number of visits	17.8 ± 20.3	19.0 ± 19.8	22.8 ± 27.9†	19.0 ± 20.6	20.8 ± 23.4*	20.0 ± 24.0	11.6 ± 11.9*
Eye examination	206,179 (48.0)	121,937 (50.5)	33,931 (51.4)†	11,441 (43.1)†	1089 (53.2)*	831 (47.6)*	36,950 (40.1)*
Comorbid condition							
Hypertension	289,334 (67.3)	162,512 (67.3)	49,902 (75.6)†	17,474 (65.8)†	1,380 (67.4)	1,028 (58.8)*	57,031 (62.0)*
Cardiovascular disease	174,934 (40.7)	115,118 (47.7)	21,518 (32.6)†	8,756 (33.0)†	731 (35.7)*	606 (34.7)*	28,202 (30.6)*
Stroke	31,767 (7.4)	20,430 (8.5)	5,581 (8.5)†	2,096 (7.9)†	141 (6.9)*	108 (6.2)*	3,441 (3.7)*
Cancer	49,546 (11.5)	32,309 (13.4)	8,221 (12.5)†	2,371 (8.9)†	164 (8.0)*	123 (7.0)*	6,376 (6.9)*
COPD	65,201 (15.2)	46,285 (19.2)	8,235 (12.5)†	2,053 (7.7)†	186 (9.1)*	208 (11.9)*	8,234 (8.9)*
Depression	51,388 (12.0)	33,282 (13.8)	7,198 (10.9)†	3,599 (13.6)	207 (10.1)*	267 (15.3)	6,835 (7.4)*
Renal disease	44,671 (10.4)	26,212 (10.8)	9,699 (14.7)†	2,716 (10.2)†	263 (12.9)*	222 (12.7)*	4,650 (5.1)*
Diabetic eye disease	37,080 (8.6)	22,123 (9.2)	6,364 (9.6)†	2,060 (7.8)†	265 (13.0)*	181 (10.4)	6,087 (6.6)*
Mortality (%)	6.0	7.3	6.4†	5.6†	5.4*	7.4	2.6*

Data are means ± SD or n (%). *$P < 0.01$; †$P < 0.05$ Caucasian compared with the specific minority group. Test for significance: χ^2 test for categorical variables and independent Student's t test for continuous data.

Caucasians. In addition, African-American subjects were more likely than Caucasians to have hypertension, renal disease, and diabetic eye disease, but less likely to have CVD, COPD, cancer, or depression. Furthermore, African Americans were more likely than Caucasians to have undergone an eye examination, but were slightly less likely to have been seen by a primary care provider.

Hispanic veterans were more likely to be younger, have resided in the southern and western U.S., and have been non–service connected for their care than Caucasian veterans. However, Hispanic individuals were less likely than Caucasians to have had diagnoses of hypertension, CVD, stroke, cancer, COPD, or depression. Diabetic eye disease was diagnosed less frequently in Hispanics than in Caucasians, even though Hispanic veterans were more likely to have been seen by a primary care provider (Table 1).

On average, Asian veterans were younger than Caucasian veterans (63.0 ± 11.6 vs. 65.3 ± 10.9 years) and tended to reside predominantly in the western U.S. (83.2%). Compared with Caucasian veterans, Asian veterans were more likely to have had a service-connected disability and were much less likely to have had certain comorbid conditions, such as CVD, stroke, cancer, and COPD, but also had a higher prevalence of renal disease.

Data were available for 1,747 Native American patients who received care within the VA system. Native American veterans were, on average, the youngest of all minority groups but had similar proportions of hospitalizations, clinic visits, primary care provider visits, and service-connected disabilities when compared with Caucasians. However, Native American veterans were less likely to have had prevalent comorbid conditions, such as CVD, hypertension, stroke, depression, and COPD, and were more likely to have renal disease than Caucasians (12.7 vs. 10.8%) (Table 1).

Among patients with renal disease, racial differences were observed in baseline characteristics (Table 2). Racial minority patients tended to be younger, had fewer comorbid conditions such as CVD, cancer, and COPD, and were more likely to be diagnosed with end-stage diabetic nephropathy than Caucasians. African Americans, Hispanics, and Asians had similar levels of background retinopathy compared with Caucasians, whereas African-American and Hispanic veterans were more likely to be diagnosed with other eye diseases (blindness, glaucoma, and retinal detachment) than Caucasians.

In contrast to the racial differences described for prevalence of renal disease, minimal differences were found in the amount of health care services received among veterans with renal disease. Among all racial minorities, number of hospitalizations, days of hospitalizations, proportion with eye examinations, and proportion seen by a general practitioner or by a diabetes educator were similar among African Americans, Hispanics, Asians, and Native Americans compared with Caucasians (Table 2). Exceptions included slightly more hospitalizations for African Americans and Hispanics than Caucasians and fewer eye examinations, diabetes educator visits, and general practitioner visits for Hispanics than Caucasians. Total visit numbers were higher for all minority groups than Caucasians, although these differences were statistically significant only for African-American and Hispanic veterans.

The relative odds of renal disease were estimated using unconditional logistic regression (Table 3). African Americans, Native Americans, Hispanics, and Asians were found to have higher odds of diabetic ESRD than Caucasians. In addition, for those subjects with diabetic nephropathy who were not yet on dialysis, Native Americans (adjusted OR = 1.5, 95% CI 1.1–2.1) and African Americans (1.3, 1.2–1.4) had greater odds of diabetic nephropathy than Caucasians after adjustment for age, number of visits, region, sex, prevalent CVD, and hypertension (Table 3).

Odds of prevalent CVD were also assessed by unconditional logistic regression (Table 3). Compared with Caucasians, African Americans (adjusted OR 0.51, 95% CI 0.50–0.52), Hispanics (0.58, 0.57–0.60), Asians (0.67, 0.61–0.74), and Native Americans (0.73, 0.66–0.82) had lower odds of prevalent CVD after adjustment for age, sex, presence of renal disease, COPD, hypertension, service connection, and total number of visits. Interaction terms between race and other covariates were not significant.

As shown in Table 4, 18-month mortality was assessed prospectively. After adjustment for age, diabetic nephropathy, number of visits, region, sex, and hospitalizations, African Americans (adjusted RR = 0.93, 95% CI 0.89–0.97) and Hispanics (0.88, 0.79–0.88) were found to have lower mortality than Caucasians, whereas Asians (0.88, 0.72–1.09) and Native Americans (1.12, 0.91–1.36) were found to have similar mortality when compared with Caucasians. Patients with diabetic nephropathy (1.9, 1.7–2.0) and diabetic ESRD (2.7, 2.6–2.8) had a two- to threefold higher risk of death, and as expected, the risk of death increased significantly with increasing age category.

CONCLUSIONS — We observed significant racial differences in the prevalence of comorbid conditions, diabetic renal disease, CVD, and mortality for veterans with diabetes. The prevalence of renal disease was higher in racial minority groups than in Caucasians. In contrast, the prevalence of CVD and risk of death were higher in Caucasians than in most racial minorities, suggesting that racial differences may exist in macrovascular and microvascular disease frequency and subsequent mortality.

Among veterans treated within the VA system, our study observed a greater prevalence of diabetic renal disease in racial minorities than in Caucasians. Our results for diabetic ESRD are similar to prior reports of increased risk of diabetic ESRD in African Americans (9,11,13,17), Hispanics (11,13,18), Asians (9,11), and Native Americans (25) compared with Caucasians. In addition to finding a greater prevalence of diabetic ESRD in racial minorities, the current study also found that African Americans (adjusted OR = 1.3, 95% CI 1.2–1.4) and Native Americans (1.5, 1.1–1.6) had increased odds of diabetic renal disease before the need for dialysis compared with Caucasians. Few studies have evaluated racial variations in the risk of diabetic nephropathy prior to the need for dialysis.

The current study found that the odds of CVD were decreased in all racial minority groups in comparison with that in Caucasians. Our data are similar to those reported by Karter et al. (11), who found that the RR of CVD in most racial minority diabetic populations tended to be lower than that in Caucasians when determined prospectively in a regional health maintenance organization. Nelson et al. (35) found a 60% lower incidence of fatal coronary artery disease in diabetic Pima Indians when comparing Native American rates with those reported for diabetic

Table 2—*Demographic and clinical characteristics of veterans with diabetes and renal disease*

Characteristic	Caucasians (n = 26,212; 58.7%)	African Americans (n = 9,699; 22.7%)	Hispanic (n = 2,716; 6.1%)	Asian (n = 263; 0.6%)	Native American (n = 222; 0.5%)	Other (n = 4,650; 10.4%)
Age (years)	67.5 ± 10.0	65.1 ± 11.2*	66.1 ± 10.2*	66.4 ± 12.9	61.2 ± 10.7*	65.6 ± 11.0*
Male	98.3	98.6*	99.1*	99.3	96.8	98.3
Region						
Northeast	20.0	21.1†	8.0*	5.6*	5.9*	19.8*
South	35.3	45.7	55.4	5.6	25.7	33.2
Midwest	25.0	21.6	4.5	3.7	28.8	23.7
West	19.7	11.7	32.1	85.1	39.6	23.3
Non–service connected	56.2	63.0*	63.1*	36.9*	54.5	61.6*
Number of service connected disabilities	2.3 ± 2.3	2.0 ± 2.2	1.8 ± 2.3*	3.9 ± 2.6*	2.2 ± 2.4	2.5 ± 2.4*
Health care delivery						
Hospitalizations (number)	2.0 ± 1.4	1.9 ± 1.4*	1.9 ± 1.3†	2.1 ± 1.4	2.1 ± 1.5	1.4 ± 0.7*
Hospitalizations (days)	16.9 ± 106.9	18.7 ± 93.0	17.0 ± 23.3	13.0 ± 20.0	13.0 ± 19.9	16.5 ± 71.7
Total number of visits	26.4 ± 23.7	32.3 ± 35.0*	28.0 ± 27.9*	34.6 ± 36.3	27.9 ± 27.8	15.8 ± 14.4*
Eye examination	54.1	53.6	49.5*	58.6	50.5	45.6*
Seen by general practitioner	71.4	69.9	77.3†	76.3	64.1	73.0
Seen by diabetes educator	34.6	36.6	27.1†	23.6	38.5	32.8
Comorbid conditions						
Cardiovascular disease	65.4	51.6*	52.7	56.0*	51.8*	44.0*
Stroke	13.8	12.8†	13.1	14.2	9.9	5.9*
Hypertension	80.4	88.2*	81.5	80.2	74.8†	77.2*
COPD	26.2	18.1*	11.3*	14.6*	18.0†	12.3*
Renal disease						
Diabetic ESRD	36.2	46.8†	46.4†	52.6*	47.3*	37.6*
Diabetic nephropathy‡	18.0	15.7	13.7	11.6	21.2	17.1
Hypertension	3.0	3.8	1.7	2.6	1.4	2.3
Acute renal failure	4.4	4.8	4.5	4.5	5.4	2.2
Eye disease						
Background retinopathy	17.5	17.6	19.0†	19.4	18.9	12.7*
Eye manifestations of diabetes	16.2	16.5	15.1	19.8	21.2†	11.6*
Blindness	5.0	6.1*	7.4*	5.6	6.3	3.3*
Retinal detachment	1.3	1.8*	1.8†	3.4†	1.4	0.8†
Unadjusted mortality	18.1	15.9*	17.2	16.4	19.4	6.5*

Data are means ± SD or %. *$P < 0.01$; †$P < 0.05$ Caucasian compared with the specific minority group; ‡patients with diabetic nephropathy not yet on dialysis. χ^2 test for categorical variables, independent t test for continuous data.

Caucasians in the Framingham study, but direct comparisons of similarly treated groups are lacking. Our data are unique in that racial differences in prevalence of CVD were compared directly for a population of patients treated nationally for diabetes within one heath care system.

The present study found better overall short-term survival for most racial groups compared with Caucasians. Lower mortality of various racial minorities than Caucasians has been reported in the setting of ESRD (9,36); however, controversy exists regarding the general population. In an analysis of data from the first National Health and Nutrition Examination Survey (NHANES I), most minority groups had higher mortality rates than Caucasians with diabetes; heart disease was the most frequent cause of death and availability of health insurance was not a risk factor (37,38). In addition, the San Antonio Heart Study found that Hispanics had a greater risk of all-cause and cardiovascular mortality compared with Caucasians (39). In contrast, Vaccaro et al. (40) found that African Americans screened as part of MRFIT had a lower risk of death due to CVD but a similar risk of all-cause mortality compared with Caucasians.

Reasons for racial variation of diabetes complications are incompletely understood and may include such factors as duration of diabetes, access to health care (17), glycemic control (41), socioeconomic status (17), education (17), and control of hypertension (17). Lack of health insurance may contribute to the variation in diabetes complications reported in past studies. Low socioeconomic status, obesity, and hypertension explained some but not all of the differences in diabetic ESRD found between Caucasians and African Americans in the MRFIT (17). Karter et al. (11) concluded that variations in genetic or environmental factors may be important in explaining

Table 3—*Relative odds of diabetic nephropathy and cardiovascular disease by race and other covariates*

	ESRD		Diabetic nephropathy		Cardiovascular disease	
Covariate	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted†
Caucasian	1.0	1.0	1.0	1.0	1.0	1.0
African American	1.9 (1.8–1.9)	1.9 (1.9–2.0)	1.3 (1.2–1.3)	1.3 (1.2–1.4)	0.53 (0.52–0.54)	0.51 (0.50–0.52)
Hispanic	1.2 (1.1–1.3)	1.4 (1.3–1.4)	0.7 (0.6–0.8)	0.7 (1.6–1.8)	0.54 (0.53–0.56)	0.58 (0.57–0.60)
Asian	1.8 (1.5–2.1)	1.8 (1.5–2.1)	0.8 (0.6–1.1)	0.8 (0.5–1.1)	0.61 (0.56–0.67)	0.67 (0.61–0.74)
Native American	1.5 (1.3–1.9)	1.9 (1.5–2.3)	1.4 (1.0–1.9)	1.5 (1.1–2.1)	0.58 (0.53–0.64)	0.73 (0.66–0.82)
Age category (years)						
<40	1.0	1.0	1.0	1.0	1.0	1.0
40–65	2.4 (2.0–2.8)	1.5 (1.2–1.8)	1.5 (1.2–1.8)	1.0 (0.8–1.2)	5.82 (5.35–6.31)	3.99 (3.67–4.35)
65–75	3.4 (2.9–4.1)	2.0 (1.6–2.4)	1.8 (1.5–2.2)	1.1 (0.8–1.3)	11.70 (10.78–12.70)	7.14 (6.55–7.77)

Data are OR (95% CI). *Models adjusted for age, cardiovascular disease, hypertension, nonservice connection, total number of visits, region, and sex; †models adjusted for age, race, stroke, sex, presence of renal disease, COPD, hypertension, previous amputation, total number of visits, non–service connection, diabetic eye disease, and region.

racial differences in diabetes complications after controlling for access to care. The present study was able to control for access to care in a setting in which standard guidelines are available for diabetes care and found significant differences in racial group prevalence and risk of CVD, diabetic nephropathy, and mortality. Additional research into the risk factors responsible for these differences is necessary and will have important implications for the general U.S. population.

This study has several strengths, including a diverse population treated in a national setting with comparable access to health care; however, this study has several limitations that need to be addressed. These results were obtained in a mainly male population, many of whom are chronically ill and may have limited health insurance access; thus, the results may not be transferable to the general population. However, the VA is the largest national health care system in the U.S. and includes a large number of the Medicare-eligible elderly who receive their health care from within the system. In ad-

Table 4—*RR of 18-month mortality by race and other covariates*

Covariate	Unadjusted hazard ratio	95% CI	Adjusted* hazard ratio	95% CI
White	1.0	—	1.0	—
African American	0.87	0.84–0.90	0.93	0.89–0.97
Hispanic	0.76	0.72–0.80	0.88	0.79–0.88
Asian	0.74	0.61–0.89	0.88	0.72–1.09
Native American	1.02	0.86–1.21	1.12	0.91–1.36
Age category (years)				
<40	1.0	—	1.0	—
40–64	3.50	2.80–4.37	5.24	4.07–6.76
65–75	7.67	6.14–9.56	11.0	8.55–14.17
75+	13.47	10.79–16.81	18.5	14.36–23.81
DN†	3.02	2.85–3.21	1.85	1.72–1.98
Diabetic ESRD	3.87	3.73–4.02	2.72	2.60–2.84
Comparative risk in DN (subgroup analysis)†				
Caucasians with DN	1.0	—	1.0	—
African Americans with DN	0.79	0.76–0.83	0.91	0.87–0.95
Hispanics with DN	0.73	0.68–0.77	0.79	0.73–0.84
Asians with DN	0.63	0.50–0.80	0.79	0.61–1.01
Native Americans with DN	0.93	0.76–1.14	0.98	0.77–1.25
Comparative risk in ESRD (subgroup analysis)				
Caucasians with ESRD	1.0	—	1.0	—
African Americans ESRD	0.78	0.75–0.81	0.87	0.84–0.91
Hispanics with ESRD	0.73	0.69–0.77	0.80	0.74–0.85
Asians with ESRD	0.64	0.52–0.79	0.81	0.65–1.02
Native Americans with ESRD	1.02	0.84–1.22	1.06	0.86–1.31

*Adjusted for age, total number of visits, number of hospitalizations, region, and sex; †indicates patients with diabetic nephropathy not yet on dialysis. DN, diabetic nephropathy.

dition, the large number of veterans with unknown race may contribute to misclassification and bias in our estimates of prevalence and risk. An additional limitation is the possible misclassification of the diagnosis of renal disease. Because the criterion was ICD-9 diagnosis codes, it is not possible to determine early diabetic nephropathy or microalbuminuria; therefore, our results probably underestimate the total number of veterans in the system with renal disease. However, VA inpatient diagnosis codes have been found to be reliable and valid when compared with the medical record, but less so for outpatient diagnoses (42). In addition, diabetes type could not be ascertained from administrative records, but we believe that our results most likely represent those of patients with type 2 diabetes, which should not bias results, because individuals with childhood-onset type 1 diabetes would not have been admitted into the military. Last, our ability to determine potential confounders such as duration of diabetes, family history, medication use, smoking history, cause of death, and other clinical variables was severely limited by the nature of the administrative databases. However, these data will be useful for the generation of hypotheses, which may prompt further examination in databases in which information on these potential confounding factors is available.

In summary, among diabetic individuals treated in a national health care system, racial minorities had higher odds of diabetic nephropathy and ESRD but lower odds of CVD and a lower risk of mortality. We conclude that when access to care is comparable, racial minority groups are more likely to have microvascular disease, whereas Caucasians are more likely to develop macrovascular disease and death.

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