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Race and sex differences in rates of diabetic complications

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Abstract

Background—Studies on racial differences in diabetic complications are very limited. The objective of this study was to investigate the race and sex differences in diabetic complications between African Americans and whites with type 2 diabetes in Louisiana.

Methods—We performed a prospective cohort study of 27,113 African Americans and 40,431 whites with type 2 diabetes who were 35–95 years of age from three health care systems located in South Louisiana. Four major diabetic complications were assessed including coronary heart disease (CHD), heart failure, stroke, and end-stage renal disease (ESRD).

Results—The age- and sex-adjusted incident rates per 1000 person-years and 95% confidence intervals (CI) for CHD, heart failure, stroke, and ESRD for African Americans with diabetes were 43.1 (95% CI 41.6–44.6), 36.6 (35.2–37.9), 29.6 (28.4–30.8), and 38.3 (36.9–39.7), respectively. Cox regression models showed that African-American women would have more risks than white women in heart failure (1.26 (1.18–1.34)), stroke (1.15 (1.08–1.22)) and ESRD (1.32 (1.24–1.40)), while African-American men would have higher risks in heart failure (1.33 (1.25–1.43)) and ESRD (1.47 (1.37–1.57)) and lower risks in CHD (0.88 (0.83–0.94)) than white men.

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Disclosure

The authors have no conflict of interest to disclose.

Conclusions—Incidence of major diabetic complications varied among difference race and sex groups. More race- or sex-specific studies on complications in patients with diabetes are needed to see if incident rates are changing over time.

Keywords

Race difference; Sex difference; Diabetic complications

Introduction

Diabetes is growing at an epidemic rate in the United States¹. In the overall 2011–2012 population, 14.3% of the population had diagnosed diabetes and 38.0% of people for prediabetes in the United States¹. In Louisiana, approximately 521,294 people, or 13.9% of the adult population, have diabetes². It has been estimated that the total number of patients with diabetes will be 844,700 in Louisiana by 2030³. Race differences in diabetes have been reported^{4–6}, with higher prevalence and incidence among minorities. Further, some studies have indicated that African Americans are 2.3 times more likely to die from diabetic complications compared with whites⁷. However, studies on racial differences in diabetic complications are very limited. Existing studies of racial differences in diabetic complications between African Americans and whites are not large and representative enough, and previous studies have provided many conflicting results⁸. Results from the Kaiser Permanente Medical Care Program in northern California^{9,10} have provided evidence that incidence of diabetic complications varied dramatically among different racial and sex subgroups and highlighted the value of a more nuanced racial stratification for public health surveillance and etiologic research. However, the evidence is still limited to the generalizability to the whole nation. Access to quality health care may differ a lot among patients with different race and sex locally. Analysis of a racial diverse cohort in a specific area is useful in the comprehensive management of diabetes. Therefore, the aim of the present study was to test whether there were racial differences in the incidence of major diabetic complications between African Americans and whites with diabetes in Southern Louisiana.

Methods

Study cohort

Patients with type 2 diabetes in the Louisiana Experiment Assessing Diabetes outcomes (LEAD) cohort study was established through the Research Action for Health Network (REACHnet)¹¹ dataset between January 1, 2013 and October 10, 2017. For the present study, data from three REACHnet partners were used and included into the final pooled analysis. For duplicated patients across the three partners, a unique global identifier was used to link data across the three partners.

The definition of type 2 diabetes in the present study was as the following: a) 1 or more of the *International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM)* codes and *Tenth Revision, Clinical Modification (ICD-10-CM)* codes for type 2 diabetes associated with in-patient encounters; b) 2 or more ICD codes associated with out-

patient encounters on different days within 2 years; c) combination of 2 or more of the following associated with out-patient encounters on different days within 2 years: 1) ICD codes; 2) fasting glucose level ≥ 126 mg/dl; 3) 2-hour glucose level ≥ 200 mg/dl; 4) random glucose ≥ 200 mg/dl; 5) glycosylated hemoglobin (HbA1c) $\geq 6.5\%$; and 6) receiving antidiabetic medications. A total of 107,562 patients between the ages of 30 and 95 years were identified. After the exclusion of patients with incomplete data, the present study included 67,544 patients with diabetes (40,431 whites and 27,113 African Americans). Compared with patients with diabetes excluded in the present study because of missing data on any required variables, the cohort of patients with diabetes included in the present study were slightly older (66.5 ± 12.1 versus 66.3 ± 12.5 years of age), had more African Americans (40.1% versus 36.2%), and had fewer men in percentage (47.5% versus 49.1%).

Ethics, consent and permissions

The study and analysis plan were approved by the Pennington Biomedical Research Center, Tulane University, and Ochsner Health System Institutional Review Boards. We used an electronic dataset compiled from medical records; thus, this study was exempt from obtaining written informed consent of all participants enrolled in the study.

Baseline measurements

The National Patient-Centered Clinical Research Network (PCORnet) common data model is a specification that defines a standard organization and representation of data for the PCORnet distributed research network. The patients' information, including birth date, age at diabetes diagnosis, race, sex, date of examination, weight, height, body mass index (BMI), blood pressure, smoking habits, diagnosis of various diseases and date of diagnosis, laboratory test date, total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, HbA1c, estimated glomerular filtration rate (eGFR), and medication history such as antihypertensive drug, glucose-lowering drug and lipid-lowering drug within a half-year after the diabetes diagnosis (baseline) and during follow-up after the diabetes diagnosis (follow-up), was extracted from this common data model. Using a set of questions about smoking status at each clinical visit, we classified the patients into 3 groups: current smokers, past smokers, and never smokers. The eGFR was estimated using the Modification of Diet in Renal Disease (MDRD)¹².

Follow-up

We created the follow-up database in electronic form by using the number assigned to every patient who visited the health system as a unique patient identifier. The present study evaluated four major diabetic complications: coronary heart disease (CHD), heart failure, stroke (ischemic or hemorrhagic) and end-stage renal disease (ESRD). The ICD-9-CM and ICD-10-CM codes were used to identify CHD (ICD-9-CM codes 410–414, and 429.2; ICD-10-CM codes I20–I25), heart failure (ICD-9-CM codes 402.01, 402.11, 402.91, and 428; ICD-10-CM codes I50), stroke (ICD-9-CM codes 430–436; ICD-10-CM codes I60–I66), and ESRD (ICD-9-CM codes 250.4, 403–404, 585, and 586; ICD-10-CM codes N18.6). These diagnoses were recorded in the course of routine patient care by the patients' treating clinicians. The duration of follow-up for each cohort member (person-year) was tabulated from the date of the first record documentation of diabetes to the date of the

recorded diagnosis of one of the four disease outcome of interest, death of inpatients or October 31, 2017.

Statistical analyses

We calculated the age- and sex-adjusted race-specific incident rate for each outcome by the direct adjustment to the year 2010 United States Census population using the age groups 35–45, 45–54, 55–64, 65–74, and 75 years or older. The incident rates were presented as the number of events per 1000 person-years with 95% confidence interval (CI). Cox proportional hazards regression was used to estimate hazard ratios (HRs) for each of the four outcomes between African Americans and whites (reference group). The above analyses were first carried out adjusting for age and sex, and further for smoking, BMI, systolic blood pressure, HbA1c, LDL cholesterol, HDL cholesterol, triglycerides, eGFR, use of antihypertensive drugs, use of glucose-lowering medications, and use of lipid-lowering medications. A chi-squared log-likelihood ratio test was carried out to test the significance of the interaction. Statistical significance was considered to be $P < 0.05$. All statistical analyses were performed by using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, N.Y., USA)

Results

Of 67,544 patients, 19,301 (29%) were white women, 16,170 (24%) were African American women, 21,130 (31%) were white men, and 10,943 (16%) were African American men. Table 1 shows baseline characteristics of the study population according to race and sex. African Americans with diabetes were younger but had higher blood pressure, HDL cholesterol, LDL cholesterol, HbA1c, and higher proportion of current smokers and using more lipid lowering medication when compared with whites with diabetes. Whites with diabetes had higher triglycerides and more glucose-lowering treatment than their African American counterparts.

Coronary heart disease

During a mean follow-up of 2.91 years, 11,260 patients developed CHD. Whites had a higher age-adjusted incident rate per 1000 persons-years of CHD than African Americans: 46.2 (95% CI 44.8–47.5) vs 43.1 (95% CI 41.6–44.6) (Table 2). Age-adjusted incident rates of CHD were lower in women than in men for both races. Compared to white men, African American men had a 12% decreased risk for CHD when adjusting for major risk factors (Table 3). However, African American women showed a similar multivariable-adjusted hazard ratio (HR) (1.03, 95% CI 0.97–1.09) for CHD compared with white women. There was a significant interaction of sex and race with the risk of CHD (P for interaction < 0.001).

Heart failure

We identified 9066 new cases of heart failure during a mean follow-up of 3.09 years. Age-adjusted incident rates of heart failure were lower in African American women than in African American men and white age-adjusted incident rates of heart failure were lower in white women than in white men. When men and women were combined, age- and sex-adjusted incident rates per 1000 person-years were 36.6 (95% CI 35.2–37.9) in African

Americans and 26.6 (95% CI 25.7–27.5) in whites (Table 2). Multivariable-adjusted HR of heart failure was 1.33 (95% CI 1.25–1.43) for African American men compared with white men, and 1.26 (95% CI 1.18–1.34) for African American women compared with white women (Table 3). There was no interaction between sex and race with the risk of heart failure (P for interaction >0.25).

Stroke

There were 8496 patients who experienced a first stroke during a mean follow-up of 3.09 years. Age- and sex-adjusted incident rates per 1000 person-years of stroke were higher in African Americans than in whites: 29.6 (95% CI 28.4–30.8) vs 25.5 (95% CI 24.6–26.4) (Table 2). Multivariable-adjusted HR of stroke was 1.15 (95% CI 1.08–1.2) for African-American women compared with white women. African-American men had a similar HR of stroke compared with white men when adjusting for major risk factors (Table 3). There was a significant interaction between sex and race with the risk of stroke (P for interaction < 0.05).

End-stage renal disease

During a mean follow-up of 2.89 years, 8565 diabetes patients developed ESRD. African Americans had a higher age-adjusted incident rate per 1000 person-years of ESRD than whites: 38.3 (95% CI 36.9–39.7) vs 27.5 (95% CI 26.5–28.5) (Table 2). Multivariable-adjusted HRs of ESRD for African Americans compared with whites were 1.47 (95% CI 1.37–1.57) for men, and 1.32 (95% CI 1.24–1.40) for women (Table 3). There was a significant interaction between sex and race with the risk ESRD (P for interaction < 0.05).

Discussion

This is a large-scale study investigating the incidence of diabetic complications between African-Americans and whites among 67,544 patients with type 2 diabetes. We found race and sex differences in the incidence of diabetic complications in the current study. The results suggested that African Americans with type 2 diabetes had lower CHD rates, and higher heart failure and ESRD rates than whites with diabetes. The risk of CHD was lower in African Americans than whites in men and the risk of stroke was higher in African Americans than whites in women.

While a number of studies have found racial and ethnic differences in diabetes prevalence or incidence, few studies have examined complications of diabetes. Compared with other studies, our study included a large African American population with diabetes. As a large cohort of patients with type 2 diabetes, the present study has more statistical power to observe the potential racial differences, especially in population with diabetes in Louisiana. Louisiana has one of the highest adult obesity rates in the nation¹³ and high prevalence of these risk factors for diabetic complications such as current smoking, physical inactivity, hypertension and high cholesterol. These factors play an important role in the higher incidence of diabetic complications. Although there are differences in the risk factors for CHD, with African Americans being more likely than whites to have hypertension and poor glycemic control, there is no clear evidence for differences in CHD among individuals with

diabetes. In the present study, we found African Americans with diabetes had lower incident rates of CHD than whites although African Americans had higher blood pressure, HbA1C, and LDL cholesterol level compared with whites. Our study is consistent with 2 studies from the United Kingdom^{14,15} which reported a lower risk of cardiovascular disease in blacks and Asians compared with whites. A systemic review indicated that blacks had a lower risk of developing cardiovascular complications of diabetes compared with whites¹⁶. Although the categories used during the analysis were not directly comparable among these studies, a generally concordant lower risk of CHD was found in African Americans, especially in African American men^{9,10,17,18}. Demographic and socioeconomic characteristics among different cohorts might vary and bias the results, therefore additional studies are still needed to confirm these findings.

Previous studies have provided conflicting data on sex or racial differences in heart failure incidence among people with diabetes^{10,19}. Results from the EMPA-REG OUTCOME trial showed a numerically higher event rate of HF in women than in men²⁰. In the National Registry of Myocardial Infarction, women were more likely to have HF at the time of acute MI presentation or complicating their MI hospitalization¹⁹. The present study indicated that African Americans with diabetes showed a higher risk of heart failure compared with whites. Meanwhile, the age-adjusted incident rate of HF was higher in white women than in white men²¹. Sex difference in the rates of HF might be explained by the sex difference in the cardiac remodeling. Racial differences in the rates of HF are still necessary to be confirmed in further studies.

Very few studies have assessed racial differences in stroke risk between African Americans and whites with diabetes, and results are inconsistent. Kaiser Permanente Medical Care Program found a higher hospitalization risk for cerebrovascular diseases among African Americans than whites²², while analysis from another cohort (the Atherosclerosis Risk in Communities, ARIC) however showed an increasing prevalence of intracranial atherosclerotic disease in black men²³. In our previous report of a large health system in Louisiana called the Louisiana State University Hospital-Based Longitudinal Study, we reported a higher risk of stroke among whites with diabetes than that among African Americans (HR, 1.16 (1.10–1.22)), who are poor and underinsured²⁴. The result is opposite to the current study and may be explained by the differences between these two cohorts in health insurance types, health care quality, health care access and the ratio of African Americans and whites in the study population.

With the number of patients with diabetes growing, the prevalence of diabetic kidney disease (DKD), which is one of the most serious complications, is expected to rise. DKD is one of the leading causes of end stage renal disease (ESRD) in the world. The prevalence and incident rates of ESRD in the United States have increased steadily over the past 3 decades with an estimated 16,000 patients beginning treatment for ESRD in 2011. More than 600,000 patients need dialysis or a kidney transplant²⁵. In the U.S., the incident rate of ESRD is 3.4-fold higher among African Americans than whites with and without diabetes^{26,27}. The risk factors identified for the development and progression of DKD include duration of diabetes, poor glycemic control and hypertension²⁸. A meta-analysis indicated that African Americans with type 2 diabetes had worse metabolic control than

whites. Studies of European and American populations suggested a higher frequency of obesity, metabolic syndrome^{29,30} and worse glycemic control³¹ in the black population, which might partly contribute to the higher prevalence of ESRD in blacks. Our study showed that African Americans with diabetes had higher blood pressure and HbA1c level than whites which might result in a higher risk of ESRD among African Americans with diabetes. This result was consistent with the other previous studies.

Epidemiological studies have indicated that women with diabetes have about a 4 times greater risk of cardiovascular diseases than non-diabetic women, and men with diabetes have about a 2 times greater risk of cardiovascular diseases than non-diabetic men. However, evidence on sex differences in diabetes complications are not clear. A meta-analysis of 37 prospective studies suggested that women with diabetes had a 50% increase in cardiovascular mortality compared with men after taking into consideration cardiovascular risk factors³². The causes that can partly explain the sex difference are as follows: women with diabetes have higher rates of specific risk factors such as gestational diabetes mellitus^{33–35} and poly-cystic ovarian syndrome³⁶ with the exception of smoking and low HDL cholesterol than men with diabetes³⁷. Moreover, women with diabetes have more marked endothelial dysfunction^{38,39}, greater degree of thrombosis⁴⁰, more adverse changes in coagulation and cardiovascular risks compared with men with diabetes^{41,42}. There are limited and even less consistent data regarding the contribution of sex to the rate of progression of nephropathy in type 2 diabetes⁴³. ESRD registry data suggested that in the US in 2010, per million population of diabetes individuals, adjusted for age and race, the incident rate was 24% greater in men than in women⁴⁴. In contrast, numerous studies have found no impact of sex on the prevalence, incidence of nephropathy in type 2 diabetes.

In addition to the above factors, socioeconomic status (SES) can partly explain the race differences in diabetes-related outcomes⁴⁵. Excess adverse health outcomes among African Americans are likely due in part to lower SES. Disparate access to quality health care is a common explanation for race differences in diabetic complication rates in the United States. Some studies found age-adjusted diabetes-related mortality rates to be two to three times higher for those with less than a high school education compared with those with at least a college degree^{46,47}. The present study has no relevant data on health insurance coverage or another marker of SES, thus we cannot make conclusions about the relationship between SES and incident rates of diabetic complications.

The major strength of this study is the large sample size with rich clinical data, the latest data on Louisiana populations with diabetes and high proportion of African Americans. We reported the adjusted incident rates of four major diabetic complications of population with type 2 diabetes, which provides important information for understanding the race differences between African Americans and whites of Louisiana. The data we used from administrative databases avoided the problem of differential recall bias. Data in this study were all extracted from the three partners of REACHnet, which minimizes the influence from the accessibility of health care, particularly in comparing African-Americans with whites. There are several limitations in our study. Health system records are subject to misclassification. Whether health care quality received by the study population was equivalent or not across race groups was unclear. We were unable to evaluate the socioeconomic status of the study

cohort due to missing health insurance information, education level and family income information in the REACHnet. Because our analyses were mainly focused on the patients with complete information, the results have limited external generalizability and also are only generalizable to Southern Louisiana. Our analyses adjusted for some confounding factors, however, unmeasured factors such as family history of diabetes, other related chronic diseases, dietary factors and physical activity status cannot be excluded.

Conclusions

In conclusion, our study suggests that African Americans with diabetes have higher risks of heart failure, stroke and ESRD than whites, whereas whites with diabetes have a higher risk of CHD than African Americans. More race-specific studies on complications in patients with diabetes are needed to see if incident rates are changing over time.

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Highlights

- We conducted a large prospective cohort study to test whether there were racial and sex differences in the incidence of major diabetic complications between African Americans and whites with diabetes
- African Americans with diabetes had lower CHD rates, and higher heart failure, stroke and ESRD rates than whites with diabetes.
- The risk of CHD was lower in African American men than that in white men and the risk of stroke was higher in African American women than that in white women.

Table 1.

Baseline characteristics of African-American and white men and women with diabetes

Characteristics	Men			Women		
	African-American	White	P value	African-American	White	P value
Participants, n=67,544	10,943	21,130		16,170	19,301	
Age (yr), mean (SE)	63.4 (0.1)	67.4 (0.1)	<0.001	65.0 (0.1)	68.6 (0.1)	<0.001
BMI (kg/m ²), mean (SE)	32.0 (0.07)	32.1 (0.05)	0.244	34.1 (0.06)	33.1 (0.06)	<0.001
Blood pressure (mmHg), mean (SE)						
Systolic	136 (0.1)	131 (0.1)	<0.001	136 (0.1)	132 (0.1)	<0.001
Diastolic	78 (0.1)	75 (0.1)	<0.001	76 (0.1)	73 (0.1)	<0.001
Total cholesterol (mg/dl), mean (SE)	166 (0.4)	159 (0.3)	<0.001	179 (0.3)	178 (0.3)	0.058
HDL cholesterol (mg/dl), mean (SE)	42 (0.1)	39 (0.1)	<0.001	49 (0.1)	47 (0.1)	<0.001
LDL cholesterol (mg/dl), mean (SE)	99 (0.3)	90 (0.2)	<0.001	106 (0.3)	100 (0.2)	<0.001
Triglycerides (mg/dl), mean (SE)	128 (0.8)	161 (0.7)	<0.001	118 (0.5)	159 (0.6)	<0.001
HbA1c (%), mean (SE)	7.7 (0.02)	7.2 (0.01)	<0.001	7.5 (0.01)	7.1 (0.01)	<0.001
Estimated GFR (mL/min/1.73 m ²) (%)			<0.001			<0.001
90	23.5	36.7		57.2	65.8	
60–89	46.5	43.2		25.2	23.1	
30–59	20.1	16.3		11.0	8.8	
15–29	4.0	2.6		3.3	1.6	
<15	5.9	1.2		3.3	0.6	
Obesity status (%)			<0.001			<0.001
Normal weight (<25 kg/m ²)	13.8	11.5		10.4	13.8	
Overweight (25–29.9 kg/m ²)	30.5	30.9		23.2	25.0	
Obesity class I (30.0–34.9 kg/m ²)	28.4	30.3		27.1	26.3	
Obesity class II and III (≥ 35 kg/m ²)	27.3	27.3		39.3	34.9	
Current smoker (%)	25.0	23.0	<0.001	18.0	15.9	<0.001
Insurance type (%)			<0.001			<0.001
Commercial/private	43.1	46.7		40.4	41.4	
Medicare	34.9	41.2		37.2	44.8	
Medicaid	3.9	1.9		4.9	2.9	
Self-pay	6.5	4.9		5.3	4.6	
Others	0.4	0.3		0.2	0.2	
No information	11.1	5.1		12.0	6.2	
Use of medications (%)						
Lipid-lowering medication	57.4	64.0	<0.001	57.3	62.6	<0.001
Antihypertensive medication	76.8	77.5	0.156	78.1	77.1	0.029
Glucose-lowering medication	70.9	73.4	<0.001	71.2	72.2	0.042

Values are adjusted for age. BMI, Body mass index. GFR, Glomerular filtration rate.

Table 2.

Incident rates of coronary heart disease, heart failure, stroke, and end-stage renal disease among African-American and white patients with diabetes

	African-American			White		
	Men	Women	Men and women combined ^a	Men	Women	Men and women combined ^a
Coronary heart disease						
Case/participants, n	1710/9307	2422/14,484	4132/23,791	4026/16254	3102/16,666	7128/32,920
Person-years	26,732	43,638	70,370	45,061	49,496	94,558
Unadjusted incidence rate (95% CI)	64.0 (61.0–66.9)	55.5 (53.4–57.7)	58.7 (57.0–60.5)	89.3 (86.7–92.0)	62.7 (60.5–64.8)	75.4 (73.7–77.1)
Age-adjusted incidence rate (95% CI)	45.4 (42.4–48.3)	42.1 (40.3–44.0)	43.1 (41.6–44.6)	51.7 (49.7–53.8)	40.3 (38.5–42.0)	46.2 (44.8–47.5)
Heart failure						
Case/participants, n	1469/9789	2179/14,817	3648/24,606	2907/19,343	2511/17,842	5418/37,185
Person-years	29,222	45,842	75,064	59,964	55,880	115,844
Unadjusted incidence rate (95% CI)	50.3 (47.8–52.8)	47.5 (45.6–49.5)	48.6 (47.1–50.1)	48.5 (46.8–50.2)	44.9 (43.2–46.7)	46.8 (45.6–48.0)
Age-adjusted incidence rate (95% CI)	37.2 (35.1–39.4)	36.6 (34.9–38.3)	36.6 (35.2–37.9)	25.5 (24.2–26.8)	27.2 (25.8–28.5)	26.6 (25.7–27.5)
Stroke						
Case/participants, n	1235/10,141	2041/15,064	3276/25,205	2738/19,569	2482/17,903	5220/37,472
Person-years	30,949	46,583	77,532	60,430	55,737	116,167
Unadjusted incidence rate (95% CI)	39.9 (37.7–42.1)	43.8 (42.0–45.7)	42.3 (40.8–43.7)	45.3 (43.7–47.0)	44.5 (42.8–46.2)	44.9 (43.7–46.1)
Age-adjusted incidence rate (95% CI)	28.0 (26.2–29.9)	31.3 (29.7–32.8)	29.6 (28.4–30.8)	24.6 (23.4–25.8)	26.1 (24.7–27.4)	25.5 (24.6–26.4)
End-stage renal disease						
Case/participants, n	1387/9310	2035/14,424	3422/23,734	2679/19,255	2464/17,832	5143/37,087
Person-years	26,074	42,312	68,386	56,670	52,797	109,467
Unadjusted incidence rate (95% CI)	53.2 (50.5–55.9)	48.1 (46.1–50.1)	50.0 (48.4–51.7)	47.3 (45.5–49.0)	46.7 (44.9–48.5)	47.0 (45.7–48.2)
Age-adjusted incidence rate (95% CI)	41.6 (39.2–44.0)	37.0 (35.2–38.8)	38.3 (36.9–39.7)	26.3 (25.0–27.6)	28.3 (26.9–29.7)	27.5 (26.5–28.5)

Incidence rate presented as per 1000 person-years.

^a Also adjusted for sex.

Table 3.

Hazard ratio for nonfatal coronary heart disease, heart failure, stroke, and end-stage renal disease among African-American and white patients with diabetes

	Age-adjusted hazard ratios (95% CIs)		Multivariate-adjusted hazard ratios (95% CI) ^a		
	White	African-American	White	African-American	P interaction
Coronary heart disease					
Men	1.00	0.83 (0.78–0.88)	1.00	0.88 (0.83–0.94)	<0.001
Women	1.00	1.01 (0.96–1.07)	1.00	1.03 (0.97–1.09)	
Heart failure					
Men	1.00	1.24 (1.17–1.32)	1.00	1.33 (1.25–1.43)	>0.25
Women	1.00	1.25 (1.18–1.33)	1.00	1.26 (1.18–1.34)	
Stroke					
Men	1.00	1.04 (0.98–1.12)	1.00	1.03 (0.96–1.10)	<0.001
Women	1.00	1.16 (1.09–1.23)	1.00	1.15 (1.08–1.22)	
End-stage renal disease					
Men	1.00	1.36 (1.27–1.45)	1.00	1.47 (1.37–1.57)	<0.05
Women	1.00	1.27 (1.20–1.35)	1.00	1.32 (1.24–1.40)	

^a Adjusted for different health care system, age, smoking, body mass index, systolic blood pressure, HbA1c, LDL cholesterol, HDL cholesterol, triglycerides, use of antihypertensive drugs, use of glucose-lowering medications, and use of lipid-lowering medications.