End-stage Renal Disease Due to Diabetes in Racial/Ethnic Minorities and Disadvantaged Populations

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This review presents data on end-stage renal disease (ESRD) due to diabetes (ESRD-DM) from populations of several racial/ethnic groups and regions; it also identifies factors that may explain differences in risk of ESRD-DM among these groups. Diabetes is a major cause of ESRD in several developed countries, including the United States, England, and Australia. However, in these countries, the incidence is much higher for some groups, such as Blacks and Native Americans in the United States, Blacks and Indo-Asians in England, and indigenous populations in Australia. Despite the worldwide increase in the prevalence of diabetes, in some regions such as South Africa and Brazil, the rates of ESRD attributed to hypertension and glomerulonephritis are even higher than rates attributed to diabetes. High prevalence of accelerated/malignant hypertension and infection-related glomerulonephritis in addition to a higher risk of early death from diabetes might partially explain the predominance of ESRD attributed to hypertensive nephropathy and glomerulonephitis in South Africa and Brazil. These data call attention to the need to develop more effective strategies to prevent type 2 diabetes and thereby reduce the racial/ethnic gap in ESRD-DM. A greater emphasis on hypertension and diabetes control, particularly in racially and economically disadvantaged populations, is also necessary. (*Ethn Dis.* 2009; 19[Suppl 1]:S1-47–S1-51)

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Introduction

Diabetic nephropathy is a major cause of end-stage renal disease (ESRD) in the United States and other developed countries.[1,2] Most ESRD cases in these regions are caused by type 2 diabetes, a potentially preventable disease. In developing nations, diabetes is also a major cause of ESRD; however, variation in the distribution of the underlying nephropathy in patients with ESRD in developing regions has been observed.[3,4]

The present review has the following objectives: 1) discuss variations in the incidence of ESRD attributed to diabetes (ESRD-DM) among racial/ethnic groups and regions; 2) present potential explanations for differences in ESRD-DM among these groups; 3) and identify interventions that might reduce the racial/ethnic gap in ESRD-DM and its burden in disadvantaged populations.

Incidence of End-stage Renal Disease by Race, Ethnicity, and Region

Table 1 shows the incidence rate of ESRD-DM by racial groups in the United States as reported by the United States Renal Data System, combining the data from 2001 to 2004.[5] Compared with Whites, the age- and sex-adjusted incidence of ESRD-DM was 3.8 times higher for Blacks, 3.5 times higher for Native Americans, and 1.5 times higher for Asians. No variation by sex was observed in the age-adjusted Asian/White rate ratio of ESRD-DM. Variation by sex was observed in the Black/White and Native American/White rate ratios, which were higher among women than among men. An effect modification by age was also observed for the Asian/White comparisons. For example, below age 45, there was no excess incidence of ESRD-DM for Asians, but for ages above 44 the incidence rate of ESRD-DM was higher among Asians, with a consistent increase in the rate ratio with increasing age. Asians were the only group that showed an increase in the incidence rate of ESRD-DM for ages above 74. With Whites as the reference group, an excess incidence was observed for Blacks and Native Americans for all age groups above 19 years.

Until 1999, the incidence of ESRD-DM was higher for Native Americans than for Blacks.[5] By contrast, since 2000 the reported incidence rate of ESRD-DM has been higher for Blacks than for Native Americans. Until 1994, hypertension was reported as the main cause of ESRD in US Black men.[6,7] Currently, however, diabetes is the main reported cause of ESRD in this group.[5,8] In April 1995, the United States Renal Data System introduced a new form that provides information on Hispanic ethnicity. It is now clear that the incidence rate of ESRD is much higher for Hispanics than for non-Hispanics, and this difference is wider for ESRD-DM.[5]

Studies outside the United States have also shown racial/ethnic differences in the incidence of ESRD-DM. One study found that for ages above 30 years, Surinamese South Asian migrants living in the Netherlands had a nearly 40-fold higher age-adjusted risk of ESRD-DM than their European Dutch counterparts.[9] Similar to the United States, in the United Kingdom, diabetes is the major reported cause of ESRD.[2] Higher incidence rates of ESRD-DM have been reported for Indo-Asians and African Caribbeans

Table 1. Incidence of end-stage renal disease attributed to diabetes in the United States by race, stratified and adjusted for sex and age

	Incidence Rate (per 10 Million)				Rate Ratio			
	White	Black	Native American	Asian	White (Reference)	Black	Native American	Asian
Age (years)					Men			
20–44	331	990	824	174	1	3.0	2.5	0.5
45–64	2309	8590	7365	3199	1	3.7	3.2	1.4
65–74	5859	18,279	15,279	8860	1	3.1	2.6	1.5
≥75	5529	14,397	9657	9865	1	2.6	1.7	1.8
All adjusted for age*	1358	4498	3631	2003	1	3.3	2.7	1.5
Age (years)					Women			
20–44	240	801	972	145	1	3.3	4.1	0.6
45–64	1748	7792	7561	1895	1	4.5	4.3	1.1
65–74	4639	19,674	21,061	7202	1	4.2	4.5	1.6
≥75	3102	13,591	11,326	8246	1	4.4	3.7	2.7
All adjusted for age*	980	4281	4251	1470	1	4.4	4.3	1.5
Age (years)					Overall			
20–44	272	898	925	162	1	3.3	3.4	0.6
45–64	2247	9535	8617	2999	1	4.2	3.8	1.3
65–74	5253	19023	18050	8119	1	3.6	3.4	1.5
≥75	4006	12853	9049	8578	1	3.2	2.3	2.1
All adjusted for age*	1148	4390	3975	1713	1	3.8	3.5	1.5

* Also includes ages <20 years.

than for Whites living in the United Kingdom.[2,10] In Oceania, the incidence of ESRD is higher among Aborigines, Torres Straits Islanders, Pacific Islanders, and Maori than in nonindigenous populations.[11] Most kidney disease in indigenous populations from Oceania is attributed to diabetes.[4]

Despite the worldwide increase in the prevalence of diabetes, data from certain developing regions indicate that rates of ESRD due to hypertension and glomerulonephritis are even higher than the rate of ESRD-DM.[12–14] In Brazil, for example, diabetes has been reported as the third leading cause of ESRD; hypertension and glomerulonephritis are first and second, respectively.[3] In the Prospective Study of the Prognosis in Chronic Hemodialysis Patients, developed in Salvador—a large city in northeastern Brazil where a substantial proportion of the population is of African ancestry—hypertension is the main cause of ESRD, followed by glomerulonephrits and diabetes (Table 2).[15] However, a variation in the distribution of the underlying nephropathy by race and educational level is apparent. The percentage of ESRD cases attributed to hypertension or glomerulonephritis was significantly higher ($P < .05$) in patients with less than a high school education (66.3%), compared with those with at least a high school education (56.5%) and in Black (68.3%) or mixed race (62.0%)

Table 2. Distribution of causes of end-stage renal disease by education level and race in patients treated in dialysis units in the city of Salvador, Brazil—PROHEMO*

	Education		Race			All
Cause	% Less than High School ($n = 487$)	% At Least High School ($n = 271$)	% White ($n = 66$)	% Mixed ($n = 471$)	% Black ($n = 221$)	% ($n = 758$)
Hypertension	40.9	28.0	31.8	33.3	43.9	36.3
Glomerulonephritis	25.5	28.4	18.2	28.7	24.4	26.5
Diabetes	15.8	19.9	22.7	17.8	14.5	17.3
Polycystic kidney disease	4.5	3.7	6.1	5.1	1.8	4.2
Obstructive	3.7	7.0	6.1	5.1	4.1	4.9
Unknown	1.2	.7	0	1.1	1.4	1.1
Other	8.4	12.2	15.2	8.9	10.0	9.8

* PROHEMO (Prospective Study of the Prognosis of Chronic Hemodialysis Patients) is a prospective cohort study that has been conducted in dialysis units in the city of Salvador, northeastern Brazil, since 2005.

patients, compared with White patients (50%).

Similar to findings from Salvador, in populations from sub-Saharan Africa, including Black South Africans, glomerulonephritis and hypertension were found to be the major causes of ESRD.[12] High prevalence of accelerated/malignant hypertension and infection-related glomerulonephritis might partially explain the predominance of ESRD attributed to hypertensive nephropathy and glomerulonephitis in Brazil and African countries.[12,16,17] The risk of early death in diabetic patients because of poor access to health care should also be viewed as a potential explanation for the pattern of specific causes of ESRD reported in these regions.[18–21]

Potential Explanations for the Racial/Etnic Differences in ESRD-DM

There are large differences in the prevalence of primary causes of ESRD among racial/ethnic groups in the United States.[22–25] Blacks, for example, have higher prevalence than Whites of both type 2 diabetes and hypertension.[23,25] A much higher risk of type 2 diabetes has also been observed for Native Americans and Hispanics than Whites.[22,24] Obesity, lack of exercise, and dietary habits are modifiable factors that could explain, at least partially, the higher prevalence of type 2 diabetes as well as hypertension in racial/ethnic minorities in the United States. Racial/ethnic differences in prevalence of diabetes, however, can explain only partially the excess risk of ESRD-DM observed in racial/ethnic minorities in the United States.[26]

The fact that the excess risk of ESRD for racial/ethnic minorities in United States cannot be totally explained by differences in prevalence rates of the primary causes of renal diseases suggests that, among patients from minority populations, diabetes is associated with higher risk of chronic kidney disease (CKD). We should also consider the possibility of a faster progression of diabetic nephropathies toward ESRD in minority populations. Consistent with these possibilities, data indicate that type 2 diabetes in Native Americans is associated with high risk of nephropathy and a faster progression toward ESRD.[27,28] In addition to genetic factors, environmental factors, such as smoking, diet, and treatment factors may also contribute to accelerated kidney disease and should be viewed as potential mediators of the higher incidence of ESRD-DM in racial/ethnic minorities in the United States.

Another factor that should be viewed as potential contributor for racial/ethnic differences in ESRD-DM is low birthweight. Black Americans have a higher risk of low birthweight than do White Americans.[29] Low birthweight is associated with postpartum anatomic and functional alterations in the kidney and pancreas as well as with progressive renal damage in animals and increased risk for hypertension and type 2 diabetes during adulthood in humans.[30] A case-control study in the southeastern United States showed an increased odds of ESRD in those with history of low birthweight (<2,500 g).[31] Several environmental/behavioral factors have been cited as potential contributors to the large difference in low birthweight between Black and White Americans.[32–34] Moreover, evidence suggests that genetic factors play only a minor role in low birthweight.[35] These data suggest that the differences between Blacks and Whites in low birthweight and ESRD could be reduced by interventions directed to the primary causes of low birthweight.

INTERVENTIONS TO REDUCE THE RACIAL/ETHNIC GAP IN ESRD-DM AND THE BURDEN OF THE DISEASE IN DISADVANTAGED POPULATIONS

The individual risk of chronic kidney disease initiation and progression is likely determined by interactions among genetic, environmental, and behavioral factors. To reduce the large racial/ethnic gap and the burden of ESRD-DM for disadvantaged populations, however, more attention should be directed to modifiable environmental and behavioral factors that cause type 2 diabetes. Based on previous studies, population-based programs aimed at reducing obesity, preventing low birthweight, changing dietary habits, and increasing physical exercise practice should reduce the racial/ethnic gap in type 2 diabetes and the burden of the disease for disadvantaged populations.[36,37] Additionally, these population-based interventions should reduce the racial gap in uncontrolled hypertension that is also a mediator of the progression of diabetic nephropathy and a major cause of ESRD, particularly in minority and disadvantaged populations.

In addition to interventions directed to the primary causes of type 2 diabetes, it is important to increase the focus on interventions to reduce the progression of diabetic nephropathy toward ESRD, such as glycemic control, smoking cessation, and blood pressure control. To improve the control of diabetes and hypertension and reduce/eliminate smoking in minority populations, access to high-quality health care should be improved and health education should be promoted. The need to improve healthcare access and quality to reduce the racial/ethnic gap in chronic diseases such as diabetes, hypertension, and chronic kidney diseases in the United States is supported by numerous epidemiologic studies.[38–40] A national survey showed that Blacks had less access to health care, received less information about their disease from the physicians, and were more dissatisfied than Whites with treatment received.[39] In this national survey, Black patients with diagnosed hypertension were ≈60% more likely than their White counterparts to not have at least one annual blood

pressure check. These Black/White disparities in health care were observed at all income levels. Observations among inner-city hypertensive Blacks are also consistent with poor blood pressure control.[38] The rate of uncontrolled blood pressure was equally poor among inner-city Blacks with public and private sources of health care.

The control of hypertension and diabetes is also poorer for Mexican Americans than for non-Hispanic Whites.[23,40] Data from the third National Health and Nutrition Examination Survey showed that a lower proportion of both Mexican Americans and African Americans than Whites with type 2 diabetes had their blood pressure checked.[25] Moreover, the proportion of diabetic patients with hemoglobin A1C ≥7% and blood pressure ≥140/90 mm Hg was also higher for African American and Mexican Americans than for Whites. Barriers to high-quality health care also prevent improvements in the treatment of diabetes among Native Americans and disadvantaged populations in South America and Africa.[28,41–44]

CONCLUSIONS

Diabetes is a major cause of ESRD, particularly for racial/ethnic minorities in nations such as the United States and United Kingdom. Programs to prevent diabetes should target high-risk populations, particularly racial/ethnic minorities from developed countries and disadvantaged populations worldwide. A higher incidence of ESRD due to hypertension and glomerulonephritis, compared with the incidence of ESRD-DM in certain countries such as Brazil and South Africa, could be explained by higher rates of accelerated/malignant hypertension, higher prevalence of infection-related glomerulonephritis, or high risk of early death in patients with diabetes. A greater emphasis on primary prevention of diabetes and on interventions to reduce the risk and progression of the associated nephropathy could reduce the incidence of ESRD-DM, particularly for racial/ethnic minorities and disadvantaged populations.

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