Ethnic and Racial Differences in Diabetes Care

The Insulin Resistance Atherosclerosis Study

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OBJECTIVE — Diabetes and its complications disproportionately affect African Americans and Hispanics. Complications could be prevented with appropriate medical care. We compared five processes of care and three outcomes of care among African Americans, Hispanics, and non-Hispanic whites.

RESEARCH DESIGN AND METHODS — We used data from the Insulin Resistance Atherosclerosis Study (1993–1998) of participants with known diabetes. African Americans and Hispanics were compared with non-Hispanic whites from the same region. Five process measures (treatment of diabetes, hypertension, hyperlipidemia, albuminuria, and coronary artery disease) and three outcome measures (control of diabetes, hypertension, and hyperlipidemia) were evaluated.

RESULTS — Comparison groups were similar in baseline characteristics. African Americans and Hispanics were equally likely as their non-Hispanic white comparison group to receive treatment for diabetes, hypertension, hyperlipidemia, albuminuria, and coronary artery disease, although treatment rates for hyperlipidemia and albuminuria were poor for all groups. African Americans were more likely to have poorly controlled diabetes (HbA_{1c} >8.0%: OR 2.23, 95% CI 1.26–3.94). Both African American and Hispanics were significantly more likely to have borderline or poorly controlled hypertension than non-Hispanic whites (blood pressure >130–140/85–90 or >140/90 mmHg: African American/non-Hispanic white OR 3.22, 95% CI 1.57–6.59; Hispanic/non-Hispanic white 3.14, 1.35–7.3).

CONCLUSIONS — The rates of treatment for diabetes and associated comorbidities are similar across all three ethnic groups. Few individuals in any ethnic group received treatment for hyperlipidemia and albuminuria. Ethnic disparities exist in control of diabetes and hypertension. Programs should be tested to improve overall quality of care and eliminate these disparities.

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Diabetes is a major health problem in the U.S. Reducing the incidence and economic burdens of diabetes is one of the goals of Healthy People 2010 (1). Over 5% of the American population have diagnosed diabetes, and another 7% have undiagnosed diabetes (2). Minority populations are disproportionately affected by diabetes and its complications (3). Nearly 14% of Hispanics and 12% of African Americans are affected by diabetes compared with 7% of non-Hispanic whites (2). On a national level, African Americans and Hispanics have more diabetes-associated nephropathy (4), retinopathy (5), and diabetes-related amputations than non-Hispanic whites (6). However, studies conducted in populations with uniform health coverage have demonstrated attenuated health disparities in outcomes (7). The reasons for these disparities in complications are unclear. Several theories have been proposed, including greater burden of disease among minorities, disease severity, genetic predisposition, inadequate access to diabetes prevention and control programs, and differences in access and quality of diabetes care (1). The recent Institute of Medicine report on health care disparities among ethnic groups, as well as other studies, examined quality of care, and some but not all studies have shown disparities in the quality of care provided to minorities with diabetes (8–12). In this report, we compare processes and outcomes of care of individuals with diabetes among three different ethnic/racial groups: African Americans, Hispanics, and non-Hispanic whites.

RESEARCH DESIGN AND METHODS

— The Insulin Resistance Atherosclerosis Study (IRAS) was begun in 1992 with the primary aim of exploring the relationships among insulin resistance, cardiovascular disease risk factors and behaviors, and clinical and subclinical cardiovascular disease in a large multiethnic population. Expanded study methods have been published previously (13). Briefly, 1,624 individuals aged 40–69 years with either normal glucose tolerance, impaired glucose tolerance, or type 2 diabetes not treated with insulin were recruited from four clinical centers (African Americans and non-Hispanic whites from Los Angeles and Oakland, CA; Hispanics and non-Hispanic whites

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Abbreviations: IRAS, Insulin Resistance Atherosclerosis Study.

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

from San Luis Valley, CO, and San Antonio, TX) with approximately equal representation from the three ethnic/racial groups. The California sites recruited participants from Kaiser Permanente membership rosters, while the Colorado and Texas sites recruited from ongoing observational cohort studies. The study design was observational; no interventions were performed, and participants received their usual medical care from their primary care physician if they had one. Two interview/clinical evaluations were performed, ~5 years apart (1992–1994 and 1998–1999). At these visits, medical histories were obtained by interview and several clinical tests were performed.

To evaluate processes and outcomes of care in 1998–1999 among persons with diabetes, we defined our analysis cohort as those participants either having diabetes at visit 1 (by self-report or World Health Organization glucose tolerance criteria) or at visit 2 (by self-report). Because the primary goal of the study was to compare processes and outcomes of care in individuals with known diabetes, we excluded participants with unknown or undiagnosed diabetes at visit 2. Comparisons were made between African Americans and non-Hispanic whites from the same clinical centers, and between Hispanics and non-Hispanic whites, again from the same clinical centers. To maximize sample size, we combined data from the two California sites for the African American and non-Hispanic white comparison and data from the Colorado and Texas sites for the Hispanic and non-Hispanic white comparison. Clinical site interaction with ethnic group was tested before pooling data across clinical sites and found to be not statistically significant.

Process of care comparisons

Data from the second interview/clinical examination were used. Standards for processes of care were based on the 1998 American Diabetes Association Clinical Practice Recommendations (14). We choose these recommendations because they were published before the second visit and thus represented the most current guidelines for community physicians. We examined five processes of care: *1*) treatment of diabetes; *2*) treatment of hypertension, if present; *3*) treatment of hyperlipidemia, if present; *4*) treatment of albuminuria, if present, with an ACE inhibitor; and *5*) treatment of coronary artery disease, if present, with aspirin. Cohort members were defined as hypertensive if they reported hypertension on the visit 2 medical survey, their average blood pressure at the visit 2 clinical examination was systolic >140 mmHg or diastolic >90 mmHg, or the subject listed an antihypertensive agent in their list of current medication at visit 2. Hyperlipidemia was defined in a similar manner: by self-report, LDL cholesterol concentrations >130 mg/dl, or lipid-lowering agent reported in the medication interview. Presence of albuminuria was determined by self-report or presence of albumin/creatinine ratio >30 mg/g on the urine sample obtained on the day of the clinical examination. Presence of coronary artery disease was defined as self-reported heart attack, coronary artery bypass surgery, or coronary angioplasty (including stenting).

Medications were obtained by directly examining all medication bottles the participant brought to visit 2. Individual medications were classified into drug classes using the National Drug Code classification system. To compare treatment of diabetes, four categories of care were established: *1*) no treatment, *2*) diet and exercise only, *3*) oral agents (sulfonylureas, biguanides, meglitinides, α-glucosidase inhibitors, and thiazolidinediones) with or without diet and exercise, and *4*) insulin (any preparation). A participant was defined as being on an antihypertensive medication if he/she was taking a medication in the following classes: ACE inhibitor, diuretic, β-blocker, calcium channel blocker, or vasodilator. We used the drug class for lipid-lowering agents, ACE agents, and aspirin for comparisons of treatment of hyperlipidemia, albuminuria, and coronary artery disease, respectively.

Outcomes of care

Three outcomes of care were compared: *1*) control of diabetes, *2*) control of blood pressure, and *3*) control of hyperlipidemia (LDL cholesterol concentration). Values from visit 2 were used for each of the above. For diabetes care, control was defined as HbA_{1c} <7.0%, borderline as HbA_{1c} between 7.0 and 8.0%, and uncontrolled as HbA_{1c} >8.0%. These categories were chosen because they represented the American Diabetes Association recommendations for either treatment goal (<7.0%) or additional action (>8.0%) at the time of the second clinical interview (14).

Hypertension control was divided into three categories. Using American Diabetes Association treatment goals, control was defined as systolic blood pressure <130 mmHg and diastolic blood pressure <85 mmHg, borderline as systolic between 130 and 140 mmHg or diastolic between 85 and 90 mmHg and not controlled, and uncontrolled as systolic >140 mmHg or diastolic >90 mmHg (14). Hyperlipidemia was divided into two categories, with controlled defined as LDL cholesterol <130 mg/dl and uncontrolled as LDL cholesterol ≥130 mg/dl, as recommended in the 1998 American Diabetes Association treatment recommendations.

Statistical analysis

Descriptive statistics are reported using mean ± SD or % (*n*). Two group comparisons were performed using two sample *t* tests for continuous variables and χ^2 tests for categorical variables. Significance levels from χ^2 tests were reported as omnibus *P* values as an indication of the overall association between ethnicity and other nominal variables.

To adjust for potential confounding variables in the modeling of treatment or outcomes as a function of ethnic group, generalized logit models were employed utilizing the PROC CATMOD component of the SAS statistical software (version 8; SAS, Cary, NC). Each outcome of interest contained two or three levels of severity. Levels of severity were tested, and several did not fulfill the proportional odds assumption that is required with ordered logistic regression. Therefore, in the case where three levels were constructed for outcome measures, comparisons were made as follows: the most severe level was compared with both the least and moderately severe levels, and the least severe level was compared with both the moderately and most severe levels. For example, worst diabetes control (HbA_{1c} >8%) was compared with good and moderate control (HbA_{1c} <7% or 7–8%) and an odds ratio and *P* value were obtained, and best control (HbA_{1c} <7%) was compared with worst and moderate control (HbA_{1c} >8% or 7–8%). In this way, meaningful comparisons could be made between ethnic groups, adjusted for demographic and other potential confounding variables, while utilizing all of the data available in

Table 1—*Description of IRAS sample with diabetes at visit 2*

	California sites		Texas and Colorado sites	
	African American	Non-Hispanic white	Hispanic	Non-Hispanic white
n	147	102	156	47
Age	61.5 ± 8.2	60.5 ± 7.2	61.4 ± 9.1	64.2 ± 7.3*
Female	57 (84)	41 (42)†	55 (86)	57 (27)
BMI	32.26 ± 6.01	31.00 ± 6.02	30.66 ± 5.68	30.23 ± 5.81
Duration of diabetes				
>5 years	54 (80)	50 (51)	60 (93)	40 (19)
5 years	35 (52)	39 (40)	23 (36)	32 (15)
<5 years	10 (15)	11 (11)	17 (27)	15 (7)
Tobacco use				
Never	42 (62)	35 (36)	50 (76)	36 (17)
Past	48 (70)	58 (59)	38 (57)	47 (22)
Current	10 (15)	7 (7)	13 (19)	17 (8)
Alcohol use				
Never	8 (12)	3 (3)	22 (33)	19 (9)
Past	28 (28)	34 (50)	29 (44)	40 (19)
Current	58 (85)	69 (69)	50 (76)	40 (19)
General health rating				
Excellent/good	66 (97)	74 (75)	48 (75)	77 (36)
Fair/poor	34 (50)	26 (26)	52 (78)	23 (11)
Education/income				
High school grad	90 (132)	92 (92)	58 (91)	85 (40)
Not high school grad	10 (15)	8 (8)	42 (65)	15 (7)
Income >$35,000	66 (90)	70 (68)	21 (33)	38 (18)
Income <$35,000	34 (47)	30 (29)	79 (121)	62 (29)

Data are mean ± SD or % (*n*). *$P \leq 0.05$; †$P \leq 0.01$.

the same model and making no assumptions about the change in relative odds across the three outcome levels. In cases where there were only two levels of the outcome variable (e.g., LDL control), only one comparison was necessary (e.g., LDL controlled versus uncontrolled).

RESULTS — One-hundred and forty-seven African-American and 102 non-Hispanic white participants at the Oakland and Los Angeles sites had known diabetes at visit 2. One-hundred and fifty-six Hispanics and 47 non-Hispanic whites at the San Luis Valley and San Antonio sites had known diabetes (Table 1). The African-American and non-Hispanic white comparison groups were similar in age, BMI, duration of diabetes, percentage of participants who either drank alcohol or smoked, education, and income. The African-American group included more women than the comparison non-Hispanic white group. The Hispanic and their comparison non-Hispanic white group were also similar in BMI, duration of diabetes, smoking and alcohol use history, education, and income and sex distribution. The Hispanic group was younger than their comparison non-Hispanic white group (61 vs. 64 years) (Table 1).

We found little difference in the process of care measures (Table 2). Similar percentages of African Americans and their comparison group of non-Hispanic whites were untreated for diabetes (10 and 17%, respectively), treated with diet and exercise (12 and 14%), and treated with oral agents (63 and 60%) or insulin (15 and 10%). More than two-thirds of participants in both the African-American and non-Hispanic white groups had hypertension (78 and 70%), and nearly 90% of both groups were receiving some type of antihypertensive drug (88 and 92%). Both the African-American and non-Hispanic white groups had high percentages of participants with hyperlipidemia (57 and 67%). However, in both groups, there were low levels of treatment of those individuals who had hyperlipidemia (39 and 37%). Albuminuria was seen in similar proportions in both the African-American and non-Hispanic white groups (28 and 21%). However, a smaller percentage of African Americans who had albuminuria were receiving treatment with an ACE inhibitor (27 and 48%). Few participants from either group reported coronary artery disease (4 and 3%), but most of those that did were taking aspirin (83 and 100%) (Table 2).

When we compared Hispanic with non-Hispanic white participants on process of care in an unadjusted analysis, we found similar numbers in both groups that were not receiving any therapy for diabetes (18 and 21%, respectively), were receiving diet and exercise treatment only (14 and 11%), were receiving oral agents (53 and 55%), or were receiving insulin (15 and 13%). Nearly two-thirds of both groups had hypertension (62 and 68%), and high percentages in both groups were receiving medication for hypertension (88 and 91%). Likewise, both Hispanics and non-Hispanic whites had high percentages of hyperlipidemia (62% for both) but low percentages of treatment for hyperlipidemia (22 and 41%). The proportion with albuminuria was also similar (33 and 26%), but again the percentage receiving treatment was low in both groups (28 and 16%). Most participants with coronary artery disease (4 and 0%) reported taking aspirin (71% and none eligible).

Outcome of care measures did show some variation. In unadjusted analysis, African Americans had a lower percentage of participants with HbA_{1c} <7.0% (African American 35% vs. non-Hispanic white 48%) and higher percentages of participants with HbA_{1c} >8.0% (African American 44% vs. non-Hispanic white 27%, $P \leq 0.05$ for omnibus test of association). Hispanics showed a trend toward higher percentages of participants with HbA_{1c} >8.0 (Hispanic 40% vs. non-Hispanic white 28%, $P = 0.08$ for omnibus test of association). Blood pressure control demonstrated more dramatic differences. Of African Americans being treated for hypertension, 66% had blood pressure >140/90 mm/Hg, as compared with 38% of non-Hispanic whites ($P \leq 0.001$), while 44% of Hispanics had uncontrolled blood pressure, as compared with 34% of non-Hispanic whites ($P \leq 0.05$). All comparison groups had similar percentages of LDL >130 mg/dl in unadjusted analysis (African American 69%, non-Hispanic white 61%; Hispanic 62%, non-Hispanic white 54%).

Table 2—*Process and outcome measures*

	California sites		Texas and Colorado sites	
	African American	Non-Hispanic white	Hispanic	Non-Hispanic white
Process measures				
Diabetes				
Untreated	10 (15)	17 (17)	18 (28)	21 (10)
Diet and exercise only	12 (17)	14 (14)	14 (22)	11 (5)
Oral agents	63 (93)	60 (61)	53 (108)	55 (26)
Insulin ± oral agents	15 (22)	10 (10)	15 (30)	13 (6)
Hypertension	78 (114)	70 (71)	62 (97)	68 (32)
On BP-lowering agent	88 (100)	92 (65)	88 (85)	91 (29)
Hyperlipidemia	57 (83)	67 (68)	62 (97)	62 (29)
On lipid-lowering agent	39 (32)	37 (25)	22 (21)	41 (12)
Albuminuria	28 (41)	21 (21)	33 (51)	26 (12)
On ACE inhibitor	27 (11)	48 (10)	28 (14)	16 (2)
Coronary artery disease	4 (6)	3 (3)	4 (7)	0 (0)
On aspirin	83 (5)	100 (3)	71 (5)	0 (0)
Outcome measures				
Diabetes control				
HbA_{1c} <7%	35 (50)	48 (49)*	42 (65)	40 (19)
HbA_{1c} 7–8%	22 (31)	26 (26)	18 (28)	32 (15)
HbA_{1c} >8%	44 (63)	27 (27)	40 (63)	28 (13)
Hypertension control				
BP <130/85 mmHg	18 (20)	41 (29)†	34 (33)	59 (19)
BP 130–140/85–90 mmHg	17 (19)	21 (15)	22 (21)	6 (2)
BP >140/90 mmHg	66 (75)	38 (27)	44 (42)	34 (11)
Hyperlipidemia control				
LDL <130 mg/dl	31 (25)	39 (26)	38 (35)	46 (13)
LDL >130 mg/dl	69 (56)	61 (41)	62 (58)	54 (15)

Data are % (*n*). *$P \leq 0.05$; †$P \leq 0.001$. BP, blood pressure.

In generalized logit analyses adjusted for age, sex, and clinic site, both African Americans and Hispanics showed trends toward both poorer outcome and process measures, although many of these were not statistically significant (Table 3). African Americans were more likely to have uncontrolled hypertension (OR 2.69, 95% CI 1.42–5.10) and HbA_{1c} values >8.0% (2.23, 1.26–3.94). African Americans were somewhat more likely to have albuminuria that was not treated (2.10, 0.98–4.51). Hispanics also showed poor control, although fewer conclusions can be drawn due to the small sample size. They were more likely to have uncontrolled or borderline blood pressure (3.14, 1.35–7.3).

We examined the outcomes of the untreated or diet/exercise-treated group of diabetic subjects to see whether their level of treatment was appropriate. We found that 24% had HbA_{1c} >8%, 65% had blood pressure >140/90 mmHg, 72% had LDL levels >130 mg/dl, and 23% had micro- or macroalbuminuria. To determine regional differences in processes and outcomes, we compared non-Hispanic whites across sites. We found significant differences in hypertension control, with the California sites less likely to have optimal control (41 vs. 59%, $P < 0.05$), as well as in treatment of albuminuria, with the Colorado and Texas sites more likely to have albuminuria and not be under treatment (22 vs. 11%, $P < 0.05$). Our other comparisons did not show any differences.

Finally, we also compared complexity of treatment for both diabetes and hypertension, with complex treatment defined as having two or more medications prescribed for that condition. We found no difference between African Americans and non-Hispanic whites for either diabetes (56% of both groups on two or more diabetes drugs, $P = 1.0$) or hypertension (24% of African Americans and 18% of non-Hispanic whites on two or more blood pressure medications, $P = 0.3$). Findings were similar between Hispanics and non-Hispanic whites for diabetes (43% of Hispanics and 40% of non-Hispanic whites on two or more diabetes medications, $P = 0.9$) or hypertension (12% of Hispanics and 23% of non-Hispanic whites on two or more blood pressure medications, $P = 0.08$), consistent with poorer control.

CONCLUSIONS — Our study compares process and outcome measures of diabetes care of three different ethnic groups enrolled in the IRAS. Baseline characteristics of these groups were similar, including rates of comorbidities such as hypertension, hyperlipidemia, and albuminuria. The proportions receiving treatment for hypertension, diabetes, and hyperlipidemia were also similar. Despite these baseline similarities and equal likelihood of receiving treatment, African Americans and Hispanics had significantly worse control of hypertension and African Americans had worse control of diabetes. This poor control is especially worrisome in light of research that demonstrates that poor glucose control contributes to the risk of micro- and macrovascular complications and mortality (15–18). Poorly controlled hypertension has been reported in one study to be the strongest predictor of the development of coronary heart disease in people with diabetes (19).

What can account for the disparity in blood pressure and diabetes control? Several possible reasons exist. Lack of insurance to pay for medications and physician visits may prevent individuals of an ethnic/racial group from receiving treatment. Recent data have shown that African Americans and Hispanics accounted for the largest increases in uninsured individuals between 1989 and 1996 (20). However, Harris (21), in her 1999 analysis of the Third National Health and Nutrition Examination Survey, found that African Americans and non-Hispanic whites with diabetes had similar rates of insurance coverage (93 and 95%, respectively); however, Hispanics did have lower rates of health care coverage (77%). Whereas insurance status was not available in this dataset, the California participants were originally recruited from the Kaiser Permanente Health Insurance membership roster, a fully integrated health plan, thus indicating health insurance at the beginning of the study. The socioeconomic fac-

Table 3—*Generalized logit models for process and outcome measures*

Outcome variable Logit comparison	African American vs. Non-Hispanic whites Odds ratio (95% CI)	*P*	Hispanic vs. Non-Hispanic whites Odds ratio (95% CI)	*P*
Diabetes treatment				
No treatment vs. diet and exercise or insulin ± oral agents	0.57 (0.27–1.23)	0.15	0.86 (0.37–2.0)	0.73
No treatment or diet/exercise only vs. insulin ± oral agents	0.63 (0.35–1.13)	0.12	1.02 (0.5–2.1)	0.95
Hypertension treatment				
BP >140/90 mmHg and no treatment vs. BP <130/85 mmHg or BP >140/90 mmHg and treatment	1.93 (0.64–5.83)	0.25	1.17 (0.28–4.87)	0.83
BP >140/90 mmHg and treatment or BP >140/90 mmHg and no treatment vs. BP <130/85 mmHg	1.40 (0.78–2.51)	0.26	0.85 (0.42–1.73)	0.65
Lipid treatment				
LDL >130 mg/dl and no treatment vs. LDL <130 mg/dl or LDL >130 mg/dl and treatment	0.66 (0.38–1.12)	0.12	1.50 (0.75–2.98)	0.25
LDL >130 mg/dl and treatment or LDL >130 mg/dl and no treatment vs. LDL <130 mg/dl	0.60 (0.38–1.12)	0.07	0.84 (0.42–1.69)	0.63
Albuminuria treatment				
Albuminuria and no treatment vs. no albuminuria or albuminuria and treatment	2.10 (0.98–4.51)	0.06	1.16 (0.51–2.62)	0.72
Albuminuria and treatment or albuminuria and no treatment vs. no albuminuria	1.56 (0.84–2.88)	0.16	1.43 (0.67–3.03)	0.35
Diabetes control				
HbA_{1c} >8% vs. $HbgA_{1c}$ HbA_{1c} <7% or HbA_{1c} 7–8%	2.23 (1.26–3.94)	0.006	1.68 (0.79–3.58)	0.18
HbA_{1c} 7–8% or HbA_{1c} >8% vs. HbA_{1c} <7%	1.65 (0.97–2.81)	0.07	0.91 (0.46–1.83)	0.80
Hypertension control				
BP >140/90 mmHg vs. BP <130/85 mmHg or BP 135–140/85–90 mmHg	2.69 (1.42–5.10)	0.002	1.65 (0.71–3.87)	0.24
BP 135–140/85–90 mmHg or BP >140/90 mmHg vs. BP <130/85 mmHg	3.22 (1.57–6.59)	0.001	3.14 (1.35–7.3)	0.25
Lipid control				
LDL >130 mg/dl vs. LDL <130 mg/dl	1.49 (0.73–3.05)	0.28	1.99 (0.78–5.05)	0.15

All models were adjusted for age, sex, and clinic site. BP, blood pressure.

tors we were able to examine (income and education) were similar in African Americans and non-Hispanic whites. Hispanics were somewhat less likely to have completed high school but had similar income levels to their non-Hispanic white counterparts. Additionally, the differences we found were not in rate of treatment, which would be expected if insurance were a major factor. Both Hispanics and African Americans were equally as likely as their non-Hispanic white comparison groups to be on treatment for their diabetes, hypertension, hyperlipidemia, and albuminuria, arguing against process of care being a major contributor to observed health outcome differences across races.

Another cause for the variation in control is variation in the intensity of treatment by the health care provider. Testing for physician bias as a cause for variation is difficult due to the number of possible confounding factors and the difficulty in measuring bias, whether conscious or unintentional. Thus, while both African Americans and Hispanics were as likely to receive treatment as their non-Hispanic white comparison group in our study, physicians may be less aggressive in their management of both blood glucose and blood pressure. However, when we checked for differences in treatment intensity by comparing the percentage of individuals in each group on two or more medications, we found no difference for either diabetes or hypertension.

The variation in control of diabetes and hypertension may be due to the physiologic response of particular ethnic groups to treatment. Several studies have reported ethnic differences in response to particular medications (22,23). These differences are thought to represent different distributions among ethnic groups of polymorphic traits (24), such as varying activity of enzymes (25) or receptors (26). Whether biologic differences in responsiveness underlie the observed differences in these end points, our data suggest that more intensive treatment is needed in these groups.

Finally, patient preferences and understanding of treatment may also account for some of the differences in control of diabetes and blood pressure. Previous research in cardiac procedures (27) and renal transplants (28) has reported ethnic differences in acceptance of recommended treatments between African Americans and non-Hispanic whites. Language, family values, and cultural belief discordance between physician and

patient have all been found to affect compliance with recommended treatments (29,30). The recent Institute of Medicine report concluded that while there are studies demonstrating ethnic differences in acceptance of treatment recommendations, patient preference does not entirely account for the observed differences (8).

The comparison of three ethnic groups is a strength of this study, as is the ability to compare a variety of outcome and process measures. However, this study is limited by the small number of individuals in the non-Hispanic white group for the Hispanic/non-Hispanic white comparison. Our study cohort may not be representative of individuals with diabetes in general. The African-American and their non-Hispanic white comparison group were receiving insurance coverage from a comprehensive insurance plan, while the insurance status of the Hispanic and their non-Hispanic white comparison group is unknown. Individuals using insulin were excluded from participating in the baseline examination due to the interference with the measurement of insulin sensitivity. Additionally, the individuals in our comparison groups were participating in a study and may represent a more highly motivated group and thus be more likely to comply with treatment. Despite this, we found significantly worse control of blood pressure and diabetes in ethnic minorities. Differences in a less select group may be greater.

Diabetes is a national epidemic of increasing public health importance. Complications of diabetes contribute to premature morbidity, mortality (15,31), and substantial negative impacts on health-related quality of life (32) and health care costs (33). Intensive management of blood glucose (15), blood pressure (31), and dyslipidemia (34), in concert with widespread use of ACE inhibitors (35) and aspirin (36), can reduce complication rates. Because the burden of diabetes and associated complications on a national level fall disproportionately on minorities (3), evidence of ethnic disparities in control of diabetes and hypertension in our study is especially worrisome. If we are to achieve the national goal of eliminating health disparities (1), methods of evaluating ethnic disparities in quality and access to care must be developed.

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