Racial/Ethnic Differences in Multiple Diabetes Outcomes in Patients with Type 2 Diabetes in the Southeastern United States

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Objective: To determine racial/ethnic differences in control of multiple diabetes outcomes in a large, diverse primary care sample.

Methods: 661 adults with type 2 diabetes (T2DM) were recruited from three primary care settings. The primary outcomes were individual and composite control of multiple diabetes outcomes. Control of individual diabetes outcomes were defined as hemoglobin A1c (HbA1c) <7%, blood pressure (BP) <130/80 mmHg and low-density lipoprotein (LDL)-cholesterol <100mg/dL. Composite control was defined as having all three outcomes under control. Linear and logistic regression models were used to assess differences in individual means and individual and composite outcomes control between non-Hispanic Blacks (NHB) and Whites (NHW) adjusting for relevant covariates.

Results: NHBs were 67% of the sample, ~61% earned <$20,000, and 78% earned <$35,000. Unadjusted mean HbA1c (8.0 vs 7.6, *P*=.024), SBP (134 vs 126 *P*<.001), DBP (76 vs 69, *P*<.001) and LDL (96 vs 87, *P*=.003) levels were significantly higher in NHBs. Adjusted linear regression showed that SBP (β=9.4; 4.5–8.6) and DBP (β=5.7; 3.5–7.9) were significantly higher in NHBs. 12.6% had composite control and NHBs had lower composite control (10.0% vs 17.6%). Adjusted logistic models showed that BP control (OR .45; .30–.67) and composite control (OR .57; .33–.98) were significantly lower in NHBs.

Conclusions: In this diverse sample of primary care patients with T2DM, NHBs had significantly lower BP control and composite outcome control compared to NHWs adjusting for relevant confounding factors. Strategies are needed to optimize control of multiple outcomes and reduce disparities in patients with T2DM. (*Ethn Dis.* 2014;24[2]:189–194)

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Key Words: Race/ethnicity, Diabetes, Diabetes Outcomes

Introduction

The number of individuals diagnosed with type 2 diabetes (T2DM) continues to increase, largely attributed to the increasing obesity epidemic, decrease in leisure time physical activity, and the aging population.[1] In conjunction with population shifts, the number of racial/ethnic minorities developing the disease is also growing. Individuals with T2DM are placed in a high-risk category for greater comorbidity and complications including cardiovascular disease (CVD), kidney disease, nerve damage, and retinal eye disease.[2–6] Despite recent reports of improved disease management over the past decade,[7–9] racial and ethnic disparities in multiple diabetes outcomes continue to persist. To that end, race and ethnicity are recognized as risk factors for diabetes.[1]

Overall, only 10–20% of patients nationally achieve simultaneous control of cardiovascular and diabetes-related risk factors.[10–12] Despite having adequate control of blood glucose levels, simply having a diagnosis of diabetes greatly increases the risk of CVD and related complications.[13] In the face of a two- to four-fold higher risk of heart disease or stroke than adults without diabetes,[3,13] recent studies of diabetes prevalence show the trend of glycemic control substantially improved over time.[11,12] However, national estimates indicate more than 45% of those with diagnosed diabetes have yet to attain good diabetes control. Significant regional variation has been shown with the southeastern United States having the highest diabetes-specific mortality rates; thus labeled the Diabetes Belt.[14,15] Hyperglycemia is one of several modifiable risk conditions that must be monitored closely and managed appropriately to delay and prevent the development of CVD and other diabetes-related complications in patients with T2DM.[16] Other diabetes-related risk factors needing attention for control include blood pressure (BP) and low-density lipoprotein (LDL) cholesterol levels.[7]

The 2012 American Diabetes Association clinical guidelines[17] recommend control of multiple endpoints including glycosylated hemoglobin A1c (HbA1c) <7%, BP <130/80 mm Hg, and LDL-cholesterol <100 mg/dL as these have been shown to decrease risk of heart disease and stroke. However, few studies have examined control of multiple diabetes outcomes in diverse primary care settings, in particular, among indigent populations. The purpose of our study was to determine whether there were racial/ethnic differences in control of multiple diabetes outcomes in a large, diverse primary care sample in the southeastern United States. We hypothesized, based on the current literature, that non-Hispanic Blacks (NHBs) would have poorer control of multiple diabetes outcomes in primary care.

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RESEARCH DESIGN AND METHODS

Sample Characteristics

Patients with a diagnosis of T2DM were recruited from three primary care clinics in the southeastern United States: a general internal medicine clinic at an academic institution, a primary care clinic of a Veterans Administration medical center, and an indigent clinic of a federally qualified health center. Patients eligible for our study were adult males and females, ≥18 years of any race/ethnicity, having a diagnosis of T2DM, willing to complete survey instruments, and receiving care at one of the aforementioned clinics. Patients were ineligible if they did not speak English were deemed cognitively impaired, or too ill to participate during interactions with the research assistants. Patients diagnosed with type 1 diabetes or gestational diabetes were also excluded. Our Institutional Review Board approved the study. All demographic characteristics collected and reported were based on self-report.

Recruitment

Patients were recruited between May 2011 and August 2011. Research assistants reviewed the daily electronic clinic roster (based on ICD-9 codes) to identify eligible patients. With an approved script, they subsequently approached patients waiting to be seen by the clinician and provided a brief description of the study. Research assistants abstracted data on most recent blood pressure values and laboratory data from patients' charts to assess clinical outcomes.

Diabetes-related Outcomes

The primary outcomes were individual and composite control of multiple diabetes outcomes. Control of individual diabetes outcomes were defined as HbA1c<7%, BP<130/80 mm Hg, and low-density lipoprotein (LDL)-cholesterol<100mg/dL. Composite control was defined as having all three outcomes under control simultaneously.

Variables and Instruments

Demographics

Demographic variables collected for this study included age, sex, race/ethnicity, marital status, educational level, employment status, annual income level, and health insurance.[18] Age was grouped into three categories: <50 years, 50–64 years, and ≥65 years. Sex was dichotomized into male or female. Race/ethnicity was based on self-report and included non-Hispanic Whites (NHWs), NHBs, Hispanics, and other. Marital status was dichotomized as married or not married. Educational level was categorized as < high school (HS) graduate, HS graduate, some college, or > college graduate. Employment status was dichotomized as unemployed or employed. Four income categories were defined: <$9,999, $10,000–$19,999, $20,000–$34,999, and ≥$35,000. Health insurance was divided into three groups: private, government (Medicare, Medicaid and Tricare), or uninsured. Health status was listed as same/better or worse.

Statistical Analyses

We performed three main types of analyses. First, we calculated sample percentages for each demographic variable by race/ethnicity using chi-square. Second, we calculated unadjusted means for HbA1c, SBP, DBP, and LDL cholesterol and compared differences by race/ethnicity using *t*-tests. Third, linear and logistic regression models were used to assess differences in individual means and control of individual and composite outcomes, respectively, between NHBs and NHWs, while adjusting for relevant covariates including age, sex, education, employment, insurance, income, health status and site. The primary dependent variable for both the linear and logistic models was diabetes-related outcomes. All variables were included in the models because each was conceptually related to the outcome of interest or were significantly different in bivariate analysis. A two-tailed alpha of .05 was used to assess for significance. All analyses were performed using STATA v12.0 software.[19]

RESULTS

Table 1 shows the demographic characteristics of the sample by race/ethnicity. Overall, the majority of the sample was NHBs (67%), more than half were male and not married, and only about one-third were high school graduates. More than 61% earned <$20,000 annually while 78% earned <$35,000 annually. When considering differences by race/ethnicity, males were nearly 75% of the sample of NHWs, but more than 50% of the NHB population was female. The majority (54%) of the NHWs in the sample were at ≥65 years, while 48% of NHBs were younger, 50 to 64 years. Fifty-two percent of NHWs in the sample were married compared to only 34% of NHBs. In general, more NHWs had achieved higher educational levels than NHBs. Nearly three-quarters (73%) of the NHWs and 64% of the NHBs were covered by government-sponsored insurance; otherwise, almost twice as many NHBs were uninsured as NHWs. There were no statistically significant differences in employment or health status by race/ethnicity.

Table 2 shows racial/ethnic differences in unadjusted means for multiple diabetes outcomes. Unadjusted mean HbA1c (8.0% vs 7.6%, $P=.024$), SBP (134 mm Hg vs 126 mm Hg $P<.001$),

Table 1. Sample demographic characteristics by race/ethnicity, %

	All (*n*=661)	NHW (*n*=217)	NHB (*n*=444)	*P*
Age				<.001[a]
<50 years	16.3	10.1	19.4	
50–64 years	44.5	36.4	48.4	
≥65 years	39.2	53.5	32.2	
Sex				<.001[a]
Female	44.0	27.5	52.1	
Male	56.0	72.5	47.8	
Marital status				<.001[a]
Married	39.8	51.8	33.9	
Not married	60.1	48.2	66.1	
Education level				<.001[a]
<HS graduate	24.0	13.5	29.2	
HS graduate	34.7	26.5	38.7	
Some college/College graduate	33.3	42.3	28.9	
>College graduate	7.9	17.7	3.2	
Employment status				.676
Unemployed	76.6	75.6	77.0	
Employed	23.4	24.4	22.9	
Annual income level				<.001[a]
≤$9,999	35.4	16.8	44.5	
$10,000–$19,999	26.0	22.9	27.5	
$20,000–$34,999	16.3	21.5	13.7	
≥$35,000	22.3	38.8	14.2	
Health insurance				.004[a]
Private	14.8	16.1	14.2	
Government insurance	67.1	72.9	64.2	
Uninsured	18.0	11.0	21.5	
Health status				.987
Same or better	71.6	71.5	71.6	
Worse	28.4	28.4	28.4	

NHW, non-Hispanic Whites; NHB, non-Hispanic Blacks.
[a] Statistically significant, $P<.05$.

DBP (76 mm Hg vs 69 mm Hg, $P<.001$) and LDL cholesterol (96mg/dL vs 87mg/dL, $P=.003$) levels were significantly higher in NHBs.

Table 3 shows unadjusted and adjusted linear regression models for multiple diabetes outcomes between NHBs and NHWs. Adjusted linear regression showed that SBP (β=9.37; 5.65–13.1) and DBP (β=5.7; 3.51–7.90) were significantly higher in NHBs. However, HbA1c and LDL cholesterol were not significantly different by race/ethnicity.

Table 4 shows logistic regression models (unadjusted and adjusted) for control of multiple diabetes outcomes by race/ethnicity. Adjusted logistic models for outcome control showed that BP (OR .45; 95% CI .30–.67) and composite control (OR .57; 95% CI .33–.98) were significantly lower in NHBs. Glycemic control and lipid control were not significantly different by race/ethnicity.

DISCUSSION

In this diverse sample of primary care patients with type 2 diabetes in the southeastern United States, NHBs had significantly lower BP control and composite outcome control compared to NHWs, adjusting for relevant confounding factors. In unadjusted analyses, NHBs had higher mean HbA1c, SBP, DBP, and LDL levels compared to NHWs. However, after adjustment for relevant confounding factors, the difference between groups only persisted for SBP and DBP. Similarly, in logistic models, unadjusted and adjusted analyses showed that NHBs were more likely to have poor BP control and also were more likely to have poor composite outcome control. This suggests that a significant reason for disparities in multiple outcomes is primarily due to poor BP control in NHBs. In addition, our findings suggest that BP control is an important target in diabetes if the goal is to reduce racial/ethnic disparities in outcomes.

Our findings are supported by evidence from prior studies, which suggest

Table 2. Racial/ethnic differences in unadjusted means for multiple diabetes outcomes

	All	NHW	NHB	*P*
Glycosylated hemoglobin A1c	7.8 ± 1.9	7.6 ± 1.5	8.0 ± 2.0	.024[a]
Systolic blood pressure	131.5 ± 20.4	125.7 ± 18.1	134.4 ± 20.8	<.001[a]
Diastolic blood pressure	73.7 ± 12.8	69.3 ± 12.0	75.9 ± 12.7	<.001[a]
Low-density lipoprotein cholesterol	93.1 ± 35.4	87.1 ± 34.2	96.1 ± 35.7	.003[a]

Data are means ± standard deviation.
NHW, non-Hispanic Whites; NHB, non-Hispanic Blacks.
[a] Statistically significant, $P<.05$.

Table 3. Unadjusted and adjusted linear regression models for multiple diabetes outcomes between non-Hispanic Blacks and non-Hispanic Whites[a]

Outcome	Unadjusted Model Coefficient (CI)	*P*	Adjusted Model Coefficient (CI)[b]	*P*
Mean HbA1c	.36 (.05, .68)	.024[c]	.09 (−.26, .43)	.629
Mean SBP	8.65 (5.37, 11.93)	<.001[c]	9.37 (5.65, 13.10)	<.001[c]
Mean DBP	6.58 (4.53, 8.62)	<.001[c]	5.71 (3.51, 7.90)	<.001[c]
Mean LDL cholesterol	9.05 (3.15, 14.95)	.003[c]	4.03 (−2.60, 10.65)	.233

[a] Non-Hispanic Whites is the reference group.
[b] Model adjusted for age, sex, employment, insurance, education, income, health status, and clinic site.
[c] Statistically significant, $P<.05$.

In unadjusted analyses, non-Hispanic Blacks had higher mean HbA1c, SBP, DBP, and LDL levels compared to non-Hispanic Whites.

that there are racial/ethnic differences in multiple diabetes outcomes, both individually and collectively;[6,12,20–24] and thus, increase the risk of CVD[13] in racial/ethnic minorities. Additional studies have shown that NHBs have poorly controlled hypertension and cholesterol.[12,25–26] In our sample, we found NHBs to have poorer BP control compared to NHWs. Our study also found that only 12.6% of the sample had good composite control, and NHBs were less likely to have good composite control compared to NHWs (10.0% vs 17.6%) (data not shown). This is similar to the findings of Jackson et al, who discovered that <5% of over 8,000 veterans with T2DM from a large Veteran's Health Administration in the Southeast had simultaneous control of all three individual outcomes for composite control.[23]

The clinical relevance of simultaneously controlling diabetes-related outcomes clearly comes from the benefit of reducing the risk of a CVD event.[23] However, the extent of this benefit likely depends on the prevalence of diabetes and its CVD-relevant comorbidities. For instance, the southeastern United States has the highest rate of diabetes-related morbidity and mortality, frequently presented as the Diabetes and Stroke Belt,[14,15] because of the concentration of diabetes, obesity, and hypertension, which is partly attributed to poor behavioral risk factors, low socioeconomic status, and a high proportion of African Americans and rural residents. So it is more likely that a sample population will have poor glycemic, blood pressure, and cholesterol control. Our study is unique in presenting findings from a random sample of low-income adults with diabetes, two-thirds being urban African American residents of the Southeast, who have attained fairly good control of CVD risk factors. Thus, they likely represent a best case scenario for disparities in health outcomes for a region considered to be high risk for adverse CVD outcomes. Potential reasons for better CVD risk control (A1c, BP, LDL-cholesterol) in this sample may be attributed to the fact that the study was composed largely of participants who received care from an academic medical center where physicians in residency training are less prone to clinical inertia as they are likely to be more aggressive in their efforts to manage disease. Moreover, the foundation of academic centers is such that strong multidisciplinary research and clinical efforts are likely to result in significantly improved health outcomes in high-risk populations, such as the one used for our study. Alternatively, the dissemination of information about a high concentration of morbidity and mortality in the Southeast may drive providers to focus more of their efforts on management of those specified high-risk diseases,

Table 4. Logistic regression models, unadjusted and adjusted, for control of multiple diabetes outcomes by race/ethnicity[a] controlling for covariates

Outcome	Unadjusted Odds Ratio (95% CI)	*P*	Adjusted Odds Ratio (95%CI)[b]	*P*
HbA1c<7%	.78 (.56, 1.10)	.168	.82 (.79, 2.25)	.279
BP<130/80 mm Hg	.47 (.34, .65)	<.001[d]	.45 (.30, .67)	<.001[d]
LDL-C<100 mg/dL	.76 (.53, 1.08)	.124	1.01 (.66, 1.54)	.969
Composite control[c]	.52 (.32, .83)	.006[d]	.57 (.33, .98)	.044[d]

[a] Non-Hispanic Whites is the reference group.
[b] Model adjusted for age, sex, employment, insurance, education, income, health status, and clinic site.
[c] Composite control is defined as having all three outcomes under control.
[d] Statistically significant, $P<.05$.

even in the face of patient's personal inertia (ie, lack of health engagement).

Hypertension is a highly prevalent comorbid condition in patients with diabetes. Our study findings, demonstrating a significant statistical difference by race/ethnicity for BP control, are consistent with the current literature showing NHBs to have higher BP levels than NHWs and other minority groups.[21,25] Factors that may contribute to this finding include psychosocial factors such as depression or anxiety, lack of knowledge about medications, complexity of the medication schedule—particularly if multiple medications have been prescribed, medication non-compliance, and dislike of medication due to associated side effects.[27] While medication use and adherence were beyond the scope of this study, it is imperative to address the issue of medication adherence as a primary mechanism for BP control. Lifestyle modifications such as diet and exercise are also known to impact BP. However, studies demonstrate that minorities are less likely to perform self-management behaviors at the recommended levels, and when they do engage in these necessary behaviors are less likely to perform them well.[28–30] Regardless, estimates for engaging in these behaviors have remained low (personal inertia) despite significant and creative efforts to effect long-term behavior change.

With regards to glycemic control, NHB patients have been shown to have higher HbA1c levels (less glycemic control) when compared to NHWs and other racial/ethnic minorities.[24] Although we found higher mean HbA1c levels in NHBs in this sample, we did not find any significant differences in glycemic control by race after adjusting for relevant confounding factors. The reasons for this finding are unclear and future studies may need to evaluate why observed differences in glycemic control in the general population do not hold true for lower income patients. Such studies may need to collect information on self-care behaviors, medication adherence, quality of care, health literacy, and beliefs and attitudes about diabetes in order to generate sufficient answers. Furthermore, studies support that certain sociodemographic measures likely serve as mediators in the relationship between race/ethnicity and diabetes-related outcomes (micro- and macrovascular consequences).[31,32] Thus, it is important to acknowledge the role of social determinants of health (education, insurance, employment, income, environmental context, access to care) as one of the primary drivers for attaining adequate control of CVD risk factors like diabetes.

Our study has a few limitations. First, a cross-sectional analysis was performed, which does not allow cause-effect relationships to be inferred. Second, there are potential confounders that were not controlled for such as comorbidity burden, medication adherence, diabetes self-management, social support, and diabetes knowledge. All of these factors have the potential to impact risk factor control, quality of care, and diabetes-related outcomes. Since we did not control for these factors, it is not possible to determine any influence they may have had on the findings. Third, the generalizability of the study findings may be limited given the study population. These results are representative of a sample comprised solely of low-income NHW and NHB patients from health care institutions in the Southeast and may not reflect the larger United States population of people with diabetes.

Nevertheless, the results of this study are important and provide new information about racial/ethnic differences in control of multiple diabetes outcomes. In this diverse sample of primary care patients with T2DM, NHBs had significantly lower BP control and composite outcome control compared to NHWs when adjusting for relevant confounding factors. Strategies like patient activation and empowerment and improved patient-provider communication are needed to optimize control of multiple outcomes and reduce disparities in patients with type 2 diabetes.

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