Original Paper

Ethnic Differences in the Treatment and Control of Hypertension in Patients With Diabetes

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Among diabetic hypertensive patients, ethnic differences in blood pressure control and outcomes have been attributed in part to greater reluctance of providers to prescribe combination antihypertensive regimens to African Americans than to Caucasians. African Americans purportedly receive fewer angiotensin-converting enzyme inhibitors (ACEIs) and/or angiotensin receptor blockers (ARBs), which reduce target organ complications. To assess these issues, cross-sectional data were analyzed from 19,864 diabetic hypertensives from 62 primary care clinics. Among diabetic hypertensives, African Americans (N=6230) were less likely than Caucasians (N=8041) to have blood pressure (BP) <130/80 mm Hg at their last clinic visit (23.1% [23.0%–23.2%] vs. 30.7% [30.6%–30.9%]) despite a greater number of prescriptions for antihypertensive medications (2.67 [2.63–2.70] vs. 2.23 [2.20–2.26]). African Americans were more likely than Caucasians to have an ACEI and/or ARB prescribed and to receive prescriptions for at least two antihypertensive medications that included an ACEI or ARB (64.1% [63.8%–64.4%] vs. 53.1% [52.8%–53.4%]). Among diabetic hypertensives, African Americans are less likely than Caucasians to attain BP <130/80 mm Hg, despite receiving more antihypertensive medication prescriptions. African Americans receive more ACEIs and/or ARBs than Caucasians for target organ protection and/or BP control. The data suggest provider prescribing patterns are not a major contributor to ethnic differences in BP control and outcomes in diabetic hypertensives. (J Clin Hypertens. 2005;7:445–454)

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Diabetes mellitus affects 8.7% of adults 20 years of age and older, or about 18 million people in the United States, including 8.4% of Caucasians and 11.4% of African Americans.[1] Hypertension, defined as a blood pressure (BP) ≥130/80 mm Hg and/or antihypertensive treatment, is present in 73% of diabetic patients.[1] Diabetic hypertensive patients are at high risk for cardiovascular and renal complications.[2–5] African Americans, especially women, are more likely than Caucasians to have hypertension and diabetes.[1,6,7] The Insulin Resistance Atherosclerosis Study (IRAS)[8] indicated that African Americans with diabetes were less likely to have controlled hypertension than Caucasians, despite comparable treatment. Although men have higher rates of cardiovascular events than women, the gender difference disappears in diabetics.[9,10] Moreover, diabetic women appear to increase life expectancy more than diabetic men after receiving antihypertensive treatment.[11]

Several studies document that controlling hypertension greatly reduces cardiovascular complications in patients with diabetes.[12–16] Given this evidence, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) recommends a BP goal of <130/80 mm Hg for diabetics and suggests that an agent that blocks the renin–angiotensin system

be used in these patients as part of a treatment regimen.[17] Despite the guidelines, the National Health and Nutrition Examination Survey (NHANES 1999–2000) found that only approximately 35.8% of all diabetics had a BP <130/80 mm Hg, which included those who were normotensive.[18] Among 1143 diabetic, hypertensive, dyslipidemic patients in another study,[19] 24% had a BP <130/80. Women (21.9%) and African Americans (17.2%) were less likely to reach this target.

The demographic differences in BP control in diabetics may partially reflect the reluctance of providers to prescribe combination regimens, including renin-angiotensin system blockers, especially in African Americans.[20] Thus, the gap between the evidence and clinical practice may be larger in African American than Caucasian diabetics. The southeastern United States has higher rates of hypertension, diabetes, and cardiovascular and renal diseases as well as ethnic disparities than the national average.[21] To assess the magnitude of ethnic disparities, this study examines antihypertensive medication prescriptions and BP control among African American and Caucasian diabetic hypertensives in the southeastern United States.

METHODS

Hypertension Initiative Data

The study was reviewed and approved by the office of research protection at the Medical University of South Carolina (MUSC). The Hypertension Initiative database, which contains information from 62 practices in the southeast on demography, medications, comorbidities, and risk factor values of adults with hypertension, was used for this study. A business associate agreement was executed with each site, which addressed the treatment, payment, and operations and research components of the Health Insurance Portability and Accountability Act (HIPAA).

Data are received either from data cards completed by clinic staff at each patient visit, which are sent to the Initiative database, or by downloading electronic medical record (EMR) information.[22] The database is maintained at MUSC and is password protected. Data from all sites are validated to ensure accuracy. As of January 2, 2004—the final date used for this report—the database contained information from 272 providers at 62 practice locations in the southeastern United States and included 58,436 hypertensive patients who had three or more visits. Among this group, 19,864 patients had concomitant diabetes.

The subjects for this study were all 18 years of age or older with a diagnosis of hypertension. The diagnoses of hypertension and diabetes were made by the provider and conveyed on the data cards or electronic record information. Patients were excluded if BP readings were unavailable at the last visit.

At present, BP control for diabetic hypertensives is defined as systolic <130 mm Hg and diastolic <80 mm Hg at the last visit in the study period, which is consistent with the Health Employer Data and Information System (HEDIS) guidelines.[23] Partial BP control is designated as BP 130–139/80–89 mm Hg, and uncontrolled hypertension as a BP ≥140/90 mm Hg. Prescribed medications are determined as recorded in the database. BP medications are divided into therapeutic classes as α blocker; α,β blocker; β blocker, angiotensin-converting enzyme inhibitor (ACEI); angiontensin receptor blocker (ARB); calcium channel blocker (CCB), both dihydropyridine and nondihydropyridine; diuretic; K^+-sparing diuretic; sympatholytic; and vasodilator.

Descriptive statistics are calculated using the statistical software Stata 8.0 (StataCorp LP, College Station, TX).[24] Multivariate logistic regression analysis was performed with SPSS 12.0 (SPSS, Chicago, IL) to evaluate the independent effects on BP control in diabetics of demography, clinic site (Veterans Affairs Hospitals and Clinics [VA] vs. non-VA), sex, and treatment factors (number and class of medications). The 95% confidence intervals are reported to illustrate the precision with which means are estimated and to allow statistical comparisons between groups.

RESULTS

Demographic Characteristics

Data from 58,408 hypertensive patients were examined, including 19,864 (34.0%) with diabetes. Descriptive data on all hypertensives and for diabetic and nondiabetic subsets are provided in Table I. Diabetic hypertensives were prescribed more antihypertensive medications, were more likely to have a BP <130/80 mm Hg, and more likely to be receiving two or more medications, including an ACEI and/or ARB, than nondiabetic hypertensive patients.

Table II follows the same format as Table I, except that data are provided separately for African-American and Caucasian patients. Among both diabetic and nondiabetic groups, African Americans were less likely to have BP <130/80 or <140/90 mm Hg than Caucasians, yet they were more likely to receive prescriptions for two or more antihypertensive medications.

Table III provides information for African-American and Caucasian diabetic hypertensive patients in the three groups, i.e., VA and non-VA men and non-VA women. African Americans were less likely to have BP <130/80 or <140/90 mm Hg than Caucasians in

Table I. Descriptive Data for All Hypertensive Patients and Diabetic and Nondiabetic Subgroups

	All Hypertensives (N=58,408)	Diabetic Hypertensives (n=19,864)	Nondiabetic Hypertensives (n=38,544)
VA (%)	39.9 (39.8–40.0)	43.9 (43.8–44.0)*	37.9 (37.8–38.0)
Age (yr)	63.8 (63.7–63.9)	65.7 (65.5–65.9)*	62.8 (62.7–63.0)
Sex (M/W [%])	62.3/37.7	64.9/35.1	61.0/39.0
Ethnicity (AA/C/U [%])	27.3/44.5/26.4	31.4/40.5/26.6	25.2/46.6/26.4
Blood presssure (BP) (mm Hg)			
Systolic BP	137.2 (137.1–137.4)	138.0 (137.7–138.2)*	136.9 (136.7–137.1)
Diastolic BP	78.2 (78.1–78.3)	76.0 (75.9–76.2)	79.4 (79.3–79.5)*
<130/80 mm Hg (%)	24.4 (24.3–24.4)	26.8 (26.7–26.9)*	23.1 (23.0–23.2)
<140/90 mm Hg (%)	51.9 (51.8–52.0)	52.1 (52.0–52.3)	51.9 (51.8–52.0)
No. of BP medications (%)			
0	19.7 (19.6–19.8)	15.9 (15.8–16.0)	21.7 (21.6–21.8)*
1	25.9 (25.8–26.0)	23.7 (23.6–23.9)	27.1 (27.0–27.2)*
2	26.6 (26.5–26.7)	25.5 (25.4–25.7)	27.1 (27.0–27.2)
3	16.3 (16.2–16.4)	19.0 (18.9–19.1)*	15.0 (14.9–15.1)
≥ 4	11.5 (11.4–11.5)	15.8 (15.7–15.9)*	9.2 (9.2–9.3)
No. of BP medications (mean)	2.24 (2.23–2.25)	2.43 (2.41–2.45)*	2.13 (2.12–2.15)
ACEI and/or ARB (%)	60.0 (59.9–60.1)	75.34 (75.21–75.47)*	49.88 (49.75–50.01)
≥2 with ACEI±ARB (%)	48.0 (47.9–48.1)	58.7 (58.5–58.9)*	42.1 (41.9–42.2)

VA=Veterans Affairs hospitals and clinics; M=men; W=women; AA=African American; C=Caucasian; U=unknown; ACEI=angiotensin-converting enzyme inhibitor; ARB=angiotensin-1 receptor blocker; *95% confidence intervals (CIs) do not overlap with the other two groups ($p<0.05$); parentheses indicate 95% CIs

all three groups. African Americans received more antihypertensive medications including dihyrodpyridine CCBs, diuretics, K^+-sparing diuretics, sympatholytics, vasodilators, total number of antihypertensives medications, and two or more antihypertensives than Caucasians at all three care sites. At non-VA sites, African Americans were much more likely than Caucasians to receive two or more antihypertensive medication regimens that included an ACEI or ARB.

Table IV provides data on diabetic hypertensives subdivided into three groups based on BP control: <130/80 mm Hg (controlled), 130–139/80–89 mm Hg (partially controlled), and ≥140/90 mm Hg (uncontrolled). BP control <130/80 mm Hg and <140/90 mm Hg for diabetic and nondiabetic patients and the four race and gender subgroups are depicted in Figure (A). Controlled hypertensives received more α_1 blockers than the other two groups, but fewer prescriptions for all other classes of BP medications than uncontrolled hypertensives. The association of better BP control with α_1 blockers was unexpected, given findings in the Antihypertensive Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) in which BP was higher in those randomized to doxazosin. The findings in this trial may reflect the fact that patients seen at VA sites were more likely to receive α_1 blockers and to have controlled BP. In other words, the site of care may explain the observation that patients with controlled diabetic hypertension were more likely to receive α_1 blockers.

Patients with uncontrolled diabetic hypertension were more likely to be African American and to receive more antihypertensive medications than those with controlled hypertension. BP control tended to decline as the number of prescribed antihypertensive medications increased (Figure [B]).

Given the multiple variables that tracked with BP control, multivariate logistic regression analysis was performed, with the data available, to identify independent predictors. Site of care positively predicted BP control to <130/80 mm Hg in diabetic hypertensives (VA vs. non-VA) (1.44 [1.36–1.52]), while race (African American vs. Caucasian) (0.76 [0.72–0.80]) and number of medications (0.94 [0.92–0.96]) were negative predictors. The class of antihypertensive medication was not strongly related to BP control after controlling for site of care, sex, race, and number of medications. In an attempt to understand the independent effects of African-American ethnicity on lower rates of BP control, information on nutritional patterns, physical activity, obesity, renal function, baseline (untreated) BP, and medication adherence would have been useful. However, these variables were not included in the multivariate model, since reliable data were unavailable.

Table II. Descriptive Data for All Hypertensive Patients and Diabetic and Nondiabetic Subgroups

	All Hypertensives		Diabetic Hypertensives		Nondiabetic Hypertensives	
	Caucasian	African American	Caucasian	African American	Caucasian	African American
n	25,987	15,930	8041	6230	17,946	9700
VA (%)	47.4 (47.3–47.6)*	43.8 (43.7–44.0)	56.5 (56.3–56.6)*	46.7 (46.6–46.9)	43.4 (43.3–43.6)*	42.0 (41.8–42.1)
Age (yr)	65.0 (64.8–65.1)*	61.6 (61.4–61.8)	67.2 (67.0–67.5)*	64.0 (63.7–64.3)	64.0 (63.8–61.2)*	60.1 (59.8–60.4)
Sex (M/W [%])	68/32	58/42	75/25	60/40	66/34	57/43
BP (mm Hg)						
Systolic BP	135.7 (137.1–137.4)	138.8 (138.5–139.1)*	136.0 (135.6–136.5)	139.8 (139.2–140.3)*	135.5 (135.3–135.8)	138.2 (137.8–138.6)*
Diastolic BP	76.8 (76.6–76.9)	80.1 (79.9–80.3)*	74.2 (74.0 – 74.5)	78.0 (77.7–78.3)*	77.9 (77.8–78.1)	81.5 (81.3–81.7)*
<130/80 mm Hg (%)	27.0 (26.9–27.1)*	21.3 (21.2–21.4)	30.7 (30.6–30.9)*	23.1 (23.0–21.2)	25.3 (25.2–25.4)*	20.1 (20.0–20.2)
<140/90 mm Hg (%)	55.3 (55.1–55.4)*	48.1 (47.9–48.2)	55.9 (55.8–56.1)*	48.0 (47.9–48.2)	55.0 (54.8–55.1)*	48.1 (48.0–48.3)
No. of BP medications (%)						
0	23.2 (23.1–23.3)*	14.6 (14.5–14.7)	19.4 (19.2–19.6)*	11.8 (11.7–12.0)	24.9 (24.7–25.0)*	16.5 (16.3–16.6)
1	27.7 (27.5–27.8)*	23.0 (22.8–23.1)	26.2 (26.0–26.5)*	21.4 (21.2–21.7)	28.3 (28.2–28.5)*	24.0 (23.8–24.1)
2	26.2 (26.0–26.3)	26.6 (26.4–26.7)*	26.0 (25.8–26.2)*	24.7 (24.5–25.0)	26.3 (26.1–26.4)	27.8 (27.6–28.0)*
3	14.4 (14.3–14.5)	18.9 (18.8–19.1)*	17.0 (16.8–17.1)	20.2 (20.0–20.4)*	13.2 (13.1–13.3)	18.1 (18.0–18.3)*
≥ 4	8.6 (8.6–8.7)	16.9 (16.8–17.0)*	11.4 (11.3–11.5)	21.8 (21.6–22.0)*	7.4 7.3–7.5)	13.7 (13.6–13.8)*
No. of BP medications (mean)	2.10 (2.08–2.11)	2.48 (2.45–2.50)*	2.23 (2.20–2.26)	2.67 (2.63–2.70)*	2.03 (2.01–2.05)	2.35 (2.32–2.38)*
ACEI±ARB (%)	58.8 (58.6–58.9)	61.9 (61.7–62.1)*	69.4 (69.1–69.7)	77.7 (77.5–77.9)*	53.6 (53.4–53.8)*	51.2 (51.0–51.5)
≥2 with ACEI±ARB (%)	44.9 (44.7–45.1)	52.6 (52.3–52.8)*	53.1 (52.8–53.4)	64.1 (63.8–64.4)*	41.0 (40.7–41.2)	44.7 (44.5–45.0)*

VA=Veterans Affairs hospitals and clinics; M=men; W=women; BP=blood presure; ACEI=angiotensin-converting enzyme inhibitor; ARB=angiotensin-1 receptor blocker; *value significantly higher (p<0.05) for within-group ethnic comparison; parentheses indicate 95% confidence intervals

DISCUSSION

African Americans are more likely than Caucasians to have hypertension and diabetes and to suffer related cardiovascular and renal complications.[6–8] BP control reduces adverse outcomes, especially in those at highest risk, including African Americans and diabetics.[12–15,20,25]

In our study, BP control to <130/80 or <140/90 mm Hg was significantly lower in African Americans than Caucasians with diabetes and hypertension. The ethnic disparity in BP control was present, despite the fact that African Americans received a greater number of antihypertensive medications, such as diuretics and CCBs, which tend to be more effective antihypertensive monotherapeutic agents in this ethnic group than ACEIs, ARBs, and β blockers. However, the ethnic difference in BP response to ACEIs, ARBs, and β blockers disappear when a diuretic is included in a combination regimen.[20,26,27] Of note, African Americans were also more likely to receive combination therapy that included an ACEI and/or ARB, which is consistent with the

Table III. Medications Prescribed to African-American and Caucasian Diabetic Hypertensive Patients at VA and Non-VA Sites

	VA Sites		Non-VA Sites		Non-VA Sites	
	African-American Men (n=2828)	Caucasian Men (n=4462)	African-American Men (n=910)	Caucasian Men (n=1543)	African-American Women (n=2407)	Caucasian Women (n=1958)
Age (yr)	66.2 (65.8–66.7)	69.5 (69.2–69.8)*	58.6 (57.8–59.5)	62.8 (62.1–63.4)*	62.2 (61.7–62.7)	63.8 (63.2–64.4)*
Systolic BP (mm Hg)	138.9 (138.1–139.8)*	136.4 (135.8–137.1)	140.6 (139.3–142.0)*	134.9 (134.0–135.9)	140.3 (139.5–141.1)*	135.8 (135.0–136.6)
Diastolic BP (mm Hg)	77.0 (76.5–77.5)*	73.2 (72.9–73.6)	81.1 (80.3–81.9)*	76.2 (75.6–76.7)	77.8 (77.3–78.3)*	75.0 (74.6–75.5)
<130/80 mm Hg (%)	27.2 (26.8–27.6)	33.3 (32.9–33.7)*	18.4 (18.1–18.7)	28.0 (27.6–28.4)*	20.2 (19.9–20.5)	27.1 (26.7–27.5)*
<140/90 mm Hg (%)	51.7 (51.3–52.2)	56.6 (56.2–57.0)*	43.3 (42.8–43.8)	56.1 (55.6–56.6)*	45.7 (45.2–46.2)	54.7 (54.2–55.2)*
BP medications						
α Blocker (%)	22.2 (21.8–22.5)	22.2 (21.9–22.4)	13.1 (12.7–13.5)*	8.8 (8.6–9.0)	6.7 (6.6–6.9)*	1.8 (1.8–1.9)
ACEI (%)	60.6 (60.1–60.7)	60.7 (60.3–61.0)	75.6 (74.9–76.2)*	60.7 (60.0–61.4)	74.7 (74.3–75.1)*	57.5 (56.8–58.1)
ARB (%)	10.8 (10.6–11.0)*	9.4 (9.3–9.6)	22.0 (21.4–22.6)	22.7 (22.2–23.2)*	27.1 (26.7–27.5) *	21.1 (20.7–21.5)
α_1, β Blocker (%)	2.0 (1.9–2.0)	2.1 (2.0–2.1)	3.7 (3.4–3.7)*	2.8 (2.8–2.9)	2.7 (2.7–2.8)*	1.0 (1.0–1.0)
β Blocker (%)	32.3 (31.9–32.8)	36.6 (36.2–37.0)*	28.6 (27.9–29.4)	32.2 (31.6–32.9)*	29.7 (29.3–30.2)	30.2 (29.6–30.7)
Dihydropyridine CCB (%)	26.1 (25.7–26.5)	20.4 (20.1–20.6)	36.1 (35.3–37.0)*	21.0 (20.5–21.5)	43.7 (43.1–44.2)*	25.0 (24.5–25.5)
Nondihydropyridine CCB (%)	15.9 (15.6–16.2)*	15.5 (15.3–15.7)	17.8 (17.3–18.3)*	14.6 (14.2–14.9)	22.3 (21.9–22.7)*	14.7 (14.4–15.0)
Diuretic (%)	49.2 (48.7–69.7)*	46.0 (45.6–46.4)	60.3 (59.5–61.6)*	50.8 (50.0–51.5)	72.0 (71.6–72.5)*	57.9 (57.2–58.5)
K^+-sparing (%)	6.5 (6.4–6.7)*	6.1% (6.0–6.2)	9.3 (9.0–9.6)*	6.4 (6.2–6.6)	12.2 (12.0–12.5)*	10.3 (10.1–10.6)
Sympatholytic (%)	6.3 (6.2–6.4)*	2.9 (2.8–2.9)	7.8 (7.5–8.0)*	2.7 (2.6–2.7)	8.0 (7.9–8.2)*	4.8 (4.7–4.9)
Vasodilator (%)	2.9 (2.9–3.0)*	1.4 (1.4–1.5)	2.2 (2.1–2.2)*	0.5 (0.5–0.6)	1.8 (1.7–1.8)*	0.9 (0.9–0.9)
No. of BP medications (mean)	2.35 (2.30–2.40)*	2.23 (2.19–2.27)	2.76 (2.65–2.87)*	2.23 (2.16–2.30)	3.01 (2.94–3.08)*	2.25 (2.19–2.31)
≥2 BP medications (%)	68.5 (68.1–69.0)*	67.4 (67.0–67.7)	76.7 (76.1–77.4)*	67.2 (66.5–67.8)	83.8 (83.5–84.1)*	68.4 (67.8–68.9)
≥2 with ACEI±ARB (%)	51.6 (51.1–52.1)*	51.2 (50.8–51.6)	69.7 (69.0–70.5)*	56.3 (55.6–57.1)	77.0 (76.6–77.4)*	56.1 (55.4–56.7)

VA=Veterans Affairs hospitals and clinics; BP=blood pressure; ACEI=angiotensin converting enzyme inhibitor; ARB=angiotensin-1 receptor blocker; CCB=calcium channel blocker; *value significantly higher ($p<0.05$) for within-group ethnic comparison; parentheses indicate 95% confidence intervals

Table IV. Comparison of Antihypertensive Medication Utilization Among Diabetic Hypertensive Patients by Blood Pressure (BP) Control Category

	Controlled BP <130/80 mm Hg (n=5303)	Partially Controlled BP 130–139/80–89 mm Hg (n=4976)	Uncontrolled BP ≥140/90 mm Hg (n=9443)
VA (%)	49.1 (48.8–49.5)*	41.3 (41.0–41.7)	42.9 (42.7–43.2)
Age (yr)	66.7 (66.3–67.0)	64.1 (63.7–64.4)	66.1 (65.9–66.4)
Sex (M/W [%])	68.9*/31.1*	63.5/36.5	63.8/36.2
Ethnicity (AA/C/U [%])	27.0*/46.2*/25.3	30.9/40.2/27.2	33.9/37.2/27.4
BP medications (%)			
α_1 Blocker	13.3 (13.2–13.5)*	11.5 (11.4–11.7)	7.37 (7.36–7.38)
Sympatholytic	3.42 (3.37–3.47)	4.18 (4.12–4.24)*	3.3 (3.0–3.6)
α,β Blocker	3.0 (2.9–3.1)	1.75 (1.72–1.77)	7.81 (7.80–7.82)*
ACEI	59.3 (58.9–59.7)	61.7 (61.3–62.1)	70.32 (70.31–70.33)*
ARB	14.8 (12.23–12.27)	17.4 (17.1–17.6)*	16.69 (16.68–16.69)
β Blocker	34.3 (34.0–34.7)	29.0 (28.7–29.3)	37.47 (37.46–37.48)*
Dihydropyridine CCB	21.3 (21.1–21.6)	25.4 (25.1–25.7)	36.16 (36.15–36.17)*
Nondihyropyridine CCB	14.5 (14.4–14.7)	14.4 (14.2–14.6)	22.58 (22.57–22.59)*
Diuretic	54.7 (54.3–55.1)	52.9 (52.5–53.3)	63.55 (63.54–63.57)*
K^+-sparing diuretic	10.6 (10.4–10.7)	8.5 (8.4–8.6)	11.71 (11.70–11.72)*
Vasodilator	1.56 (1.54–1.58)	0.86 (0.85–0.87)	7.2 (6.8–7.6)*
No. of BP medications (mean)	2.31 (2.27–2.34)	2.27 (2.24–2.31)	2.75 (2.73–2.78)*
≥2 BP medications (%)	57.1 (56.7–57.4)	55.6 (55.3–56.0)	64.7 (64.5–65.0)*
≥2 with ACEI±ARB (%)	44.3 (43.9–44.6)	45.2 (44.9–45.6)	54.4 (54.1–54.6)*

VA=Veterans Affairs hospitals and clinics; M=men; W=women; AA=African American; C=Caucasian; U=unknown; ACEI=angiotensin-converting enzyme inhibitor; ARB=angiotensin-1 receptor blocker; CCB=calcium channel blocker; *95% confidence intervals (CIs) do not overlap with the other two groups; parentheses indicate 95% CIs (p<0.05)

guidelines,[17,20] in an effort to minimize target organ complications.[20,27] These findings are consistent with other evidence that the racial disparity in BP control is not due to a lack of prescribed medication.[8,22] The consonance in evidence that African Americans do not receive fewer prescriptions for hypertension does not preclude the potential for improving hypertension control through more effective prescribing patterns.

From our database, it is not possible to assess the impact of differential lifestyle patterns, obesity, and access to and/or compliance with prescribed treatment on the observed ethnic disparity in BP control. Of note, the ethnic disparity in BP control is smallest for men at the VA and largest for men outside the VA (Table IV). Moreover, the smallest ethnic disparity in the number of antihypertensive medications prescribed is seen at the VA sites. Our previous report indicates that the smaller ethnic disparity in BP control at VA than non-VA sites is not explained by age, comorbid cardiovascular risk factors, or target organ complications. In fact, the disparity in control between African American hypertensive men at VA and non-VA sites increases after correction for these confounders.[22] African Americans outside the VA may have more limited access to medications that leads to inadequate BP control and, subsequently, to prescribing of additional antihypertensives. At VA sites, the economic disadvantages of African Americans would have less impact on access to care and medications, which could minimize ethnic differences.

Ethnic Differences in Antihypertensives Prescribed

The higher percentage of African Americans prescribed CCBs and diuretics are in accord with the literature, which suggests that these medications are effective antihypertensives agents in this group.[25,26] Although African Americans did receive more of these agents that have proved efficacy in monotherapy, perhaps an even higher proportion of patients should have received these agents to reduce the disparity in BP control. Conversely, findings show that African Americans are less likely to be prescribed β blockers, which coincide with reports that these drugs tend to be less effective antihypertensive agents, at least as monotherapy, for African Americans.[27]

The high rate of prescriptions for ACEIs and/or ARBs in our database is appropriate for diabetic

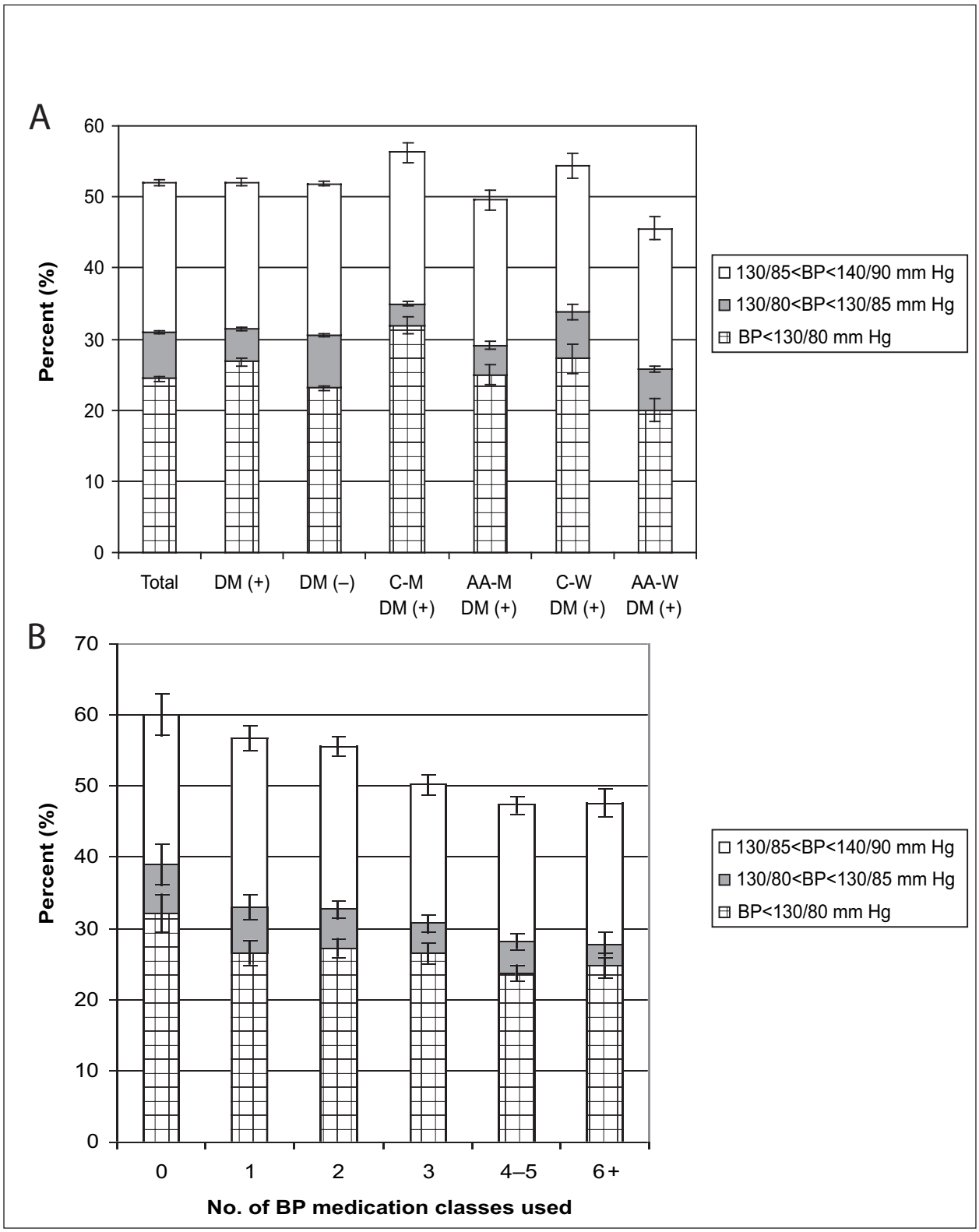

Figure. A) Blood pressure (BP) control is shown at three target levels: <140/90 (≥130/85), <130/85 (≥130/80), and <130/80 mm Hg in all hypertensive patients and all diabetic hypertensive patients combined and subdivided by race and sex. BP control for the three targets was highest in Caucasian (C) men (M) and lowest in African-American (AA) women (W). B) BP control among diabetic hypertensive patients for the same three targets noted in Figure A is depicted according to the number of BP medications; BP control was higher in diabetic hypertensive patients prescribed 0–2 antihypertensive medications and lower among those prescribed four or more medications. DM=diabetes mellitus; error bars denote 95% confidence intervals.

hypertensives. The observation that African Americans are more likely to have prescriptions for ACEIs and/or ARBs was unexpected. African Americans are reportedly less likely to receive ACEIs than Caucasians,[27] presumably since these agents are less effective in lowering BP as monotherapy in African Americans. However, in view of the higher rates of target organ injury in African Americans and benefits afforded by ACEIs and ARBs, these agents are recommended in African Americans with hypertension as part of a treatment regimen, particularly in patients with concomitant diabetes.[20] The majority of hypertensive African Americans require combination therapy, and ethnic differences in BP response to ACEIs and ARBs disappear when combined with diuretics.[20,25,27]

Our data suggest that clinicians, at least in the southeastern United States, have incorporated these complex considerations for ACEIs and ARBs in their therapeutic decisions for African Americans with hypertension and diabetes.[26,28] Physicians in this region may be more likely than physicians in other regions of the country to prescribe an ACEI and/or ARB to their African-American patients, although this possibility cannot be addressed with our database.

BP Control in Diabetic Hypertensives From Various Perspectives

On average, diabetics with uncontrolled hypertension receive more medications, including ACEIs and/or ARBs, than those with controlled hypertension (Table IV). BP control in diabetic hypertensives tends to decline as the number of antihypertensive medication prescriptions increase (Figure 1B). These data suggest that clinicians prescribe more medications in response to poorly controlled BP in diabetics. Since African American diabetic hypertensives are less likely to have controlled BP, this may contribute to a greater proportion receiving combination therapy that includes an ACEI and/or ARB. Nevertheless, BP levels are >130/80 mm Hg in the majority of diabetic hypertensives regardless of ethnicity and the number of antihypertensive medications. Approximately 40% of diabetic hypertensives are receiving no or one medication and another 25% are receiving two antihypertensive medications. For these patients, there is an opportunity to improve BP control with additional therapy recommended in national guidelines.[17,20,29] The data suggest that many clinicians treat to a BP range above the target and are reluctant to increase therapy further to achieve the goal.

The percentage of diabetic hypertensives with BP controlled to goal is low. It is relatively rare that BP control in clinical practice surpasses that in clinical trials. Clinical trials typically exclude patients who do not take 80% or more of prescribed medication or who miss multiple visits during the run-in period. Moreover, most clinical trials in hypertension exclude patients with mental illness, dependence on alcohol or illicit drugs, advanced kidney disease, and recent stroke or coronary events. Therefore, it is noteworthy that the mean BP of 138/76 mm Hg among diabetic hypertensives in this clinical practice database (Table I) is better than the 144/82 mm Hg reported for the intensively treated group in the United Kingdom Prospective Diabetes Study (UKPDS)[14] and the 140/81 mm Hg for diabetic hypertensives at target diastolic of <80 mm Hg in the Hypertension Optimal Treatment (HOT) study.[13]

In both studies referenced, outcomes improved significantly in the groups with more stringent BP targets. In the HOT study, diabetics treated to a diastolic BP goal of <80 mm Hg (81 mm Hg achieved) had approximately 50% fewer cardiovascular events than those treated to a goal of <90 mm Hg (85 mm Hg achieved).[13] UKPDS showed that "tight" BP control as compared with usual BP control, i.e., 144/82 vs. 154/87 mm Hg, for diabetics significantly reduced complications, including stroke, microvascular disease, and heart failure.[14] These study results figured prominently in the recommendation to treat BP to <130/80 mm Hg in hypertensive diabetic patients.[17,20,29]

In multivariate logistic regression analysis, African-American race and increasing number of medications were negative predictors of BP control. Of note, care at the VA independently predicted better BP control. Moreover, ethnic disparities in BP control among diabetic hypertensives are smaller at VA than non-VA health care sites.[22] The latter observations raise the potential value of systems-based interventions to address health disparities.

Study Limitations

Our study describes BP control and medication use in diabetic hypertensives receiving health care at select practices in the southeastern United States. The comparatively large database on diabetic hypertensives with a substantial proportion of African Americans provides insight on the management of hypertension and ethnic differences in the region. Because the data are cross-sectional, it is impossible to attribute causality to the relationship between medications and BP. The database does not contain information about lifestyles, i.e., physical activity and diet, which are important in

BP control and could contribute to the observed ethnic disparity in BP control. Selection bias may affect the findings. While participation in the Hypertension Initiative is voluntary, in larger practices with multiple providers and EMRs, the decision to participate is often made by one person. Providers who directly agree to participate may be more knowledgeable and more aggressive in treating patients with diabetes and hypertension.

The database for this study did not include the dose of antihypertensive medication. Although African Americans received more prescriptions than Caucasians for multiple antihypertensive medications including diuretics, dihyropyridine CCBs, ACEIs, and ARBs, it is possible that the doses were not equivalent. Moreover, evidence suggests that African Americans may require higher doses of renin–angiotensin system blockers to lower BP than Caucasians.[20,26,27]

The fact that these data are generated from an audit and feedback program may also render the information less representative.[22] Audit and feedback programs can elicit small, but significant, positive changes in treatment practices and health outcomes.[30] While the potential for selection bias limits our ability to generalize to all clinical settings, the database provides valuable insight on the characteristics of diabetic hypertensive patients and BP treatment and control patterns of these individuals in a high-risk region.

The data for the Hypertension Initiative are obtained from two sources. There is the possibility that the quality of the data differs according to whether the data are obtained from data cards completed by providers and/or staff or downloaded from EMRs. Moreover, participating clinics with an EMR use a variety of systems. To ensure accuracy, sites are visited by Hypertension Initiative staff to facilitate data exchange. A systems programmer evaluates the quality of the EMR data according to prespecified rules before they are downloaded into the database. After the EMR data and paper cards are entered in the database, they undergo a series of validation rules to ensure accuracy.

SUMMARY

Hypertension control is lower in African Americans than Caucasians with diabetes. African American diabetic hypertensives were more likely than their Caucasian counterparts to receive diuretics and dihydropyridine CCBs, and were more likely to receive two or more BP medications, including an ACEI and/or ARB. While ACEIs and ARBs are less effective as monotherapy in African Americans, the ethnic disparity resolves when these agents are combined with diuretics.[20,26,27] While more than 75% of diabetic hypertensive African American women received combination antihypertensive therapy, including an ACEI and/or ARB, they had the lowest proportion of BP control to <130/80 mm Hg. The data suggest that prescribing patterns are not a major contributor to ethnic disparities in BP control and outcomes among African Americans and Caucasians with diabetes and hypertension. However, it is possible that the prescribing of diuretics and calcium channel antagonists in an even higher proportion of African Americans would result in better BP control. Moreover, prescribing higher doses of renin–angiotensin system inhibitors to African Americans might also reduce ethnic differences in BP response.[20]

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