ORIGINAL RESEARCH

Racial Differences in Clinical Treatment and Self-Care Behaviors of Adults With Chronic Heart Failure

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***Background*—**In the United States, the highest prevalence of heart failure (HF) is in blacks followed by whites. Compared with whites, blacks have a higher risk of HF-related morbidity and mortality and HF-related hospitalization. Little research has focused on explaining the reasons for these disparities. The purpose of this study was to examine racial differences in demographic and clinical characteristics in blacks and whites with HF and to determine if these characteristics influenced treatment, or together with treatment, influenced self-care behaviors.

***Methods and Results*—**This was a secondary analysis of existing data collected from adults (n=272) with chronic HF enrolled from outpatient sites in the northeastern United States and followed for 6 months. After adjusting for sociodemographic and clinical characteristics within reduced (HF*r*EF) and preserved ejection fraction (HF*p*EF) groups, there were 2 significant racial differences in clinical treatment. Blacks with HF*r*EF were prescribed ACE inhibitors and hydralazine and isosorbide dinitrate (H-ISDN) more often than whites. In the HF*p*EF group, blacks were taking more medications and were prescribed digoxin and a diuretic when symptomatic. Deficits in HF knowledge and decreased medication adherence, objectively measured, were more prominent in blacks. These racial differences were not explained by sociodemographic or clinical characteristics or clinical treatment variables. Premorbid intellect and the quality of support received contributed to clinical treatment and self-care.

***Conclusion*—**Although few differences in clinical treatment could be attributed solely to race, knowledge about HF and medication adherence is lower in blacks than whites. Further research is needed to explain these observations, which may be targets for future intervention research. **(*J Am Heart Assoc*. 2015;4:e001561 doi: 10.1161/JAHA.114.001561)**

Key Words: African Americans • comorbidity • ethnic groups • evidence-based medicine • guideline adherence • medication adherence • self-care

The epidemic of heart failure (HF) has captured the attention of investigators worldwide.[1] In the United States, where this study was conducted, an estimated 5.7 million adults have HF.[2] Changing demographics in the United States include a growing cohort of ethnic minority groups, which contributes to the HF epidemic. Among the various racial and ethnic minority groups in the United States, the highest prevalence of HF is found in blacks (3.6% of US blacks) followed by whites (2.4% of US whites).[3] Compared with whites, racial and ethnic minority patients have a 2.5 times greater risk of HF-related mortality and a 42% higher risk of HF-related hospitalization.[4,5] Yet, little research has focused on explaining the reasons for these disparities. The purpose of this study was to examine racial differences in demographic and clinical characteristics in blacks and whites with HF and to determine if these characteristics influenced treatment, or together with treatment, influenced self-care behaviors.

Racial Differences in the Clinical Treatment of Heart Failure

Clinical guidelines specify the appropriate pharmacologic regimen for patients with HF including use of angiotensin-converting-enzyme (ACE) inhibitors, beta-blockers and angiotensin receptor blockers (ARBs) for those with reduced ejection fraction HF (HF*r*EF).[6] Some early evidence suggests that beta-blockers may be less effective in preventing death or hospitalization in black HF patients than in whites, but further evidence is needed before practice is modified.[7]

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An accompanying Appendix S1 is available at http://jaha.ahajournals.org/content/4/4/e001561/suppl/DC1

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Angiotensin receptor blockers (ARBs) are prescribed for HF*r*EF patients intolerant to ACE inhibitors; one reason for intolerance is angioedema, which occurs more frequently in blacks.[8] Although few clinical trials have focused on patients with preserved ejection fraction HF (HF*p*EF), clinical guidelines advocate using basically the same approach as for those with HF*r*EF.[6]

In recent years there has been growing awareness that the treatment of HF in blacks should be subtly modified based on recognition that some blacks have differences in nitric oxide (NO) homeostasis and impairments in NO-mediated cardiovascular effects.[9] Recognition of race as a surrogate of this alternate mechanism has strengthened the evidence supporting use of hydralazine and isosorbide dinitrate (H-ISDN) in combination to target this mechanism.[10] H-ISDN is recommended for blacks with HF*r*EF as an addition, not a substitute for guideline-driven pharmacotherapy.[6]

Racial Differences in Self-Care of Heart Failure

Once clinical treatment is prescribed, patients are sent home to perform self-care. Self-care is defined as a naturalistic decision-making process that includes self-care maintenance, those behaviors performed to maintain physiological stability (eg, treatment adherence), symptom monitoring, and self-care management or the response to HF symptoms when they occur.[11] Self-care is poor among ethnic and racial minority populations.[12,13] Race has been found to be associated with poor medication adherence[14] and treatment-seeking delays that result from poor symptom recognition and symptom interpretation.[15] The reason that self-care is poorer in these populations has been attributed in part to racial differences in symptom perception,[15,16] sociocultural factors that include health perceptions and level of acculturation,[17] provider interactions,[18] and financial resources.[14,19]

There is also growing evidence that comorbid conditions compound the difficulties associated with HF self-care.[20,21] Blacks with HF are more likely to have diabetes, hypertension, and obesity than whites[22] and those with both HF and diabetes report difficulty in reconciling dietary instructions, symptom recognition and symptom management. In addition, depression is common in blacks with HF[23] and associated with poor self-care.[24,25]

In summary, considering clinical guidelines, race-related differences in clinical treatment should be minor, but few studies have been conducted to defend or refute such a claim. Studies in other clinical populations suggest that race may be a factor in self-care,[26] but few studies have addressed this issue in HF self-care. Because so few studies of clinical treatment or self-care compare racially diverse patients with HF, the purpose of this study was to examine racial differences in demographic and clinical characteristics in blacks and whites with HF. Further, we sought to determine if sociodemographic and clinical characteristics influenced treatment, or together with treatment, influenced self-care behaviors.

Materials and Methods

Study Design

This was a secondary analysis of existing data collected for a prospective cohort study. The methods used in this study have been detailed previously.[27] In brief, the parent descriptive study was performed to explore factors influencing HF self-care. Thus, in this analysis, self-care was defined as encompassing adherence to the clinical treatment regimen including medications and low-sodium diet, symptom monitoring (eg, daily weights), and symptom management.[28] Self-care was measured carefully using both subjective and objective measures as described below. Data were collected at baseline, at 3 months, and at 6 months, primarily during home visits conducted by research assistants. Clinical information was abstracted from the medical record by registered nurses.

Study Population

A sample of 280 adults with stable, chronic HF was enrolled into the parent study. Eight of these individuals self-reported their ethnicity/race as something other than black or white, leaving a sample of 272 individuals for the current analysis. All participants provided informed consent.

Patients were identified from diverse settings that cared for ethnically diverse populations and included clinics, physician offices, HF specialty clinics, and a Veterans Administration setting located in the northeastern United States. Patients were included in the study if they had chronic HF confirmed based on recent echocardiographic and clinical evidence. Both reduced and preserved left ventricular ejection fraction patients were included, but the analysis of clinical treatment was conducted separately for each group. Other inclusion criteria were sufficient vision, hearing, and ability to read and understand English, which was necessary to perform tests. Patients with severely impaired cognition were screened out using the Telephone Interview of Cognitive Status.[29] Exclusion criteria were related to the purpose of the primary study in which daytime sleepiness was explored as a contributor to HF self-care. So, otherwise eligible patients were excluded if they worked nights or rotating shifts or lived in a long-term care setting where self-care was not an expectation. Those with a major depressive illness or a recent history of serious drug or alcohol abuse were not enrolled. Major depressive illness was screened in the medical

record and with administration of the 9-item Patient Health Questionnaire (PHQ-9).[30] Individuals with a PHQ-9 score >10 were excluded but only if depressed mood or anhedonia was reported, to minimize the risk of excluding someone with HF symptoms that mimicked depression.

Measurement

Demographic data were collected by survey. Social support was measured with the Multidimensional Scale of Perceived Social Support.[31] Knowledge about HF was assessed using the Dutch HF Knowledge Scale,[32] which assesses knowledge of HF in general, knowledge of HF treatment and HF symptoms. The Dutch HF Knowledge Scale has been used in numerous US-based studies including our own.[33,34] The American National Adult Reading Test (ANART) was used to measure premorbid intellect.[35] Intellect refers to the ability to learn and to deal with new situations and to deal effectively with tasks involving abstract thinking. Premorbid intellect is thought to be spared following cognitive decline. In measuring premorbid intellect with the ANART, participants were asked to pronounce aloud 50 irregular words (eg, capon, blatant, debt). The number pronounced correctly was used in analysis. Clinical data on the number of major comorbid conditions (eg, diabetes, arthritis, hypertension) were abstracted from the medical record. New York Heart Association (NYHA) functional class was assessed by standardized interview[36] and scored by a single cardiologist. Self-care was assessed by self-report using the Self-Care of HF Index v.6.2.[37] Objective measures of self-care included 24-hour urine samples, which were obtained to allow calculation of urinary sodium excretion to indicate salt-restricted diet adherence.[38] Medication adherence was monitored for 6 months using the medication event monitoring system (MEMS; MVW Switzerland Ltd, Sion, Switzerland).[39] All data were collected between 2007 and 2009.

Statistical Analysis

Most of the data for this analysis were categorical, but before analysis began continuous data were categorized using standard cut-points. For example, the standardized scores on the Self-Care of HF Index scales are considered to reflect inadequate self-care if <70.[37] Most variables were dichotomous, but variables with 3 levels were represented in the analyses described below with indicators for the first 2 levels shown in associated tables.

The Appendix S1 contains a detailed description of the analysis process. An overview of that process is provided here. First, unadjusted racial differences in individual sociodemographic and clinical characteristics were identified (using χ^2 tests if all expected cell counts were at least 5; otherwise using Fisher's exact test). Then, unadjusted racial differences in individual clinical treatment variables were identified (using χ^2 or Fisher's exact tests). These differences were further investigated (as described in the Appendix S1) using adaptive logistic regression models[40] adjusting for sociodemographic and clinical characteristics holding the race effect fixed in the model and testing the race effect in the resulting model (using a Wald χ^2 test). These analyses were conducted separately for HF*r*EF and HF*p*EF patients to account for possible differences in their clinical treatment. Finally, unadjusted racial differences in individual self-care variables were identified (using χ^2 or Fisher's exact tests), and these were further investigated using adaptive logistic regression models by adjusting first for sociodemographic and clinical characteristics and then for clinical treatment variables.

Results

Unadjusted Racial Differences

Of the 272 participants, 176 (64.7%) were white while the other 96 (35.3%) were black.

Sociodemographic and clinical characteristics

The participants' sociodemographic and clinical characteristics are shown in Tables 1 and 2. In unadjusted comparative analyses based on race, blacks with HF were more likely than whites with HF to be younger, less well educated, lower in premorbid intellect, disabled, living with inadequate income, and insured by the government or uninsured (Table 1). Blacks were more likely to be unmarried and to perceive lower levels of social support and lower quality of support. Considering clinical characteristics, blacks were more likely than whites to have HF of nonischemic etiology and to be in NYHA class IV (Table 2). Blacks were less likely than whites to report drinking 3 or more alcoholic drinks per day but more likely to be current smokers and to be severely obese with a body mass index (BMI) >35. Blacks were more likely to be depressed and to have a high number of comorbid conditions including anemia, diabetes mellitus, hypertension, and renal disease.

Clinical treatment of heart failure for HFrEF patients

For the 220 HF*r*EF patients (84 or 38.2% black), there were no racial differences in the likelihood of being treated by a HF specialist (Table 3). Participants with HF*r*EF were prescribed a substantial amount of medication each day in both total number of medications (M=9.8, SD=3.7, n=220) and medication doses (M=12.9, SD=5.5, n=201). Blacks were less likely to be prescribed an ACE inhibitor but more likely to be prescribed H-ISDN. Blacks were also more likely to be

Table 1. Sociodemographic Characteristics by Race

Variable	n (%)		*P* Value*
	Black	White	
Age (n=272)			0.048
≥60	51 (53.1)	115 (65.3)	
<60	45 (46.9)	61 (34.7)	
Gender (n=272)			0.640
Male	60 (62.5)	115 (65.3)	
Female	36 (37.5)	61 (34.7)	
Premorbid intellect (n=270)			<0.001
ANART≤25	59 (62.8)	31 (17.6)	
25<ANART≤36	27 (28.7)	62 (35.2)	
ANART>36	8 (8.5)	83 (47.2)	
Education (n=272)			0.004
≤12 years (at most high school)	55 (57.3)	74 (42.0)	
13 to 16 years (some college)	35 (36.5)	66 (37.5)	
>16 years (graduate study)	6 (6.2)	36 (20.5)	
Employment status (n=272)			0.001
Employed full or part-time	17 (17.7)	59 (33.5)	
Disabled due to HF	31 (32.3)	26 (14.8)	
Unemployed by choice, homemaker, or retired due to HF	48 (50.0)	91 (51.7)	
Household income (n=272)			<0.001
Not enough	31 (32.3)	13 (7.4)	
Enough	46 (47.9)	86 (48.9)	
More than enough	19 (19.8)	77 (43.7)	
Health insurance (n=272)			0.001
Government or uninsured†	65 (67.7)	83 (47.2)	
Commercial or HMO	31 (32.3)	93 (52.8)	
Marital status (n=272)			<0.001
Single, divorced, separated, or widowed	59 (61.5)	59 (33.5)	
Married or partnered	37 (38.5)	117 (66.5)	
Living situation (n=272)			0.087
Living with others	70 (72.9)	144 (81.8)	
Living alone	26 (27.1)	32 (18.2)	
Social support (n=262)			0.032
MSPSS≤70	38 (41.8)	49 (28.7)	
MSPSS>70	53 (58.2)	122 (71.3)	
Quality of support (n=272)			0.009
Satisfactory	16 (16.7)	15 (8.5)	
Good	31 (32.3)	39 (22.2)	
Very good	49 (51.0)	122 (69.3)	

ANART indicates American National Adult Reading Test; HF, heart failure; HMO, health maintenance organization; MSPSS, Multidimensional Scale of Perceived Social Support.
*Reported *P*-values are for associated χ^2 tests.
†This includes 3 patients with no insurance.

Table 2. Clinical Characteristics by Race

Variable	n (%)		*P* Value*
	Black	White	
HF type (n=271)			0.223
Systolic or mixed	74 (77.1)	146 (83.0)	
Diastolic	22 (22.9)	30 (17.0)	
Months with HF (n=253)			0.836
≤24	26 (28.3)	44 (27.3)	
25 to 60	22 (23.9)	44 (27.3)	
>60	44 (47.8)	73 (45.4)	
NYHA functional class (n=272)			0.001
IV	28 (29.2)	21 (11.9)	
III	53 (55.2)	107 (60.8)	
I to II	15 (15.6)	48 (27.3)	
HF etiology (n=271)			0.017
Ischemic	25 (26.3)	72 (40.9)	
Nonisichemic	70 (73.7)	104 (59.1)	
Alcohol consumption (n=272)			0.001
3 or more drinks	4 (4.2)	34 (19.3)	
2 or less drinks	92 (95.8)	142 (80.7)	
Body mass index (n=271)			0.003
>35	34 (35.8)	32 (18.2)	
26 to 35	43 (45.3)	89 (50.6)	
≤25	18 (18.9)	55 (31.2)	
Smoking history (n=272)			0.050
Currently smoking	15 (15.6)	14 (8.0)	
Current not smoking	81 (84.4)	162 (92.0)	
Depression (n=272)			0.024
PHQ 9>5	39 (40.6)	48 (27.3)	
PHQ 9≤5	57 (59.4)	128 (72.7)	
Number of comorbid conditions (n=272)			0.001
>4	33 (34.4)	31 (17.6)	
3 to 4	37 (38.5)	59 (33.5)	
0 to 2	26 (27.1)	86 (48.9)	
History of anemia (n=268)			0.014
Yes	24 (25.3)	23 (13.3)	
No	71 (74.7)	150 (86.7)	
History of atrial fibrillation (n=271)			0.361
Yes	36 (37.5)	56 (32.0)	
No	60 (62.5)	119 (68.0)	
History of diabetes mellitus (n=272)			0.009
Yes	43 (44.8)	51 (29.0)	
No	53 (55.2)	125 (71.0)	

Continued

Table 2. Continued

Variable	n (%)		*P* Value*
	Black	White	
History of hypertension (n=272)			<0.001
Yes	78 (81.3)	97 (55.1)	
No	18 (18.7)	79 (44.9)	
History of myocardial infarction (n=272)			0.193
Yes	30 (31.3)	69 (39.2)	
No	66 (68.7)	107 (60.8)	
History of renal disease (n=267)			0.009
Yes	33 (34.4)	34 (19.9)	
No	63 (65.6)	137 (80.1)	

HF indicates heart failure; NYHA, New York Heart Association.
*Reported *P*-values are for associated χ^2 tests.

prescribed a diuretic when symptomatic (NYHA class II to IV) than whites.

Clinical treatment of heart failure for HFpEF patients

For the 52 HF*p*EF patients (22 or 42.3% black), there were no racial differences in the likelihood of being treated by a HF specialist (Table 4). Participants with HF*p*EF were prescribed a substantial amount of medication each day in both total number of medications (M=10.4 SD=4.9, n=52) and medication doses (M=14.6, SD=6.9, n=45). Blacks were more likely than whites to be taking multiple medications (>8) daily. However, blacks were less likely to be prescribed digoxin (no blacks with HF*p*EF were prescribed digoxin so Fisher's exact test was used) but more likely to be prescribed a diuretic when symptomatic (NYHA class II to IV) than whites.

Heart failure self-care

Racial differences in the self-care variables for both HF*p*EF and HF*r*EF patients are shown in Table 5. Black patients had lower HF knowledge scores (Dutch Knowledge of HF Scale score ≤10), had less medication adherence over 6 months of follow-up (percent of doses taken [PDT] <88%), and reported less physical activity (<30 min/week) than whites.

Adjusted Racial Differences

Table 6 contains results for adjusted analyses.

Clinical treatment of heart failure for HFrEF patients

Racial differences in being prescribed an ACE inhibitor remained significant after adjusting for appropriate sociodemographic and clinical characteristics. The one determinant of being prescribed an ACE inhibitor was a rating of social support quality as only "satisfactory" (the lowest reported rating) in addition to race.

Racial differences in being prescribed H-ISDN remained significant after adjusting for appropriate sociodemographic and clinical characteristics. Determinants of H-ISDN included "good" quality of support and a history of renal disease in addition to race.

Assuming that diuretics are prescribed only for symptomatic patients, we considered race in combination with NYHA class. Racial differences in being prescribed a diuretic and having NYHA class II to IV became nonsignificant after adjusting for appropriate sociodemographic and clinical characteristics. In this analysis, determinants were low premorbid intellect and a history of renal disease.

Clinical treatment of heart failure for HFpEF patients

Racial differences in taking multiple (>8) medications daily remained significant after adjusting for appropriate sociodemographic and clinical characteristics. The only other determinant of multiple medications was a history of diabetes mellitus.

Having a history of atrial fibrillation was the only sociodemographic or clinical characteristic significantly related to being prescribed digoxin. It was removed from the model by backward elimination leaving only a race effect, but the models considered in this analysis all had questionable fit due to no blacks being prescribed digoxin and the final model had a nonsignificant race effect with *P*=0.941. However, since race was significantly related to being prescribed digoxin using Fisher's exact test, which is not affected by fit problems, racial differences in this case are reasonably considered significant.

Table 3. Clinical Treatment Variables by Race for Patients With Heart Failure With Reduced Ejection Fraction

Variable	n (%)		*P* Value*
	Black	White	
Primary physician provider a HF specialist (n=220)			0.296
Yes	27 (36.5)	64 (43.8)	
No	47 (63.5)	82 (56.2)	
Total number of medications prescribed to be taken daily (n=220)			0.215
>8	48 (64.9)	82 (56.2)	
≤8	26 (35.1)	64 (43.8)	
Receiving specialized HF services (n=220)			0.566
Yes	38 (51.4)	69 (47.3)	
No	36 (48.6)	77 (52.7)	
Receiving home health or visiting nursing care (n=220)			0.106
Yes	12 (16.2)	13 (8.9)	
No	62 (83.8)	133 (91.1)	
Prescribed an ACE inhibitor (n=220)			0.017
Yes	38 (51.4)	99 (67.8)	
No	36 (48.6)	47 (32.2)	
Prescribed an aldosterone receptor antagonist (n=220)			0.787
Yes	26 (35.1)	54 (37.0)	
No	48 (64.9)	92 (63.0)	
Prescribed an angiotension receptor blocker (n=220)			0.129
Yes	26 (35.1)	37 (25.3)	
No	48 (64.9)	109 (74.7)	
Prescribed an ACE inhibitor and an angiotension receptor blocker (n=220)			0.150
Yes	62 (83.8)	132 (90.4)	
No	12 (16.2)	14 (9.6)	
Prescribed a beta blocker (n=220)			0.447†
Yes	70 (94.6)	142 (97.3)	
No	4 (5.4)	4 (2.7)	
Prescribed hydrazaline and isorbide dinitrate (n=220)			0.005
Yes	10 (13.5)	5 (3.4)	
No	64 (86.5)	141 (96.6)	
Prescribed digoxin (n=220)			0.267
Yes	31 (41.9)	50 (34.2)	
No	43 (58.1)	96 (65.8)	
Prescribed a diuretic with NYHA ;functional class II to IV (n=220)			0.016
Yes	64 (86.5)	105 (71.9)	
No	10 (13.5)	41 (28.1)	
Prescribed warfarin (n=220)			0.861
Yes	29 (39.2)	59 (40.4)	
No	45 (60.8)	87 (59.6)	

Continued

Table 3. Continued

Variable	n (%)		*P* Value*
	Black	White	
ICD therapy (n=220)			0.262
Yes	44 (59.5)	98 (67.1)	
No	30 (40.5)	48 (32.9)	

ACE indicates angiotensin-converting-enzyme; HF, heart failure; ICD, implantable cardioverter defibrillator.
*Reported *P*-values are for associated χ^2 tests unless otherwise indicated.
†Using Fisher's exact test.

Again assuming that diuretics are prescribed only for symptomatic patients, we considered race in combination with NYHA class. No sociodemographic and clinical characteristics were significantly related to being prescribed a diuretic and having NYHA class II to IV so that the racial difference in this clinical treatment variable remained significant.

Heart failure self-care

Racial differences in HF knowledge scores for both HF*p*EF and HF*r*EF patients remained significant after adjusting for appropriate sociodemographic and clinical characteristics. In addition to race, the only other determinant of low HF knowledge was a history of myocardial infarction. The same model was generated when clinical treatment variables were also considered.

Racial differences in medication adherence (low with % PDT <88%) remained significant after adjusting for appropriate sociodemographic and clinical characteristics although a single clinical characteristic, a history of renal disease, was also a determinant of poor medication adherence. The same model was generated when clinical treatment variables were also considered.

Racial differences in physical activity (exercise <30 min/week) became nonsignificant after adjusting for appropriate sociodemographic and clinical characteristics (and so clinical treatment variables were not also considered). Low premorbid intellect and having renal disease explained low levels of physical activity rather than race.

Discussion

The purpose of this study was to examine racial differences in demographic and clinical characteristics in blacks and whites with HF. Further, we sought to determine if sociodemographic and clinical characteristics influenced treatment, or together with treatment, influenced self-care behaviors. Although we found notable racial differences in 9 of the 11 sociodemographic and 11 of 15 clinical characteristics, we found few differences in clinical treatment that could be attributed purely to race. Blacks with HF*p*EF were on more medications, received digoxin less often and took more diuretics than whites. The only self-care behaviors that unequivocally differed by race were knowledge about HF and medication adherence, which were lower in blacks than in whites. Our results suggest that blacks may experience a greater disease burden than whites, which may be complicated by social disparities.

Although clinical guidelines advocate very similar treatment regimens in blacks and whites, some important differences in the medication regimens and regimen characteristics were found. Blacks with HF*r*EF were less likely to be prescribed an ACE-I and more likely to receive H-ISDN, as expected, and a diuretic when symptomatic. Perhaps these differences reflect the choice of drugs also appropriate for the treatment of hypertension as the blacks were more likely to have hypertension than the whites. Blacks with HF*p*EF also were more likely to be prescribed digoxin and diuretics. The use of digoxin is confusing, because the blacks were not more likely to have atrial fibrillation. Notably, the blacks were also significantly more likely to be taking more than 8 medications daily, which is probably a reflection of their other comorbid conditions. Overall, we found comparable treatment between blacks and whites. This encouraging news is consistent with recent research illustrating that racial disparities in ICD therapy have declined over time.[41]

An important finding was racial differences in medication adherence. Although other investigative teams have found that blacks were more likely than whites to report running out of medications and not following provider instructions on medication administration,[14,42] this is the first study to document racial differences in medication adherence measured objectively. Racial differences have been attributed to disparities in health insurance,[43,44] health literacy,[45] patient-provider communication,[44,46] self-efficacy, depression, and difficulty accessing providers.[44] We found that neither health insurance, income, education, premorbid intellect, number of

Table 4. Clinical Treatment Variables by Race for Patients With Heart Failure Preserved Ejection Fraction

Variable	n (%)		*P* Value*
	Black	White	
Primary physician provider a HF specialist (n=52)			0.575
Yes	10 (45.5)	16 (53.3)	
No	12 (54.5)	14 (46.7)	
Total number of medications prescribed to be taken daily (n=52)			0.026
>8	17 (77.3)	14 (46.7)	
≤8	5 (22.7)	16 (53.3)	
Receiving specialized HF services (n=52)			0.931
Yes	12 (54.5)	16 (53.3)	
No	10 (45.5)	14 (46.7)	
Receiving home health or visiting nursing care (n=52)			0.149†
Yes	4 (18.2)	1 (3.3)	
No	18 (81.8)	29 (96.7)	
Prescribed an ACE inhibitor (n=52)			0.375
Yes	10 (45.5)	10 (33.3)	
No	12 (54.5)	20 (66.7)	
Prescribed an aldosterone receptor antagonist (n=52)			0.167
Yes	3 (13.6)	9 (30.0)	
No	19 (86.4)	21 (70.0)	
Prescribed an angiotension receptor blocker (n=52)			0.717
Yes	7 (31.8)	11 (36.7)	
No	15 (68.2)	19 (63.3)	
Prescribed an ACE inhibitor and an angiotension receptor blocker (n=52)			0.888
Yes	15 (68.2)	21 (70.0)	
No	7 (31.8)	9 (30.0)	
Prescribed a beta blocker (n=52)			0.169†
Yes	15 (68.2)	26 (86.7)	
No	7 (31.8)	4 (13.3)	
Prescribed hydrazaline and isorbide dinitrate (n=52)			0.070†
Yes	3 (13.6)	0 (0)	
No	19 (86.4)	30 (100)	
Prescribed digoxin (n=52)			0.033†
Yes	0 (0)	6 (20.0)	
No	22 (100)	24 (80.0)	
Prescribed a diuretic with NYHA functional class II to IV (n=52)			0.016†
Yes	21 (95.5)	20 (66.7)	
No	1 (4.5)	10 (33.3)	
Prescribed warfarin (n=52)			0.056
Yes	4 (18.2)	13 (43.3)	
No	18 (81.8)	17 (56.7)	

Continued

Table 4. Continued

Variable	n (%)		*P* Value*
	Black	White	
ICD therapy (n=52)			0.476
Yes	6 (27.3)	11 (36.7)	
No	16 (72.7)	19 (63.3)	

ACE indicates angiotensin-converting-enzyme; HF, heart failure; ICD, implantable cardioverter defibrillator.
*Reported *P* values are for associated χ^2 tests unless otherwise indicated.
†Using Fisher's exact test.

Table 5. Heart Failure Self-Care Variables by Race

Variable	n (%)		*P* Value*
	Black	White	
HF knowledge (n=262)			0.002
DKHFS≤10	29 (32.6)	27 (15.6)	
DKHFS>10	60 (67.4)	146 (84.4)	
SCHFI maintenance score (n=268)			0.627
<70	51 (54.3)	89 (51.1)	
≥70	43 (45.7)	85 (48.9)	
SCHFI management score (n=122)†			0.091
<70	20 (40.0)	40 (55.6)	
≥70	30 (60.0)	32 (44.4)	
SCHFI confidence score (n=272)			0.923
<70	30 (31.3)	56 (31.8)	
≥70	66 (68.7)	120 (68.2)	
Reporting trouble breathing or ankle swelling in past month item (n=272)			0.077
Yes	50 (52.1)	72 (40.9)	
No	46 (47.9)	104 (59.1)	
Urinary sodium (n=221)			0.597
≥3.5	50 (68.5)	105 (70.9)	
≥2.1 and <3.5	14 (19.2)	31 (21.0)	
<2.1	9 (12.3)	12 (8.1)	
MEMS medication adherence (n=212)			<0.001
<88% PDT	48 (77.4)	77 (51.3)	
≥88% PDT	14 (22.6)	73 (48.7)	
Exercise (n=272)			<0.001
<30 min/week	54 (56.3)	52 (29.5)	
≥30 min/week	42 (43.7)	124 (70.5)	

DKHFS indicates Dutch Knowledge of Heart Failure Scale; HF, heart failure; MEMS, Medication Event Monitoring System; PDT, prescribed doses taken; SCHFI, Self-Care Heart Failure Index.
*Reported *P* values are for associated χ^2 tests.
†Only collected from patients reporting trouble breathing or ankle swelling in past month.

medications, nor depression fully explained racial differences in medication adherence. Medication adherence is influenced by the number and frequency of pills taken daily,[47] with estimates of a 10% decline in adherence with each additional daily medication dose.[48,49] In our study, although more blacks than whites took more than 8 medications per day, the number of medications prescribed did not explain medication adherence. Only renal disease helped to explain lower

Table 6. Adjusted Results for Clinical Treatment and Self-Care Variables with Significant Unadjusted Racial Differences*

	Racial Difference			
	n	*P*	OR (95%CI)	Supplementary Predictors†
Clinical treatment variables				
For HF*r*EF patients				
Prescribed an ACE inhibitor	219	0.008	0.45 (0.25 to 0.81)	Satisfactory social support quality
Prescribed H-ISDN	215	0.041	3.37 (1.05 to 10.8)	Good social support quality, history of renal disease
Prescribed a diuretic with NYHA functional class II to IV	210	0.508	—	ANART≤25, history of renal disease
For HF*p*EF patients				
>8 medications	52	0.034	4.21 (1.12 to 15.9)	History of diabetes mellitus
Prescribed digoxin‡	52	0.016	—	—
Prescribed a diuretic with NYHA functional class II to IV	52	0.032	10.5 (1.23 to 89.7)	—
Self-care variables				
For HF*r*EF and HF*p*EF patients				
DKHFS≤10	261	0.001	3.03 (1.62 to 5.68)	History of myocardial infarction
% prescribed dose taken <88%	200	0.003	2.99 (1.47 to 6.09)	History of renal disease
Exercise <30 min/week	267	0.092	—	ANART≤25, history of renal disease

ACE indicates angiotensin-converting-enzyme; ANART, American National Adult Reading Test; CI, confidence interval; DKHFS, Dutch Heart Failure Knowledge Scale; H-ISDN, hydrazaline and isosorbide dinitrate; HF*p*EF, preserved ejection fraction HF; HF*r*EF, reduced ejection fraction HF; OR, odds ratio; NYHA, New York Heart Association.

*Results for Wald χ^2 tests using logistic regression models unless otherwise indicated.

†Chosen from among the variables of Tables 1 and 2 for analyses of clinical treatment variables and from among the variables of Tables 1 and 2 and the common variables of Tables 3 and 4 for analyses of self-care variables.

‡Results for Fisher's exact test since no blacks were prescribed digoxin, and so no OR reported.

adherence in addition to race. In other samples blacks with renal disease were no less adherent to their medications than blacks without renal disease.[50] Further research is needed to understand the persistence of racial differences in medication adherence even after adjusting for sociodemographic and clinical characteristics as well as clinical treatment variables.

Knowledge of HF has been shown to be lower in blacks than whites.[51] Few investigators have measured intellect, but low health literacy and poor educational attainment have been associated with lower levels of knowledge about HF and poor self-care.[52–54] Low levels of formal education and poor health literacy are common in minority populations, which suggests that low HF knowledge in blacks may reflect the need for tailored education that takes into account intellect, literacy, and formal education.[55] Screening for health literacy may provide important information that could help to tailor the treatment regimen.

Two factors contributed in important ways to clinical treatment and self-care: premorbid intellect (discussed in relation to knowledge above) and social support. Perceived quality of support was a significant determinant for 2 clinical treatments—the prescription of ACE inhibitors and H-ISDN. The importance of support for successful self-care has been well established.[56] Black patients with HF who lack sufficient support may be particularly challenged by the demands of daily self-care, and our results suggest that providers are taking this fact into account when prescribing therapy. We were surprised that multimorbidity was not a significant factor in self-care. We demonstrated previously that HF patients with multimorbidity receive fragmented self-care instructions that impede their ability to perform self-care[21] and decrease their confidence.[20] However, in this study, comorbidity was not a significant determinant of self-care in the blacks with higher numbers of comorbid conditions.

Although we found blacks to be more likely to be depressed than whites, depression did not influence clinical treatment or self-care. This was surprising because depression has been shown previously to affect HF self-care.[57] People who are depressed are less likely to engage in health practices such as smoking cessation or regular exercise.[58] The reason why depression had little influence on self-care was probably because patients with major depression were screened out at enrollment so the racial differences in depression reflected relatively minor differences.

Limitations of this study include primarily cross-sectional nature of the data and the secondary analysis. In addition, our analysis by HF type is limited by the small sample sizes, especially for patients with HF*p*EF. Although self-care was measured in a robust manner, the dataset was not built with the intention of describing clinical treatment so most of the variables were abstracted from the medical record rather than

being collected specifically for this study. The medical record is known to be an imprecise record of reality.[59] Categorizing continuous variables may have resulted in a loss of information, but categorizations were based on common criteria used with these variables so that reported results are based on meaningful categorizations. In addition, recruitment was limited to northeastern United States. Variations in HF care have been documented in different parts of the country, so our results should be interpreted with caution for populations outside of this region of the United States.. Further, there may be social factors that contribute to the disease burden experienced by blacks that we did not measure.

In conclusion, although numerous racial differences in sociodemographic and clinical characteristics were found in this study, few of these factors influenced either clinical treatment or patient self-care. This encouraging news suggests that providers are successfully overcoming previously identified disparities in care, at least in the HF population. However, the findings that blacks had deficits in HF knowledge and decreased medication adherence are disturbing. Further efforts are needed to personalize HF care, support improvements in self-care strategies, and support policies aimed at health equity.

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