Outcomes of Blacks Versus Whites with Cardiomyopathy

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Racial disparities in health outcomes have been widely documented in medicine, including in cardiovascular care. While some progress has been made, these disparities have continued to plague our healthcare system. Patients with cardiomyopathy are at an increased risk of death and cardiovascular hospitalizations. In the present analysis, we examined the baseline characteristics and outcomes of black and white men and women with cardiomyopathy. All patients with cardiomyopathy (left ventricular ejection fraction (LVEF) < 50%) cared for at University of Pittsburgh Medical Center (UPMC) between 2011 and 2017 were included in this analysis. Patients were stratified by race, and outcomes were compared between Black and White patients using Cox proportional hazard models. Of a total of 18,003 cardiomyopathy patients, 15,804 were white (88%), 1,824 were black (10%) and 375 identified as other (2%). Over a median follow-up time of 3.4 years, 7,899 patients died. Black patients were on average a decade younger (p <0.001) and demonstrated lower unadjusted all-cause mortality (hazard ratio [HR]: 0.83%; 95% CI 0.77 to 0.90; p < 0.001). However, after adjusting for age and other comorbidities, black patients had higher all-cause mortality compared to white patients (HR: 1.15, 95% CI 1.07 to 1.25; p < 0.001). These differences were seen in both men (HR:1.19, 95% CI 1.08 to 1.33; p < 0.001) and women (HR:1.12, 95% CI 0.99 to 1.25; p = 0.065). In conclusion, our data demonstrate higher all-cause mortality in black compared to white men and women with cardiomyopathy. These findings are likely explained, at least in part, by significantly higher rates of comorbidities in black patients. Earlier interventions targeting these comorbidities may mitigate the risk of progression to heart failure and improve outcomes. **(Am J Cardiol 2021;148:151−156)**

Racial disparities in health outcomes have been widely documented,[1] including in cardiovascular care.[2] For instance, recent studies have demonstrated the incidence of congestive heart failure to be higher in black patients, though the specific mechanisms leading to increased risk remain ill-defined.[3,4] Our group and others have demonstrated that patients with cardiomyopathy (left ventricular ejection fraction [LVEF] of ≤50%) are at an increased risk of progression to clinical heart failure and consequently, increased death and cardiovascular hospitalizations.[5-7] In the present analysis, we therefore examined the baseline characteristics and outcomes of Black and White patients with cardiomyopathy.

Methods

This study was approved by the University of Pittsburgh Institutional Review Board. All patients with cardiomyopathy (LVEF ≤ 50% as documented by echocardiogram) cared for at University of Pittsburgh Medical Center (UPMC) between 2011 and 2017 were identified through a search of the electronic health records and included in this analysis (n = 18,003). Both clinical and demographic data were compiled, including comorbid conditions, medications, imaging and laboratory studies. Patients were followed from their initial outpatient presentation in the UPMC system to the primary endpoint of all-cause mortality or secondary endpoint of first cardiac-related hospital admission. Patients were stratified by race into Blacks versus Whites with cardiomyopathy.

Continuous variables are listed as mean value ± SD and were compared between the groups using the Student's t-test. Categorical variables are presented as percentages of total population and were compared between groups using chi-squared test. Time to death or hospitalization was presented using Kaplan-Meier survival curves. Multivariable Cox proportional hazard models were used to adjust for independent, non-balanced covariates between racial groups for the endpoints of all-cause mortality and hospitalizations. All statistical analyses were performed on SPSS software (version 26, IBM, Armonk, NY).

Results

Table 1 shows baseline characteristics of the overall cohort stratified by race. Of a total of 18,003 cardiomyopathy patients (LVEF ≤ 50%), 15,804 (88%) were White, 1,824 (10%) were Black and 375 (2%) identified as other. The mean age of the cohort was 70.3 ± 14.3 years, with

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Table 1
Baseline characteristics of the overall population (N = 17,628) stratified by race

Variable	Black (N = 1,824)	White (N = 15,804)	p Value
Age (years)	62 ± 15	71 ± 14	<0.001
Women	45%	37%	<0.001
Weight (kg)	89 ± 26	84 ± 22	<0.001
Body Mass Index (kg/m^2)	30 ± 8	29 ± 7	<0.001
Left ventricular ejection fraction	30 ± 9	31 ± 8	<0.001
Hypertension	70%	57%	<0.001
Diabetes mellitus	37%	29%	<0.001
Hyperlipidemia	44%	55%	<0.001
Chronic pulmonary disease	16%	15%	0.13
Coronary artery disease	31%	48%	<0.001
Congestive heart failure	50%	41%	<0.001
Atrial fibrillation	15%	30%	<0.001
Cerebrovascular event	10%	13%	0.002
Chronic kidney disease	14%	9%	<0.001
Defibrillator implantation	8%	6%	0.008
Creatinine (mg/dL)	1.9 ± 2.4	1.5 ± 5.7	0.006
Glomerular filtration rate (ml/min)	58±31	67 ± 38	<0.001
Serum Sodium (mEq/L)	138 ± 3	138 ± 12	0.87
Serum Potassium (mEq/L)	4.15 ± 0.57	4.23 ± 0.54	<0.001
Serum Glucose (mmol/L)	128 ± 65	130 ± 58	0.15
Hemoglobin A1C (%)	7.1 ± 1.9	6.9 ± 1.6	0.11
Total Cholesterol (mg/dL)	156 ± 46	152 ± 45	0.05
Low density lipoprotein (mg/dL)	89 ± 33	96 ± 42	0.57
Triglyceride (mg/dL)	58±31	67±38	<0.001
Aspirin	40%	42%	0.16
Warfarin	10%	13%	<0.001
Novel Oral anticoagulation agents	3%	5%	0.001
Beta Blockers	49%	46%	0.015
ACE inhibitors or ARB	42%	32%	<0.001
Anti-arrhythmic drugs class I	2%	4%	<0.001
Anti-arrhythmic drugs class III	1%	1%	0.75

Black patients on average being a decade younger than White patients ($p < 0.001$). The average LVEF was 30 ± 9% and 31 ± 8% in Black and White patients, respectively. Compared to white patients, black patients had a higher prevalence of hypertension, diabetes mellitus, congestive heart failure, and chronic kidney disease, while White patients had a higher prevalence of coronary artery disease, hyperlipidemia, atrial fibrillation, and stroke.

Over a median follow-up time of 3.4 years, 7,899 (45%) patients died. In univariate analyses, the younger black patients demonstrated lower all-cause mortality compared to white patients (hazard ratio [HR]: 0.83%; 95% CI 0.77 to 0.90; $p < 0.001$) (Figure 1). However, after adjusting for differences in age and unbalanced comorbid conditions (Table 2), black patients had a 15% higher rate of all-cause mortality compared to white patients (HR: 1.15, 95% CI 1.07 to 1.25; $p < 0.001$) (Figure 2). Importantly, these differences by race were seen in both men (HR:1.19, 95% CI 1.08 to 1.33; $p < 0.001$) and women (HR:1.12, 95% CI 0.99 to1.25; $p = 0.065$) (Figures 2). These results were not affected by whether patients had ischemic or non-ischemic cardiomyopathy.

During follow-up, 12,689 (72%) had an admission to the hospital for any reason and 10,934 (62%) were admitted for a cardiac etiology. Time to first cardiac hospitalization was shorter in Black compared to White patients (HR: 1.21, 95% CI 1.14 to 1.28; $p<0.001$) and this persisted and was even more pronounced after adjusting for differences in age and comorbidities between racial groups (HR: 1.35, 95% CI 1.27 to 1.44; $p < 0.001$) (Table 2). Here again, these differences by race were observed in both men (HR:1.41, 95% CI 1.30 to 1.52; $p < 0.001$) (Figure 3) and women (HR: 1.27, 95% CI 1.16 to 1.39; $p < 0.001$) (Figure 3). Here again, the results were not affected by whether the patients' etiology of cardiomyopathy.

Discussion

Our analysis revealed higher adjusted all-cause mortality and shorter time to first cardiac hospitalization in Black compared to White patients with cardiomyopathy. This racial disparity in outcomes was present in both men and women, although more pronounced in men. Interestingly, the mean age of Black patients was approximately a decade younger than that of White patients. Therefore, adjusting for the age of patients was essential in uncovering this trend, particularly as it related to all-cause mortality where the racial impact on death was inverted after adjustment. Additionally, adjusting for other independent predictors of cardiac hospitalizations including hypertension, diabetes and atrial fibrillation again revealed disproportionate rates of earlier hospitalizations in Black compared to White patients.

The underlying mechanisms by which race may influence these important outcomes remain ill-defined but are likely multifactorial, pertaining to patients' overall health and prevalent comorbidities, their socio-economic status, as

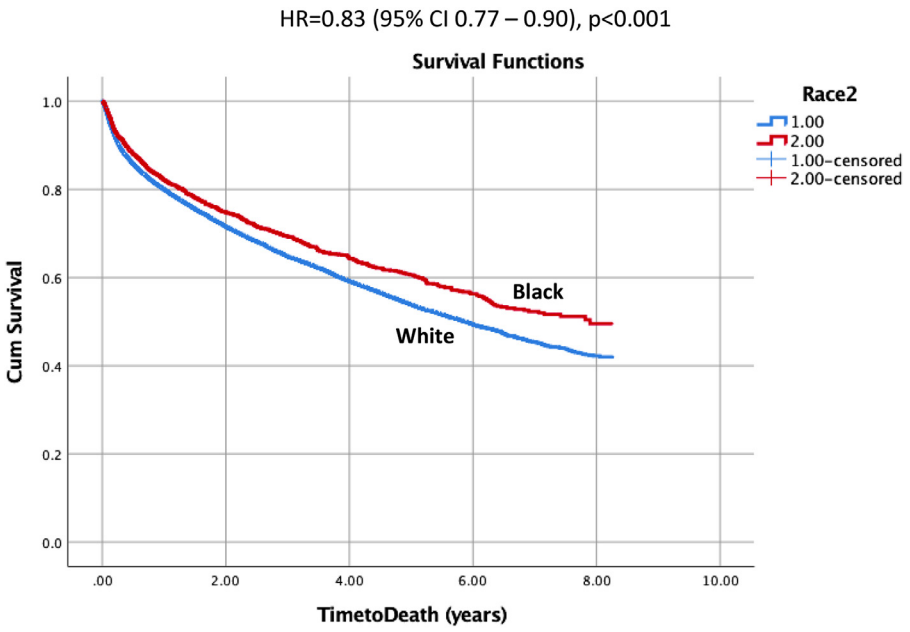

Figure 1. Unadjusted Kaplan-Meier survival curves for all-cause mortality of patients with cardiomyopathy stratified by race.

Table 2
Multivariable Models Examining Independent predictors of All-Cause Mortality and Cardiac Hospitalizations

	Hazard ratio	95% Confidence interval		p Value
		Lower	*Upper*	
Mortality				
Race (Black compared to White)	1.15	1.07	1.25	<0.001
Age (per 1-year increase)	1.05	1.04	1.05	<0.001
Hypertension	0.90	0.86	0.95	<0.001
Diabetes Mellitus	1.36	1.29	1.43	<0.001
Atrial Fibrillation	1.01	0.96	1.06	0.61
Cardiac Hospitalization				
Race (Black compared to White)	1.35	1.27	1.44	<0.001
Age (per 1-year increase)	1.2	1.01	1.02	<0.001
Hypertension	1.10	1.05	1.14	<0.001
Diabetes Mellitus	1.33	1.28	1.39	<0.001
Atrial Fibrillation	1.15	1.10	1.20	<0.001

well as their access to healthcare services for delivery of treatment.

In our population, Black patients had a higher prevalence of multiple comorbidities including hypertension, diabetes mellitus, obesity, congestive heart failure, and chronic kidney disease. Previous studies have reported that the incidence of clinical heart failure in younger patients (age <50 years) is substantially more common in Blacks compared to Whites.[3,4] It is proposed that this could be due to a higher prevalence of comorbidities in Black patients.[3] Our data demonstrate that after adjusting for age, Black patients with cardiomyopathy have higher all-cause mortality, likely signifying progression to overt cardiac failure. Despite being a decade younger than Whites, Black patients had more compromised health status at baseline as evidenced by their more prevalent comorbidities, higher body mass index, lower LVEF and worse kidney function. Conversely, Black patients in our cohort had significantly lower prevalence of coronary artery disease compared to White patients (Table 1). This was significant, as prior literature has shown higher readmission rates and mortality in ischemic compared to non-ischemic cardiomyopathy,[8-10] yet our data reveal worse outcomes in the group with more prevalent non-ischemic cardiomyopathy.

Another factor possibly accounting for the racial differences in outcomes seen in our study is patients' socioeconomic status (SES). Although this information was not available in our present cohort, prior literature has established SES as an independent predictor for both incident heart failure and poorer heart failure outcomes,[11-13] Typically, estimates of SES are derived from annual household income data or from the zip code of patients' residence, both serving as proxies.[11] The leading mechanisms by which lower SES contributes to worse outcomes remain elusive, though have been postulated to be secondary to disabling chronic illnesses, which require adequate financial

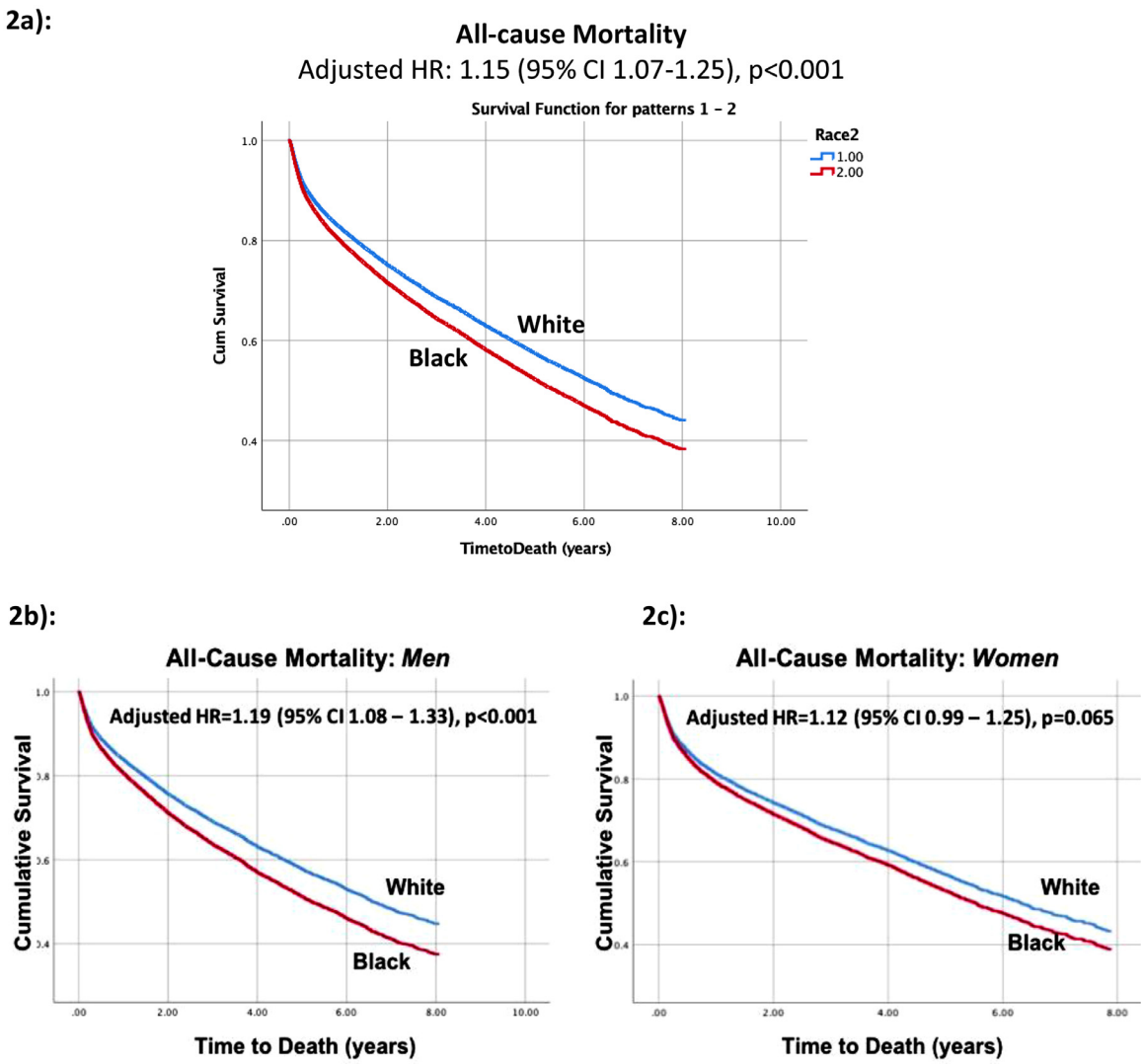

Figure 2. Adjusted Kaplan-Meier survival curves for all-cause mortality of patients with cardiomyopathy for the overall cohort (panel A) and for men (panel B) and women (panel C).

income to meet the demands of self-care.[11] Although there is less data implicating SES as a modifier of outcomes in cardiomyopathy, one could infer that similar patterns are at play in our cohort.

It has also been postulated that inadequate delivery of treatment and access to care contribute to differences in outcomes.[5] In a recent study examining age and racial and/or ethnic disparities in preventable heart failure hospitalizations, the authors found a significant gap between Black and White patients aged less than 65 years. This was attributed to the fact that health insurance plays a major role in rates of preventable hospitalizations, with highest admission rates in enrollees of Medicaid. Although Black patients outnumbered White patients even in the age >65 years group, the gap was smaller, likely due to more equitable access to health care through Medicare in the older group.[5] Interestingly, our data suggest that Black patients receive equivalent if not superior guideline directed therapy compared to White patients, as they have higher rates of prescribed ACE-inhibitors and beta blockers. This, however, does not ensure compliance with treatment (Table 1).

Finally, some degree of provider implicit bias could possibly also contribute to disparate outcomes by race, though this is difficult to measure retrospectively. In a systematic review examining bias among health care professionals, it was found that most providers tend to have more positive attitudes toward Whites and negative attitudes toward patients of color.[14] This influenced patient-physician relationships, treatment adherence, and ultimately, patient outcomes.[11] Implicit bias was not measured in our cohort but is important to consider as we work to eliminate racial disparities in health care.

Our study was conducted at a single institution, so our results may not be readily applicable to other institutions or practice settings. That stated, the University of Pittsburgh Medical Center is comprised of many hospitals distributed over urban, suburban and rural regions of Pennsylvania and the neighboring states. Additionally, this study was a retrospective, observational cohort analysis, and therefore may be fraught with unmeasured bias. We aimed to minimize such potential bias by performing rigorous statistical adjustments and by including all patients with LVEF ≤50%

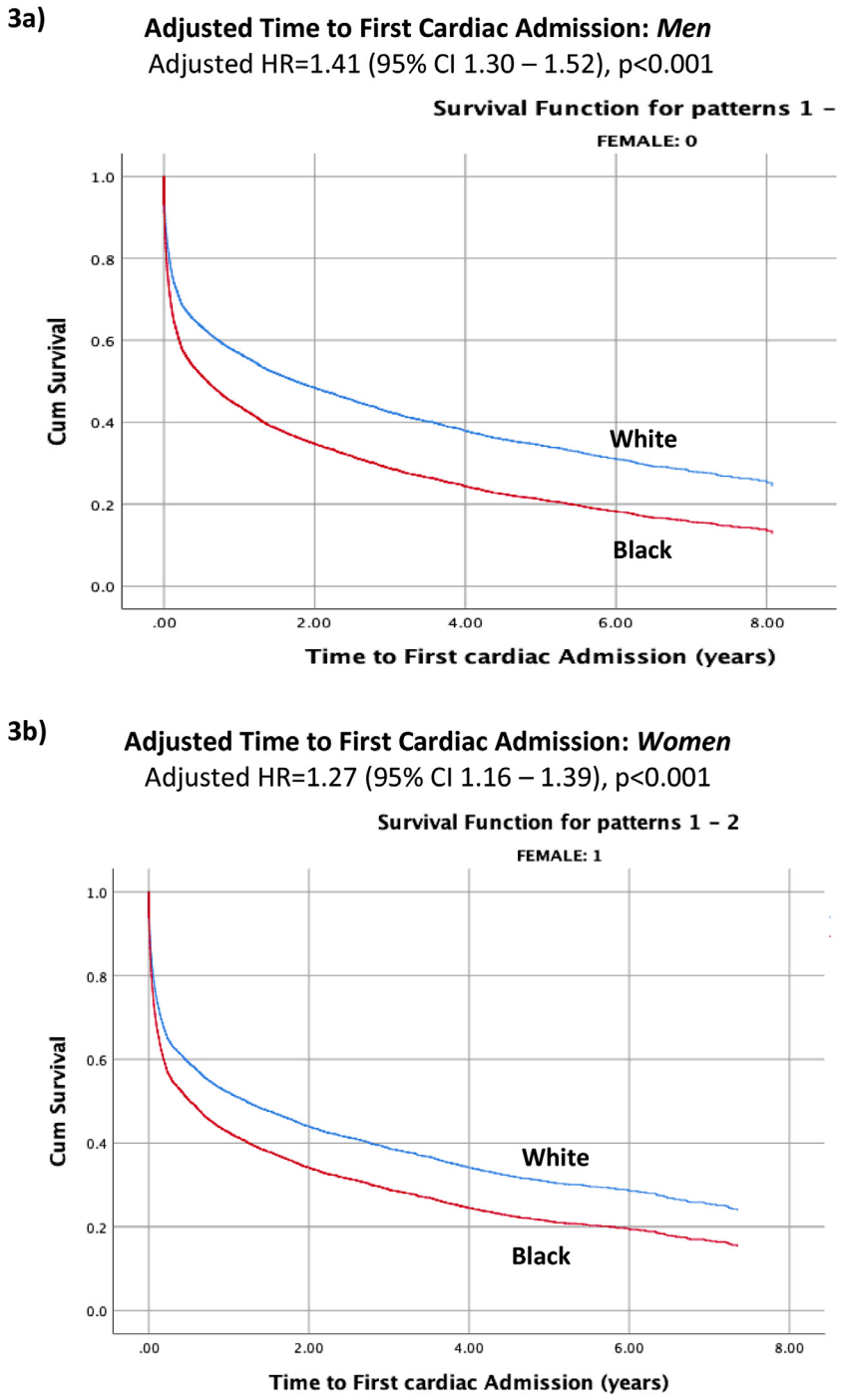

Figure 3. Adjusted Kaplan-Meier survival curves for cardiac hospitalizations of patients with cardiomyopathy for men (panel A) and women (panel B).

without exclusions. Of note, the LVEF was assessed through echocardiography by a board-certified cardiologist but the method of quantification was left to the discretion of the reader.

Our data demonstrate higher rates of all-cause mortality and cardiac hospitalizations in black compared to white men and women with cardiomyopathy. These findings are possibly explained by significantly higher rates of comorbidities in Blacks compared to Whites in our cohort.

Authors' contributions

Shazli Khan: Data analysis and manuscript writing. Suresh Mulukutla: Oversight of database management, analysis, and critical review of manuscript. Floyd Thoma: Data manger and analysis. Aditya Bhonsale: critical review of manuscript. Krishna Kancharla: critical review of manuscript. N. A. Mark Estes III: critical review of manuscript. Sandeep K Jain: critical review of manuscript. Samir Saba:

Concept of study, data analysis, and critical review of manuscript.

Disclosures

The authors declare that: They are interested in publishing their original manuscript entitled 'Racial Disparities in Outcomes of Patients with Cardiomyopathy' in the American Journal of Cardiology. The data presented in this manuscript has not been presented elsewhere and is not under consideration for publication anywhere else. All the authors are familiar with the data and are responsible for its integrity. There are no conflicts of interest for any of the authors regarding the subject matter of this study.

1. Institute of Medicine. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academies Press; 2003.
2. Yancy CW, Wang TY, Ventura HO, Piña IL, Vijayaraghavan K, Ferdinand KC, Hall LL, Credo Advisory Group. The coalition to reduce racial and ethnic disparities in cardiovascular disease outcomes (credo): why credo matters to cardiologists. *J Am Coll Cardiol* 2011; 57:245–252.
3. Bibbins-Domingo K, Pletcher MJ, Lin F, Vittinghoff E, Gardin JM, Arynchyn A, Lewis CE, Williams OD, Hulley SB. Racial differences in incident heart failure among young adults. *N Engl J Med* 2009; 360:1179–1190.
4. Bahrami H, Kronmal R, Bluemke DA, Olson J, Sheas S, Liu K, Burke GL, Lima JA. Differences in the incidence of congestive heart failure by ethnicity: the multi-ethnic study of atherosclerosis. *Arch Intern Med* 2008;168:2138–2145.
5. Doshi RP, Yan J, Aseltine RH Jr.. Age differences in racial/ethnic disparities in preventable hospitalizations for heart failure in connecticut, 2009-2015: a population-based longitudinal study. *Public Health Rep* 2020;135:56–65.
6. Medhekar A, Mulukutla S, Thoma F, Wang NC, Bhonsale A, Kancharla K, Estes NAM 3rd, Jain SK, Saba S. Impact of diabetes mellitus on mortality and hospitalization in patients with Mild-to-Moderate cardiomyopathy. *JACC Clin Electrophysiol* 2020;6:552–558.
7. Bardy GH, Lee KL, Mark DB, Poole JE, Packer DL, Boineau R, Domanski M, Troutman C, Anderson J, Johnson G, McNulty SE, Clapp-Channing N, Davidson-Ray LD, Fraulo ES, Fishbein DP, Luceri RM, Ip JH, Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) Investigators. Amiodarone or an implantable cardioverter-defibrillator for congestive heart failure. *N Engl J Med* 2005;352:225–237.
8. Higgins AY, Bjerre J, Parzynski CS, Minges KE, Ahmad T, Desai NR, Enriquez A, Spatz ES, Friedman DJ, Curtis JP, Hlatky MA, Freeman JV. Comparison of mortality and readmission in non-ischemic versus ischemic cardiomyopathy after implantable cardioverter-defibrillator implantation. *Am J Cardiol* 2020;133:116–125.
9. Corbalan R, Bassand JP, Illingworth L, Ambrosio G, Camm AJ, Fitzmaurice DA, Fox KAA, Goldhaber SZ, Goto S, Haas S, Kayani G, Mantovani LG, Misselwitz F, Pieper KS, Turpie AGG, Verheugt FWA, Kakkar AK, GARFIELD-AF Investigators. Analysis of outcomes in ischemic vs nonischemic cardiomyopathy in patients with atrial fibrillation: a report from the GARFIELD-AF registry. *JAMA Cardiol* 2019;4:526–548.
10. Corbalan R, Bassand J, Illingworth L, Ambrosio G, Camm AJ, Fitzmaurice DA, Fox KAA, Goldhaber SZ, Goto S, Haas S, Kayani G, Mantovani LG, Misselwitz F, Pieper KS, Turpie AGG, Verheugt FWA, Kakkar AK, GARFIELD-AF Investigators. Analysis of outcomes in ischemic vs nonischemic cardiomyopathy in patients with atrial fibrillation: a report from the GARFIELD-AF registry. *JAMA Cardiol* 2019;4:526–548.
11. Khariton Y, Nassif ME, Thomas L, Fonarow GC, Mi X, DeVore AD, Duffy C, Sharma PP, Albert NM, Patterson JH, Butler J, Hernandez AF, Williams FB, McCague K, Spertus JA. Health status disparities by sex, race/ethnicity, and socioeconomic status in outpatients with heart failure. *JACC Heart Fail* 2018;6:465–473.
12. Hawkins NM, Jhund PS, McMurray JJ, Capewell S. Heart failure and socioeconomic status: accumulating evidence of inequality. *Eur J Heart Fail* 2012;14:138–146.
13. Potter EL, Hopper I, Sen J, Salim A, Marwick TH. Impact of socioeconomic status on incident heart failure and left ventricular dysfunction: systematic review and meta-analysis. *Eur Heart J Qual Care Clin Outcomes* 2019;5:169–179.
14. Hall WJ, Chapman MV, Lee KM, Merino YM, Thomas TW, Payne BK, Eng E, Day SH, Coyne-Beasley T. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: a systematic review. *Am J Public Health* 2015;105:e60–e76.