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Racial, Ethnic, and Sex Disparities in Patients With STEMI and Cardiogenic Shock

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ABSTRACT

OBJECTIVES The aim of this study was to evaluate the combined impact of race, ethnicity, and sex on in-hospital outcomes using data from the National Inpatient Sample.

BACKGROUND Cardiogenic shock (CS) is a major cause of mortality following ST-segment elevation myocardial infarction (STEMI). Early revascularization reduces mortality in such patients. Mechanical circulatory support (MCS) devices are increasingly used to hemodynamically support patients during revascularization. Little is known about racial, ethnic, and sex disparities in patients with STEMI and CS.

METHODS The National Inpatient Sample was queried from January 2006 to September 2015 for hospitalizations with STEMI and CS. The associations between sex, race, ethnicity, and outcomes were examined using complex-samples multivariate logistic or generalized linear model regressions.

RESULTS Of 159,339 patients with STEMI and CS, 57,839 (36.3%) were women. In-hospital mortality was higher for all women (range 40% to 45.4%) compared with men (range 30.4% to 34.7%). Women (adjusted odds ratio [aOR]: 1.11; 95% confidence interval [CI]: 1.06 to 1.16; $p < 0.001$) as well as Black (aOR: 1.18; 95% CI: 1.04 to 1.34; $p = 0.011$) and Hispanic (aOR: 1.19; 95% CI: 1.06 to 1.33; $p = 0.003$) men had higher odds of in-hospital mortality compared with White men, with Hispanic women having the highest odds of in-hospital mortality (aOR: 1.46; 95% CI: 1.26 to 1.70; $p < 0.001$). Women were older (age: 69.8 years vs. 63.2 years), had more comorbidities, and underwent fewer invasive cardiac procedures, including revascularization, right heart catheterization, and MCS.

CONCLUSIONS There are significant racial, ethnic, and sex differences in procedural utilization and clinical outcomes in patients with STEMI and CS. Women are less likely to undergo invasive cardiac procedures, including revascularization and MCS. Women as well as Black and Hispanic patients have a higher likelihood of death compared with White men. (J Am Coll Cardiol Intv 2021;14:653-60) © 2021 by the American College of Cardiology Foundation.

Cardiogenic shock (CS) is a major cause of mortality in patients with acute ST-segment elevation myocardial infarction (STEMI) (1). Early mechanical revascularization improves outcomes in such patients (2). Recent studies have demonstrated that the use of shock protocols may further improve outcomes (3-7). These protocols incorporate key best practices, including early recognition of CS and rapid delivery of invasive therapies, including mechanical circulatory support devices,

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ABBREVIATIONS AND ACRONYMS

AKI = acute kidney injury

aOR = adjusted odds ratio

CABG = coronary artery bypass grafting

CI = confidence interval

CS = cardiogenic shock

ECMO = extracorporeal membrane oxygenation

IABP = intra-aortic balloon pump

NIS = National Inpatient Sample

PCI = percutaneous coronary intervention

pVAD = percutaneous ventricular assist device

STEMI = ST-segment elevation myocardial infarction

percutaneous coronary intervention (PCI), and pulmonary artery catheterization. Further study is necessary to prove the efficacy of this approach through robust randomized control trials. Given the heterogeneity of care present among patients with STEMI and CS and the difficulties in recruiting patients into such trials, it is likely that shock protocols will continue to be increasingly used across health systems (8-13).

It is unclear whether invasive revascularization procedures and mechanical hemodynamic support devices are less frequently used in women and racial and ethnic minorities presenting with STEMI and CS. The heterogeneity of care among patients with CS may allow these sex, racial, and ethnic disparities to go unnoticed. Studies have demonstrated that women with STEMI are less likely to receive invasive therapies (8-10). Studies have also demonstrated that racial and ethnic minorities with STEMI are less likely to receive invasive therapies (11,12). We therefore sought to evaluate the procedural and clinical outcomes of patients with STEMI and CS, on the basis of racial, ethnic, and sex differences, in a large national database.

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METHODS

DATA SOURCE. The study was exempt from Institutional Review Board approval, as it was performed using an anonymous dataset and because of the deidentified nature of the publicly available data in the National Inpatient Sample (NIS) database. The NIS database is a publicly available database of all-payer hospital inpatient stays developed by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project. We queried the NIS database from January 2006 to September 2015. The NIS was constructed from 22 states with reliable and verified patient linkage numbers in the state inpatient databases that could be used to track patients across hospitals within a state, while adhering to strict privacy guidelines.

The NIS database includes approximately 14 million patients and about 2,000 hospitals per year. National estimates are obtained using sampling weights provided. A detailed explanation of all the variables in the NIS is available online (https://www.hcup-us.ahrq.gov/db/nation/nis/nisdde.jsp).

STUDY COHORT. The study population was identified using the International Classification of Diseases-9th Revision-Clinical Modification principal diagnostic codes for STEMI (410.0x, 410.1x, 410.2x, 410.3x, 410.4x, 410.5x, 410.6x, and 410.8x) and a secondary diagnosis of CS (785.51). Sex and race, and ethnicity, cohorts were identified using the NIS variables "female" and "race" and ethnicity. "Black" refers to non-Hispanic Black patients, "Hispanic" refers to Hispanic patients of all races and origins, and "White" refers to non-Hispanic White patients.

PATIENT AND HOSPITAL CHARACTERISTICS. Baseline patient characteristics such as age, relevant comorbidities, insurance, and median household income were collected. The severity of comorbid conditions was defined using a validated Deyo modification of the Charlson comorbidity index (14,15). Other characteristics, such as teaching status of the hospital, hospital bed size, insurance status, and discharge disposition, were also included.

STUDY OUTCOMES. The primary outcome was in-hospital mortality. Secondary outcomes were divided as procedural outcomes (which included PCI, coronary artery bypass grafting [CABG], thrombolysis, use of an intra-aortic balloon pump [IABP], percutaneous ventricular assist device [pVAD] or extracorporeal membrane oxygenation [ECMO], right heart catheterization, and permanent left ventricular assist device placement) and clinical outcomes (which included acute kidney injury [AKI], AKI requiring dialysis, ischemic stroke, major bleeding, length of stay, and total hospital costs adjusted for inflation up to July 2018).

STATISTICAL ANALYSIS. Univariate differences in baseline characteristics between our cohorts were evaluated using Pearson chi-square tests for categorical variables and Wilcoxon rank sum tests for continuous variables. Multivariate linear and logistic regression was used to compare hospital outcomes between groups, adjusting for potential confounders, which included age, Charlson comorbidity index, hospital bed size, teaching status, and insurance. Statistical analysis was performed using Stata version 14 (StataCorp, College State, Texas). A p value <0.05 was considered to indicate statistical significance for all analyses.

RESULTS

We identified a total of 159,339 patients with STEMI and CS, of whom 57,839 (36.3%) were women. Of those women, 77.9% were White, 8.6% were Black,

TABLE 1 Baseline Characteristics

	White		Black		Hispanic		Other		
	Men (n = 77,532)	Women (n = 45,070)	Men (n = 6,282)	Women (n = 4,994)	Men (n = 8,473)	Women (n = 3,925)	Men (n = 9,213)	Women (n = 3,850)	p Value
Age (yrs)	65.6	72.0	61.7	66.8	62.7	69.5	62.7	71.0	<0.01
Comorbidities									
Hypertension	52.9	58.3	59.5	67.9	58.0	64.9	55.3	60.4	<0.01
Diabetes mellitus	27.7	30.6	36.5	46.2	48.8	58.2	38.9	42.9	<0.01
Insulin-dependent diabetes	2.4	3.3	3.8	5.9	3.9	5.9	3.8	6.4	<0.01
Dyslipidemia	43.1	40.4	39.0	40.9	44.8	41.0	45.2	39.9	<0.01
COPD	17.8	19.0	10.9	8.9	10.9	8.1	10.7	8.6	<0.01
End-stage renal disease	2.0	1.8	7.1	9.8	5.9	6.7	3.1	3.5	<0.01
Obesity	10.9	11.9	8.1	17.0	9.8	14.6	6.5	8.7	<0.01
Peripheral vascular disease	10.8	12.7	10.9	13.6	10.2	13.6	8.5	9.0	<0.01
Smoking	38.1	27.8	34.7	23.9	31.2	15.4	31.9	15.8	<0.01
Alcohol abuse	5.6	1.5	6.8	1.3	6.9	1.1	3.9	0.8	<0.01
Drug abuse	2.1	1.2	9.4	3.1	3.2	0.8	1.8	0.8	<0.01
Prior myocardial infarction	8.2	6.4	7.7	7.1	7.3	7.5	7.1	4.9	<0.01
Prior PCI	10.4	7.3	10.8	7.1	9.6	7.2	8.4	6.8	<0.01
Prior CABG	3.8	2.7	2.4	3.0	3.3	3.4	3.7	1.4	<0.01
Prior stroke/TIA	4.4	6.5	7.0	9.6	5.0	7.3	4.8	6.0	<0.01
Known CAD	78.1	70.6	73.1	68.5	77.3	72.6	79.8	72.4	<0.01
Carotid artery disease	1.2	1.2	0.5	0.9	0.8	1.0	0.6	0.3	0.01
Atrial fibrillation	23.6	24.4	13.9	14.8	17.6	19.2	17.8	20.3	<0.01
Anemia	15.4	20.9	20.2	28.1	22.4	27.5	18.9	24.7	<0.01
Charlson comorbidity index									
0	18.8	21.3	18.8	20.9	22.5	23.1	22.4	22.9	<0.01
1	26.8	22.9	23.6	16.8	20.6	15.8	24.8	21.0	
2	32.1	31.9	27.3	27.6	30.8	27.8	32.0	32.2	
≥3	22.2	24.0	30.3	34.8	26.2	33.3	20.8	24.0	
Other characteristics									
Teaching hospital	53.5	50.9	69.7	68.4	51.8	53.7	61.4	58.8	<0.01
Hospital bed size									
Small	8.3	9.5	7.8	6.4	7.9	6.7	11.2	13.5	<0.01
Medium	22.3	23.0	21.3	23.6	22.4	21.7	21.0	20.7	
Large	69.5	67.6	70.8	70.0	69.7	71.6	67.8	65.8	
Median household income									
0 to 25th percentile	24.1	25.8	53.3	52.6	38.8	39.2	21.9	20.8	<0.01
26th to 50th percentile	27.1	27.6	20.5	20.5	23.7	22.5	20.4	21.1	
51st to 75th percentile	26.0	24.3	14.8	15.6	22.7	22.8	23.4	26.5	
76th to 100th percentile	22.8	22.4	11.4	11.4	14.8	15.6	34.3	31.7	
Primary payer									
Medicare/Medicaid	56.5	74.7	58.5	71.9	55.1	70.1	50.2	69.9	<0.01
Private insurance	32.2	19.5	25.4	19.7	26.1	16.4	34.6	18.3	
Self-pay/other	11.3	5.8	16.1	8.4	18.9	13.5	15.2	11.9	
Discharge disposition									
Home	68.0	58.0	66.5	61.1	71.3	63.1	71.2	59.2	<0.01
Nursing home/facility	22.9	34.8	24.2	30.6	17.2	27.3	17.6	27.6	
Transfer to another hospital	8.5	6.9	8.5	8.1	10.5	9.5	10.7	13.0	

Values are %.

CABG = coronary artery bypass grafting; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; PCI = percutaneous coronary intervention; TIA = transient ischemic attack.

and 6.8% were Hispanic. Women were older (69.8 years vs. 63.2 years; p < 0.001) and overall had a higher burden of comorbidities (Table 1). Hypertension, diabetes mellitus, and obesity were more common in women, whereas hyperlipidemia, chronic obstructive lung disease, smoking, and alcohol abuse were more common in men. Hypertension was most prevalent in Black women (67.9%), followed by Hispanic women (64.9%). Diabetes mellitus was most prevalent in Hispanic women (58.2%), followed by Hispanic men (48.8%), followed by Black women (46.2%). Women were less likely to have undergone prior PCI and to have known coronary artery disease compared with men.

Women were less likely to undergo invasive cardiac procedures compared with men. These procedures included right heart catheterization; revascularization with PCI, thrombolysis, or CABG;

TABLE 2 Procedural and Clinical Outcomes Stratified by Race, Ethnicity, and Sex in Patients With CS-STEMI

	White		Black		Hispanic		Other		
	Men	Women	Men	Women	Men	Women	Men	Women	p Value
Procedural outcomes									
Percutaneous coronary intervention	67.0	62.9	66.4	59.4	66.9	58.5	65.4	57.6	<0.001
CABG	15.4	9.7	11.4	10.3	15.5	10.7	16.3	12.1	<0.001
Thrombolysis	2.1	1.9	2.8	2.0	3.1	2.0	2.8	2.7	0.019
IABP	53.3	41.9	51.2	45.4	57.0	44.3	56.2	43.5	<0.001
Percutaneous ventricular assist device	3.3	1.9	4.0	3.2	3.1	2.3	4.7	2.9	<0.001
ECMO	1.0	0.6	1.1	1.0	1.0	0.6	2.0	1.1	<0.001
Right heart catheterization	16.7	15.1	16.5	15.5	19.3	16.1	22.4	17.9	<0.001
Permanent LVAD placement	0.7	0.3	0.6	0.2	0.4	0.4	0.8	0.5	0.018
Clinical outcomes									
Mortality	33.3	40.9	33.6	40.0	34.7	45.4	30.4	43.2	<0.001
Major bleeding	8.3	8.4	10.7	9.3	10.4	9.8	8.9	10.2	0.004
AKI	38.3	33.2	44.8	40.7	40.7	39.2	39.0	40.0	<0.001
AKI requiring dialysis	3.2	2.6	4.3	4.1	6.0	4.8	5.4	5.2	<0.001
Stroke	3.1	3.4	4.0	4.7	3.4	4.1	4.3	3.8	0.011
Palliative care consultation	6.6	9.3	6.4	6.8	6.1	6.1	4.7	7.9	<0.001
Length of stay (days)	6 (3-11)	5 (2-10)	6 (3-12)	6 (2-13)	6 (3-11)	5 (2-11)	7 (3-12)	5 (2-10)	0.001
Mean hospital costs ($)	45,599	37,105	46,300	42,414	49,666	41,997	53,819	42,502	<0.001

Values are % or median (interquartile range).

AKI = acute kidney injury; ECMO = extracorporeal membrane oxygenation; IABP = intra-aortic balloon pump; LVAD = left ventricular assist device; CS-STEMI = cardiogenic shock-ST-segment elevation myocardial infarction; other abbreviations as in Table 1.

and mechanical circulatory support with an IABP, a pVAD, or ECMO (Table 2). Women underwent PCI less often compared with men. PCI was performed in 62.9% of White women compared with 67% of White men. PCI was performed in 59.4% of Black women compared with 66.4% of Black men. PCI was performed in 58.5% of Hispanic women compared with 66.9% of Hispanic men. Similarly, women had lower rates of CABG compared with men. Women had lower rates of right heart catherization and mechanical circulatory support use, including IABPs, pVADs, ECMO, and durable left ventricular assist devices, compared with men with STEMI and CS (Central Illustration).

In-hospital mortality was higher in women compared with men. White women had a mortality rate of 40.9%, compared with 33.3% for White men. Black women had a mortality rate of 40%, compared with 33.6% for Black men. Hispanic women had a mortality rate of 45.4%, compared with 34.7% for Hispanic men. We performed multivariate analysis comparing mortality on the basis of sex and race/ethnicity combined. After adjusting for age, Charlson comorbidity index, hospital bed size, hospital teaching status, and insurance using White men as the reference, women from all races had significantly higher odds of in-hospital mortality (adjusted odds ratio [aOR]: 1.11; 95% confidence interval [CI]: 1.06 to 1.16; p < 0.001) (Figure 1). Black and Hispanic men also had significantly higher odds of in-hospital mortality compared with White men (Black men: aOR: 1.18; 95% CI: 1.04 to 1.34; p = 0.011; Hispanic men: aOR: 1.19; 95% CI: 1.06 to 1.33; p = 0.003) (Table 3).

The incidence of AKI was generally lower in women compared with men. We found that Black men had the highest rates of major bleeding (10.7%) across all groups (Table 2). We also found that women generally had higher rates of stroke compared with men (3.4% for White women compared with 3.1% for White men, 4.1% for Hispanic women compared with 3.4% for Hispanic men), with the highest rate of stroke (4.7%) in Black women across all study groups. Women also had higher rates of palliative care consultation compared with men, with the highest rate of palliative care consultation in White women (9.3%) across all the study groups. After exclusion of patients who died, female sex was associated with lower mean cost ($41,005 vs. $48,846) and median length of stay (5 days vs. 6 days), with White women having the lowest cost of care ($37,105) and shortest length of stay (5 days; interquartile range: 2 to 10 days) across all groups (Table 2).

DISCUSSION

In the present analysis, we demonstrate the combined effect of racial, ethnic, and sex differences on clinical and procedural outcomes in patients with STEMI and CS. We found that women of all races and ethnicities and men from racial and ethnic minorities had higher odds of in-hospital mortality compared with White men. In particular, Hispanic women had

CENTRAL ILLUSTRATION Racial, Sex, and Ethnic Disparities in Outcomes of Patients With ST-Segment Elevation Myocardial Infarction and Cardiogenic Shock

ST-segment Elevation Myocardial Infarction and Cardiogenic Shock

		In-Hospital Mortality	Revascularization	Mechanical Circulatory Support	Right Heart Catheterization
Men	White	33.3%	82.4%	57.6%	16.7%
Men	Black	33.6%	77.8%	56.3%	16.5%
Men	Hispanic	34.7%	82.4%	61.1%	19.3%
Men	Other	30.4%	81.7%	62.9%	22.4%
Women	White	40.9%	72.7%	44.4%	15.1%
Women	Black	40.0%	69.8%	49.5%	15.5%
Women	Hispanic	45.4%	69.2%	47.2%	16.1%
Women	Other	43.2%	69.7%	47.4%	17.9%

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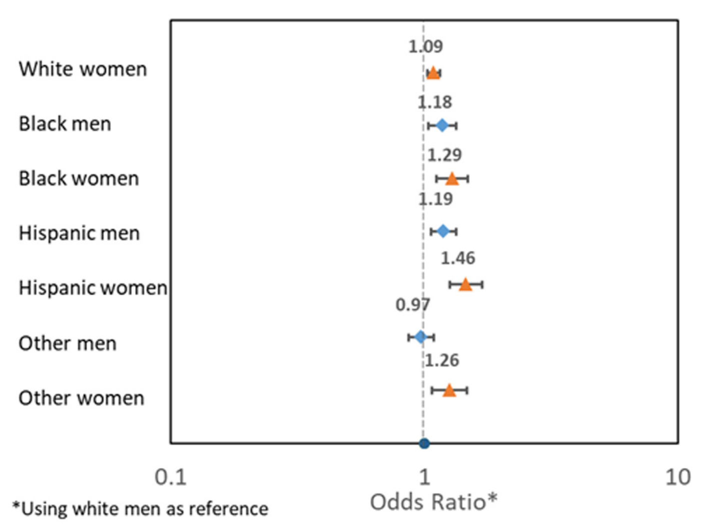
Racial, ethnic, and sex disparities were seen in the rates of in-hospital mortality, revascularization, mechanical circulatory support, and right heart catheterization in patient with ST-segment elevation myocardial infarction and cardiogenic shock.

the highest risk for in-hospital mortality. Women underwent fewer invasive cardiac procedures compared with men, including reperfusion, right heart catheterization, and mechanical circulatory support. Black women had the highest rate of ischemic stroke, while White women had the highest rates of palliative care consultation. Overall, there are considerable disparities in the care of patients with STEMI and CS.

Numerous studies have demonstrated that women undergo less revascularization compared with men (16–24) for acute coronary syndrome. D'Onofrio et al. (17) analyzed outcomes among 1,465 patients with STEMI in the VIRGO (Variations in Recovery: Role of Gender on Outcomes of Young AMI) study and demonstrated that younger women were less likely to receive reperfusion therapy and more likely to have reperfusion delays compared with men. This is despite evidence that women derive similar benefits from revascularization (18). Barthélémy et al. (16) analyzed outcomes among 775 consecutive patients with STEMI and found that 23.5% of women underwent PCI. Women who underwent PCI had similar 1-year outcomes compared with men, despite a higher risk profile at baseline, including more CS, illustrating further that women have similar benefit from PCI compared with men.

The observation that women undergo less revascularization compared with men could be attributed to having less severe obstructive coronary artery disease and a higher prevalence of other etiologies of myocardial infarction, including takotsubo cardiomyopathy, microvascular dysfunction, coronary vasospasm, and spontaneous coronary artery dissection, among other etiologies described under a broader terminology increasingly used by the cardiovascular community, myocardial infarction with nonobstructive coronary arteries (19,20). However, this does not explain why women underwent less right heart catheterization and mechanical circulatory support in the setting of shock compared with men, as seen in our analysis. Studies have shown that right heart catheterization can facilitate decision making and was associated with decreased mortality in patients with acute myocardial infarction complicated by CS who received pVADs (21,22). In addition, Joseph et al. (23) demonstrated in their analysis of patients with acute myocardial infarction complicated by CS

FIGURE 1 Forest Plot Figure Illustrating Mortality by Sex and Race



Odds ratios for in-hospital mortality were higher for all women as well as Black and Hispanic patients compared with White men. Odds ratios were adjusted for age, Charlson comorbidity index, hospital bed size, hospital teaching status, and insurance using White men as reference.

from the cVAD registry that early initiation of hemodynamic support prior to PCI with the Impella 2.5 was associated with a greater survival benefit to hospital discharge in women compared with men, despite a higher rate of revascularization failure for women.

Despite continued medical advancements, significant disparities exist in the cardiac care of Black patients, from prevention to invasive treatments and outcomes (24,25). Black patients tend to have longer delays in receiving medications, revascularization, and surgical treatments in acute coronary syndrome, including longer door-to-balloon times (25). These disparities persist even in patients with STEMI, as Anstey et al. (25) demonstrated in their analysis of the ACTION-Registry (Acute Coronary Treatment and Intervention Outcomes Network Registry-Get With the Guidelines), in which Black patients, both men and women, presenting with STEMI were less likely to undergo revascularization. Studies have shown that Black patients presenting with acute myocardial infarction are more likely to be younger, to have Medicaid insurance or no insurance, to have lower income, and to have more comorbidities compared with Whites (24). Consistent with prior data, our analysis confirms that Black patients with STEMI and CS tended to be younger and to have lower incomes. In our analysis, Black patients also underwent CABG less often and had higher rates of AKI, AKI requiring dialysis, major bleeding, and stroke compared with White patients. Black men had the highest rate of major bleeding across all groups in our cohort. Moreover, after adjusting for age, insurance, Charlson comorbidity index, hospital bed size, and teaching status, Black men had significantly higher odds of in-hospital mortality compared with White men.

Similar disparities exist in health care for Hispanic patients (24,26). Previous studies have demonstrated that Hispanic patients with myocardial infarction were younger, were more likely to be uninsured, and had a higher prevalence of diabetes mellitus (24). Hispanic patients experienced longer delays in receiving medication, revascularization, or surgical treatment for myocardial infarction compared with White patients, including longer door-to-balloon times (24). Similarly, Mochari-Greenberger et al. (26) found increased mortality and rehospitalizations among Black and Hispanic patients with coronary artery disease compared with White or Asian patients at 1 year. In our analysis, we confirm that Hispanic patients with STEMI and CS were younger, had a higher prevalence of diabetes mellitus, and were more likely to have no insurance. Similar to Black patients, Hispanic patients had higher rates of AKI, AKI requiring dialysis, and major bleeding. Importantly, we present data that Hispanic women had the highest in-hospital mortality of all patients with STEMI and CS, even after adjusting for age, insurance, Charlson comorbidity index, hospital bed size, and hospital teaching status.

The causes of racial, ethnic, and sex disparities in health care are complex and a result of sophisticated interactions among the health care system,

TABLE 3 Adjusted Odds Ratios for In-Hospital Mortality for Each Subgroup Compared With White Men, After Adjusting for Age, Charlson Comorbidity Index, Hospital Bed Size, and Hospital Teaching Status

	aOR	95% CI	p Value
White women	1.09	1.03–1.15	0.001
Black men	1.18	1.04–1.34	0.011
Black women	1.29	1.12–1.49	<0.001
Hispanic men	1.19	1.06–1.33	0.003
Hispanic women	1.46	1.26–1.70	<0.001
Other men	0.97	0.87–1.09	0.636
Other women	1.26	1.07–1.48	0.004

Odds ratios were adjusted for age, Charlson comorbidity index, hospital bed size, and hospital teaching status.
aOR = adjusted odds ratio; CI = confidence interval.

socioeconomic status, cultural background, and personal preferences (24). As such, effective solutions need to account for all of these factors to achieve consistent equity and outcomes. Studies have shown that implementing universal protocols and rigorous guideline adherence have helped diminish treatment disparities, including delays in treatment, in diverse patients with myocardial infarction (27,28). Huded et al. (27) demonstrated that STEMI protocols led to resolution of sex differences in STEMI care, including the use of guideline-directed medical therapy, door-to-balloon times, and in-hospital adverse events. Moreover, these protocols also led to a decreased, although persistent, sex discrepancy in 30-day mortality, highlighting that more work is needed to address all contributing factors in this critically ill patient population. In another study of more than 2 million patients with acute myocardial infarctions, the racial and ethnic disparity in quality measures diminished significantly after strict guideline adherence for both Black and Hispanic patients compared with White patients (28). It is important to emphasize here that the poor outcomes observed in women and minorities should not preclude them from receiving lifesaving therapies. In fact, it should urge us as physicians to lead the health care system to improve outcomes in less advantaged patients and overcome barriers such as delays in treatment and differences in hospital practice. The use of shock protocols has been associated with improved outcomes in patients with STEMI and CS (3,4). We postulate that implementing these protocols will similarly lead to reductions in the racial, ethnic, and sex disparities demonstrated in this analysis. As we move forward in designing and conducting randomized control trials in STEMI and CS, we must enroll diverse patient populations and continue the call to action of increasing diversity in trial leadership and the greater cardiovascular community.

STUDY LIMITATIONS. Data collected from the NIS use International Classification of Diseases codes, so diagnosis coding could be inaccurate and variable according to providers' preferences and variability in documentation. The definition of CS is self-reported using International Classification of Diseases-9th Revision diagnostic code, and no hemodynamic data were available to confirm the diagnosis or define the stage of CS. Similarly, there could be unmeasured and unknown confounding factors such as differences in management in community and tertiary care centers, delays in pre-hospital care and admission, and variability in treatments that could contribute to worse outcomes within the subgroups. Laboratory and angiographic findings that contribute to decision making in patients with STEMI and CS are lacking; these include TIMI (Thrombolysis In Myocardial Infarction) flow and infarct-related artery among other variables. In addition, there is no documentation of the pre-hospitalization delays, first medical contact to revascularization, and timing of mechanical circulatory support, which could influence outcomes.

CONCLUSIONS

Our analysis demonstrates the presence of significant sex, racial, and ethnic disparities in the care of patients with STEMI and CS. This heterogenous care may result from implicit bias and warrants further study in an effort to optimize care for all patients, irrespective of their race, ethnicity, or sex. The use of shock protocols may be an initial step to help minimize these disparities.

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Dr. Basir is a consultant for Abbott Vascular, Abiomed, Cardiovascular Systems, Chiesi, Procyrion, and Zoll. Dr. O'Neill is a consultant for Abiomed, Edwards Lifesciences, and Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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PERSPECTIVES

WHAT IS KNOWN? Several studies have shown racial and sex disparities in the care of patients with myocardial infarction. Our study looks at the combined racial, sex, and ethnic disparities in a specific population, patients with STEMI and CS.

WHAT IS NEW? To our knowledge, very little is known regarding the disparities in this very sick population. In our analysis, we demonstrate significant disparities on the basis of race, ethnicity, and sex in the care and outcomes of patients with STEMI and CS.

WHAT IS NEXT? We propose possible solutions and highlight the need for further studies to address these issues and decrease the gap, in order to provide care for all patients, irrespective of their race, sex, or ethnicity.

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