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Authors
Rao, Vishal
Mentz, Robert
Coniglio, Amanda
et al.

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Neighborhood Socioeconomic Disadvantage and Hospitalized Heart Failure Outcomes in the American Heart Association Get With The Guidelines-Heart Failure Registry

Vishal N. Rao, MD, MPH[1,2], **Robert J. Mentz, MD**[1,2], **Amanda C. Coniglio, MD**[1], **Michelle D. Kelsey, MD**[1,2], **Marat Fudim, MD**[1,2], **Gregg C. Fonarow, MD**[3], **Roland A. Matsouaka, PhD**[2], **Adam D. DeVore, MD, MHS**[1,2], **Melissa C. Caughey, PhD**[4]

[1.]Division of Cardiology, Duke University Medical Center, Durham, North Carolina

[2.]Duke Clinical Research Institute, Duke University School of Medicine, Durham, North Carolina

[3.]Division of Cardiology, Department of Medicine, University of California at Los Angeles, Los Angeles, California

[4.]Joint Department of Biomedical Engineering, University of North Carolina and North Carolina State University, Chapel Hill, North Carolina

Abstract

Background: Neighborhood socioeconomic status (SES) is associated with worse health outcomes, yet its relationship with in-hospital heart failure (HF) outcomes and quality metrics are underexplored. We examined the association between socioeconomic neighborhood disadvantage and in-hospital HF outcomes for patients from diverse neighborhoods in the Get With The Guidelines-Heart Failure Registry.

Methods: SES-disadvantage scores were derived from geocoded US census data using a validated algorithm, which incorporated household income, home value, rent, education, and employment. We examined the association between SES-disadvantage quintiles with all-cause in-hospital mortality, adjusting for demographics and comorbidities.

Results: Of 593,053 patients hospitalized for HF between 2017 to 2020, 321,314 (54%) had residential zip codes recorded. Patients from the most compared with least disadvantaged neighborhoods were younger (mean age 67 vs. 76 years), more often Black (42% vs. 9%) or Hispanic (14% vs. 5%), and had higher comorbidity burden. Demographic-adjusted length of stay increased by approximately 1.5 hours with each increment in worsening SES-disadvantage quintiles. Adjusted-mortality odds ratios increased with worsening SES-disadvantage quintiles (*P*-trend = 0.003), and was 28% higher (adjusted OR=1.28 [1.12 to 1.48]) for the most compared with least disadvantaged neighborhood groups.

Conclusions: Patients hospitalized for HF from disadvantaged neighborhoods were younger and more often Black or Hispanic. SES-disadvantage was independently associated with

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Address for Correspondence: Vishal N. Rao, MD, MPH, Division of Cardiology, Duke University School of Medicine, Duke Clinical Research Institute, Office: 919-668-8972, vishal.rao@duke.edu, Twitter: @VishalNRao.

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higher in-hospital mortality. Further research is needed to characterize care delivery patterns in disadvantaged neighborhoods and to address social determinants of health among patients hospitalized for HF.

Keywords

Heart failure; hospitalizations; quality improvement; outcomes; socioeconomic status

Introduction

Heart failure (HF) affects over 6.5 million adults in the US, [1,2] and carries a survival comparable to many cancers with approximately 50% mortality at 5 years after diagnosis. [3] HF remains the most common reason for hospitalization among patients age ≥65 years, [2] and patients hospitalized for HF carry exceedingly high risk for 30-day mortality and rehospitalization. [4] Despite the availability of multiple approved oral medications proven to reduce risk of mortality and HF hospitalization, [5–9] HF contributes to high burden of cardiovascular disease, reduced patient-reported quality of life, and increased healthcare expenditure. [1,2]

Substantial research has examined how socioeconomic environments may play an important role in premature cardiovascular mortality[10] and risk for HF hospitalization, [11] yet few studies have examined relationships between socioeconomic characteristics and HF outcomes. In-hospital HF mortality has been shown to vary by race and ethnicity[12] and has been associated with lower area-level median household income. [13] However, associations between the broader socioeconomic environment and HF hospitalization characteristics and clinical outcomes have not been analyzed. A deeper understanding of neighborhood socioeconomic status (SES) disadvantage and HF admission outcomes may better direct initiatives towards reducing inequities in HF care at the national level.

Accordingly, the purpose of this study was to examine the association between neighborhood socioeconomic disadvantage with HF hospitalization outcomes, including length of stay, HF quality metrics, and all-cause mortality, across a large and representative national cohort in the American Heart Association Get With The Guidelines-Heart Failure (GWTG-HF) registry. In addition, we examine how characteristics such as sex, race, and HF subtypes may modify the associations of neighborhood-level SES-disadvantage and outcomes.

Methods

Because of the sensitive nature of the data collected for this study, requests to access the dataset from qualified researchers trained in human subject confidentiality protocols may be sent to the American Heart Association GWTG Quality Programs Research Committee.

Data Source

The GWTG-HF registry data are owned by the American Heart Association. [14] The GWTG-HF registry is an in-hospital quality improvement registry which includes patient-level data as part of a standardized clinical reporting system. [14,15] GWTG-HF uses a web-based patient management tool (Outcome Sciences, Inc; Cambridge, MA) to collect clinical data through manual entry, provide decision support, and provide real-time online reports. [14,15] Trained personnel from each participating center reviewed and collected pre-specified data on patients admitted with either a new diagnosis or exacerbation of chronic HF during each hospitalization. [14] All participating institutions were required to comply with local regulatory and privacy guidelines and, if required, to secure Institutional Review Board approval. Since this database is predominantly used at the local site for quality improvement purposes, sites were granted a waiver of informed consent under the common rule. The data were made available to contestants of the Heart Failure Data Challenge, which was hosted by the American Heart Association and the Association of Black Cardiologists. All data management and statistical analyses were performed and documented using the secure, cloud-based Precision Medicine Platform.

Study Population

For the present analysis, we included patients enrolled into the GWTG-HF registry who were hospitalized for acute HF between 2017–2020. These de-identified data were accessed as part of the American Heart Association and Association of Black Cardiologists GWTG-HF Data Challenge. A total of 593,053 hospitalizations for acute HF between 2017 to 2020 were included in the GWTG-HF registry. Our study population was limited to 321,314 (54%) hospitalizations with available 5- or 9-digit residential zip codes and complete ascertainment of in-hospital outcomes.

Neighborhood Socioeconomic Disadvantage

Area-level SES scores were calculated for patient residential neighborhoods, with neighborhood defined by a zip code tabulation area (ZCTA). [16] Zip codes were converted to ZCTAs using a publicly available conversion file. A summary SES measure was calculated for each ZTCA using data from the 2019 American Communities Survey 5-year estimates, which is derived from the US census. Neighborhood SES was based on a validated algorithm[16] that incorporated average household income, home value, percentage of households receiving interest, dividends, or net rental income, percentage of adults over the age of 25 who had completed high school or college, and percentage of working adults who were employed in executive, managerial, or professional specialties. Design, methods, and individual variables selected for calculating neighborhood SES have been previously described elsewhere. [16–18] In brief, Z-scores were calculated for each of the 6 SES variables within categories of wealth, income, education, and employment. The 6 Z-scores were then summed for each ZCTA, with larger scores representing worse neighborhood SES-disadvantage. This linkage between zip code and US census data provided the opportunity to examine in-hospital outcomes among patients in the GWTG-HF registry residing across a diverse group of neighborhoods nationwide.

Patients were stratified into 5 groups according to their neighborhood socioeconomic index score that corresponded to national quintiles of neighborhood socioeconomic score, as performed in prior analyses. [17] While no consensus exists for SES index cutoffs, the distribution of SES indices was divided into the following neighborhood-level SES-disadvantage quintiles based on national socioeconomic data[16]: Q1, (lowest amount of socioeconomic disadvantage); Q2, low; Q3, middle; Q4, high; and Q5, (highest amount of socioeconomic disadvantage).

In-Hospital Outcomes

The primary outcome was in-hospital all-cause mortality. As secondary outcomes, we also examined length of stay (LOS) and guideline-recommended quality measures among patients who survived to discharge. Quality measures for all HF hospitalizations included 1) scheduled follow-up appointment within 7 days of discharge, 2) prescribed anticoagulation for atrial arrhythmias among eligible patients (without documented contraindications), and 3) composite referral to HF disease management, a 60 minutes' patient education, or a HF interactive workbook provided at discharge. Quality measures for HF with reduced ejection fraction (HFrEF) were examined among eligible patients alive at discharge with no documented contraindications for 1) β-blocker, 2) angiotensin-converting enzyme inhibitor (ACEi), angiotensin receptor blocker (ARB), or angiotensin receptor-neprilysin inhibitor (ARNI), 3) mineralocorticoid receptor antagonist (MRA), and 4) composite prescription or counseling for implantable cardioverter-defibrillator (ICD) or Cardiac Resynchronization Therapy Defibrillator (CRT-D).

Covariates

Covariates were obtained from the publicly available case report form in the AHA GWTG-HF registry and included demographics (age, sex, race/ethnicity, geographic region and hospital) and the following comorbidities as have been included in recent contemporary analyses[19,20]: HFrEF (defined by an ejection fraction ≤40%), atrial fibrillation, atrial flutter, chronic obstructive pulmonary disease, diabetes mellitus, smoking within the last year, hyperlipidemia, hypertension, chronic kidney disease, prior coronary revascularization (including percutaneous or surgical intervention), valvular heart disease, and presence of ICD/CRT-D.

Statistical Analysis

Descriptive analyses of demographics, clinical characteristics, and therapies were analyzed across the 5 SES quintiles using the Cochran-Armitage test for trend and linear regression, respectively, for categorical and continuous variables.

Associations between neighborhood disadvantage quintile with in-hospital death was analyzed using multivariable logistic regression with a generalized estimator equation to account for nonindependence of the observations by treating the hospital as a statistical cluster. Covariates were added to the pre-specified models in sequential order to observe the impact of covariate adjustment. Model 1 (primary model) adjusted only for demographics (age, sex, race/ethnicity, geographic region, and hospital). Model 2 (data-driven model) additionally adjusted for comorbidities which differed in prevalence by 5% or more across the 5 SES quintiles. These included HFrEF, atrial fibrillation, chronic obstructive pulmonary disease, diabetes mellitus, and smoking within the last year. Model 3 (final model) additionally adjusted for atrial flutter, hyperlipidemia, body mass index, hypertension, chronic kidney disease, prior coronary revascularization (including percutaneous or surgical intervention), valvular heart disease, and presence of ICD/CRT-D.

Pre-specified subgroup analyses were performed for sex, race, and HF subtype (HFrEF, ejection fraction ≤40%; HF with preserved ejection fraction [HFpEF], ejection fraction >40%), with potential heterogeneity tested by the multiplicative interaction. As exploratory analyses, we also examined relationships between neighborhood SES quintiles with LOS and HF hospitalization quality measure achievement rates. For LOS outcomes, we excluded patients who transferred in or out of the hospital visit under consideration (9%). For hospital quality metrics, patients with missing values (≤ 10% of total) were excluded. The relationship between LOS and SES deprivation quintile was modeled by linear regression, with adjustment for demographic factors. Model fit was ascertained by assessing heteroskedasticity of model residuals. All statistical analyses were performed using SAS Studio version 3.8 (SAS Institute; Cary, NC) using the Precision Medicine Platform provided by the GWTG-HF Data Challenge.

Results

Patient Characteristics

Patients hospitalized for HF in the GWTG-HF Registry between 2017 to 2020 presented from 15,388 unique ZCTAs (number of hospitalizations/ZCTA range: 1–793) and 456 unique hospitals. Of 321,314 hospitalizations for HF, 61,778 (19%) were from the highest disadvantaged neighborhoods (mean 6-item SES score −4.2 [−11.5 to −2.6]) and 67,881 (21%) were from the lowest disadvantaged neighborhoods (mean 6-item SES score 4.8 [2.6 to 14.4]). Patient demographic and clinical characteristics varied by socioeconomic environments (Table 1). Compared to patients from least disadvantaged neighborhoods, those from the most disadvantaged neighborhoods were nearly a decade younger in age (67 ± 15 vs. 76 ± 14 years), more often Black (42% vs. 9%) or Hispanic (14% vs. 5%), and more often had HFrEF (51% vs. 40%), chronic pulmonary disease (39% vs. 31%), diabetes (52% vs. 40%), and recent tobacco use (25% vs. 11%); *P*-trend across SES quintiles <0.0001 for all (Table 1).

Hospitalization Course and Length of Stay

Hospitalization characteristics are shown in Table 2. A higher proportion of patients from most disadvantaged neighborhoods were discharged to home (78% from 68%), and fewer were discharged to other health care facilities (13% vs. 21%) or home hospice (2% vs. 3%) when compared to those from least disadvantaged neighborhoods. Mean LOS was approximately 5 days for all SES categories except for the most disadvantaged, which had a mean stay of approximately 6 days (*P*-trend <0.0001 for all; Table 2). The overall demographic-adjusted LOS increased by approximately 1.5 hours (β=0.06 days [95% CI: 0.04 to 0.08 days]) per SES-disadvantage quintile.

In-hospital Mortality

A total of 8,238 in-hospital deaths were recorded in our GWTG-HF study population. Crude mortality rates declined with worsening SES-disadvantage categories. Without any adjustments, in-hospital mortality was highest for patients from the least socioeconomic disadvantaged neighborhoods (3%), and lowest for those from the most disadvantaged neighborhoods (2%). However, these observations were related to patient age, and after adjustments for demographics, the mortality risk sequentially increased with each increment in worsening neighborhood disadvantage groups. With the least disadvantaged neighborhoods as the reference, the demographic-adjusted odds of death sequentially increased across worsening SES deprivation categories (*P*-trend = 0.001) and were approximately 20% greater for those from high (1.18 [1.06 to 1.31]) and the highest (1.20 [1.07 to 1.36]) disadvantaged neighborhoods. After full adjustment, the odds of death were 28% greater for those from highest disadvantaged neighborhood (1.28 [1.12 to 1.48], *P*-trend across worsening SES deprivation quintiles = 0.0003 (Figure 1 and Table 3).

In-hospital mortality by SES-disadvantage group among pre-specified subgroups by sex, race, or HF subtype are shown in Table 3. An increasing trend in mortality odds ratios was observed with worsening neighborhood SES quintile for all categories, but there was no evidence of statistical interaction by EF type, race, or sex.

Guideline-directed Quality Measures

As SES deprivation worsened, the proportion of patients with follow-up scheduled within 7 days of hospital discharge declined (82% to 74%, *P*-trend across quintiles <0.0001) as did anticoagulation for atrial arrhythmias (89% to 87%, *P*-trend across quintiles <0.0001), Figure 2. On the other hand, patients from most disadvantaged compared with least disadvantaged neighborhoods received higher referrals for HF disease management programs, although the difference was small (74% vs. 73%), (Figure 2). Target achievement rates of guideline-directed medical therapy (GDMT) prescriptions at discharge for eligible patients with HFrEF were in general higher for patients from most compared with least disadvantaged neighborhoods (Figure 3), although the overall proportion of patients receiving prescriptions for MRA was < 50%, and the proportions receiving counseling or prescription for ICD/CRT-D were less than two-thirds across all neighborhood disadvantaged groups. Prescription for beta blockers did not differ by neighborhood deprivation (96% for each neighborhood SES category).

Discussion

Among a large, contemporary quality improvement registry of patients hospitalized for HF across the United States, patients from socioeconomically disadvantaged neighborhoods were on average a decade younger in age, more commonly Black or Hispanic, had higher comorbidity burden at the time of admission compared with those from lower disadvantaged neighborhoods, and longer LOS. Discharges to long-term, acute care, and hospice facilities were lower among those with most compared to least disadvantaged neighborhood groups. Compared to those from the least disadvantaged neighborhoods, the odds of in-hospital all-cause mortality were 28% greater among those from most disadvantaged neighborhoods, after adjusting for demographics, comorbidities, and hospital characteristics. Guideline-recommended prescribing rates for HF therapies also varied by neighborhood SES, albeit by small differences.

Patient Characteristics of Neighborhood Socioeconomic Disadvantage Groups

Similar to these observations from the GWTG-HF registry, Black patients presenting to emergency departments or hospitals for worsening HF are reported to be ~10 years younger than White patients, but were more likely to be discharged home without admission.[21] Our analysis suggests that despite being younger, there exists a disproportionately higher comorbidity burden alongside worse clinical parameters in patients with highest neighborhood disadvantage, portraying possibly greater clinical risk at time of admission. While some racial and ethnicity minority groups may develop non-ischemic HF earlier in life,[22] middle-aged non-Hispanic Black adults develop a greater burden of chronic disease and multimorbidity at an earlier age, on average, than their non-Hispanic White counterparts.[23] The same pattern has been observed by the average age of a patient at the time of a hospital visit, demonstrating that Hispanics have the lowest average age followed by Native Americans, Blacks, Asians, and Whites.[24] Socially vulnerable patients may not receive chronic ambulatory management of their comorbidities,[25] or may die at home without acute life-prolonging therapies. While we could not compare out-of-hospital characteristics and adverse events in our present analysis, disparities in clinical risk among those from higher disadvantaged neighborhoods at the time of worsening HF and subsequent outcomes may exhibit a multifactorial relationship between socioeconomic environments.[10] These data highlight a need for targeted public health interventions, including system-level interventions that improve health care services access in those with SES deprivation,[26] and provider-patient interventions to improve monitoring of progressive HF following diagnosis, particularly in higher risk subgroups.

Neighborhood Socioeconomic Disadvantage and HF Hospitalization Outcomes

Our present analysis of contemporary HF hospitalizations confirms earlier observations of higher in-hospital mortality risk among patients with lower median household income in a two-year National Inpatient Sample from 2015–2017.[13] Averbuch et al. described a marginally higher risk of in-hospital death, increasing by 2% to 3% for patients with low or medium SES relative to those with high SES.[13] In our analysis from the GWTG-HF registry, we observed a higher in-hospital mortality risk for patients from the most compared to least deprivation categories, a pattern which was observed irrespective of race or sex. Our study relied upon a ZCTA-derived neighborhood SES score, which provided a broad estimation of social vulnerability beyond a focus on economic deprivation[13] and included wealth, income, education, and employment. Our findings confirm observations that non-Hispanic Black residents from most vulnerable US regions have higher risk for HF mortality, as recently reported from the Underlying Cause of Death files from the Center for Disease Control.[10]

The adjusted in-hospital mortality risks associated with worsening neighborhood socioeconomic disadvantage groups tended to be higher for patients with HFpEF than HFrEF. Temporal surveillance trends from the Atherosclerosis Risk in Communities Study revealed that 28-day mortality is higher in HFpEF than HFrEF when adjusted for markers of congestion.[27] Yet, assessment of acute presentation of worsening HF in HFpEF is often challenging due to comorbidities that contribute to overlapping symptoms, including chronic pulmonary and renal disease.[28] While there has been recent focus on the potential to reduce worsening HF events in HFpEF with novel agents, including ARNI[28,29] and sodium-glucose cotransporter-1/2 or −2 inhibitors, [30,31] there continue to exist limitations in effective therapies for mortality reduction in this population. Further research is needed to better understand the mortality risk associated with neighborhood-level socioeconomic characteristics among HF subtypes.

The demographic-adjusted mean LOS increased with worsening neighborhood-level SES-disadvantage. Patients from the most disadvantaged neighborhoods also had a lower proportion of referrals to acute care facilities or hospice. Other post-hospitalization care patterns have been reported following acute trauma[32] or traumatic brain injury, particularly among Hispanic and Black patients, [33] suggesting that patients from disadvantaged groups may not receive ongoing acute care or rehabilitation following HF hospitalization. However, this may be confounded by increased age and frailty in those hospitalized for HF from less disadvantaged neighborhoods. Nonetheless, there may be a role for improvement in post-HF hospitalization care for at-risk underprivileged patients.

HF Hospitalization Quality Measures Vary Among Neighborhood Socioeconomic Disadvantage Groups

There were gaps in HF hospitalization quality metrics by neighborhood socioeconomic disadvantage groups, as over a quarter of patients from high and highest disadvantaged neighborhoods did not have post-hospitalization follow-up arranged within 7 days. Approximately one-quarter of the overall study population lacked referrals for HF disease management, and while between-group differences were small, the referral rate declined with worsening neighborhood deprivation. Disparate quality metrics in HF care were apparent across the entire population, although with inconsistent direction in relationship by socioeconomic disadvantage groups. A recent randomized trial using hospital-based quality improvement interventions showed no significant difference of post-discharge care patterns. [34] Understanding which socioeconomic barriers play a role in contemporary HF populations may allow for a more targeted approach to address this gap in achievement of quality metrics.

In US clinical practice between 2007 to 2018, nearly one-third of patients hospitalized with acute HFrEF were not prescribed target doses of β-blocker and nearly half or more were not prescribed target doses of ACEi/ARB/ARNI or MRA at the time of discharge. [35] More recently, greater than 90% of eligible hospitalized patients with HFrEF were not prescribed ARNI at the time of discharge and very few actually receive ARNI during follow-up. [19] Our study results demonstrate that prescribing rates for β-blocker and ACEi/ARB/ARNI are high at discharge (not representative of target dose), with similar rates for β-blockers and small differences for ACEi/ARB/ARNI across SES groups. Yet, less than one-half were prescribed MRA and less than two-thirds provided ICD/CRT-D. Data regarding social vulnerability and GDMT use is limited. Higher (albeit smaller) observed differences in achieved GDMT prescribing among those from disadvantaged neighborhoods might be due to a lower age and less frail cohort, despite their higher comorbidity burden. Additional work is needed to understand care patterns in in-hospital GDMT initiation across SES groups, and initiatives are needed to shift clinical inertia towards in-hospital GDMT prescribing in order to improve long-term clinical outcomes across socially vulnerable groups. [36]

Limitations

This study has several imitations. This was an observational study and as such, we are unable to rule out residual confounding. The cross-sectional design did not capture any dynamic characteristics of neighborhoods related to population migration, nor were we able to consider historical economic practices which may have ongoing repercussions, even when area-level neighborhood deprivation status changes over time. The GWTG-HF registry only included hospitals enrolled in the American Heart Association quality reporting program and may not be generalizable to all hospitals or ambulatory patients with chronic HF at risk for worsening HF events. Only 54% of the population had residential address data available for inclusion, potentially limiting generalizability due to the large number excluded hospitalized patients. However, demographic characteristics were similar between hospitalized patients with and without available zip codes (Table S1). While the neighborhood deprivation score relied on ZTCA characteristics beyond median household income, we were unable to describe patient-level socioeconomic deprivation. Data abstraction was de-identified and limited to the in-hospital visit, as such, we were unable to identify individual patients who may have had repeat hospitalization encounters during the study period. Since these data were not linked to the Centers for Medicare & Medicaid Services database, we were also unable to analyze out-of-hospital and downstream clinical outcomes following the HF hospitalization.

Conclusion

Among patients enrolled in a large, diverse national quality reporting registry for HF hospitalization, those from disadvantaged neighborhoods exhibited higher associated in-hospital mortality despite being nearly a decade younger and more often Black or Hispanic than those with the least neighborhood disadvantage. This study also highlights gaps in quality metrics during hospitalization for HF across neighborhood socioeconomic disadvantage groups. The reason for these observations is complex and multifaceted, and further research in heart failure should incorporate detailed examination of socioeconomic and neighborhood characteristics to better describe this relationship. Additionally, these data suggest there are further opportunities to explore and improve care delivery patterns in order to address in-hospital outcomes among patients hospitalized for HF and presenting from disadvantaged neighborhoods.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This project was developed through the Heart Failure Data Challenge, using the Get With The Guidelines® (GWTG) Heart Failure Registry data to target research related to heart failure and social/structural determinants of health. The data challenge was hosted by the American Heart Association (AHA) and the Association of Black Cardiologists (ABC). The American Heart Association Precision Medicine Platform (https://precision.heart.org/) was used for data analysis

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Abbreviations

ACEi	angiotensin-converting enzyme inhibitor
ARB	angiotensin receptor blocker
ARNI	angiotensin receptor-neprilysin inhibitor
CRT-D	Cardiac Resynchronization Therapy Defibrillator
GDMT	guideline-directed medical therapy
GWTG-HF	Get With The Guidelines®-Heart Failure
HF	heart failure
HFpEF	heart failure with preserved ejection fraction
HFrEF	heart failure with reduced ejection fraction
ICD	implantable cardioverter-defibrillator
LOS	length of stay
MRA	mineralocorticoid antagonist
SES	socioeconomic status
ZCTA	zip code tabulation area

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Clinical Perspective

What is new?

- Patients from socioeconomically disadvantaged neighborhoods across the US who are hospitalized for heart failure are younger in age, more commonly Black or Hispanic, and have higher comorbidity burden.
- Risk for in-hospital mortality is greatest among patients from the most compared to least disadvantaged neighborhoods.
- Achievement of heart failure quality care targets, including 7-day post-hospitalization follow-up, referral for heart failure disease management, and use of evidence-based therapies, vary among hospitalized patients from socioeconomically disadvantaged neighborhoods.

What are the clinical implications?

- Disparities exist in clinical outcomes for hospitalized heart failure across socioeconomically disadvantaged neighborhoods, after accounting for differences in demographics and clinical risk.
- Strategies are needed to mitigate mortality risk in heart failure, particularly among groups from disadvantaged neighborhoods.
- Further research must explore care delivery patterns among patients from disadvantaged neighborhoods in order to understand and improve quality of care during and following a hospitalization for heart failure.

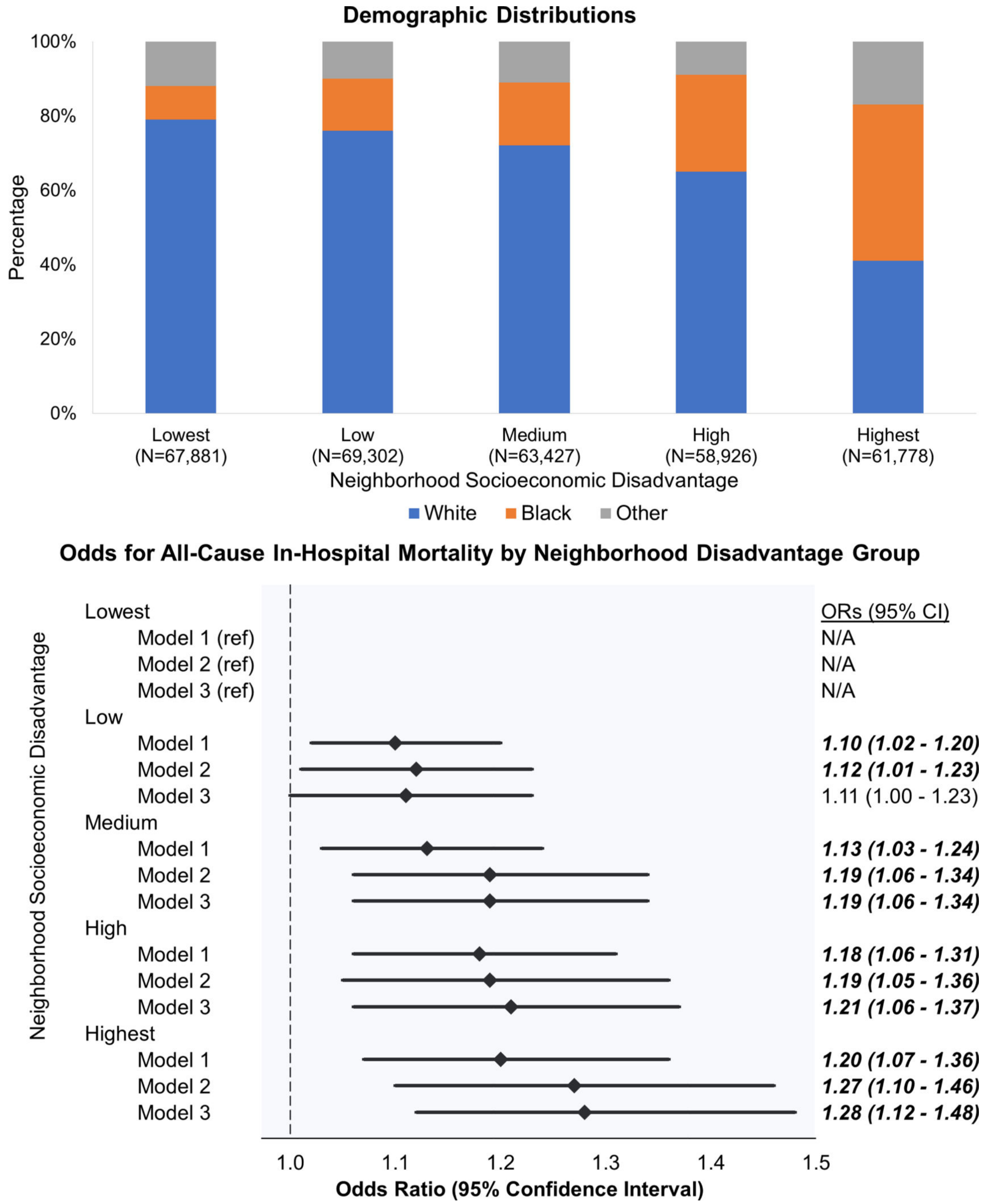

Figure 1: Association between Neighborhood Socioeconomic Disadvantage and In-Hospital Mortality among Patients Hospitalized for Acute Heart Failure.

Patients hospitalized for heart failure varied by demographics across neighborhood socioeconomic disadvantage groups (*top*). In-hospital all-cause mortality risk progressively increased with neighborhood socioeconomic disadvantage (*bottom*). Model 1 (primary model) adjusted for demographics (age, sex, race, geographic region and hospital); Model 2 additionally adjusted for comorbidities which differed in prevalence by ≥5% across SES quintiles (heart failure with reduced ejection fraction, atrial fibrillation, chronic obstructive pulmonary disease, diabetes mellitus, and smoking within the last year); Model 3 (final model) additionally adjusted for atrial flutter, hyperlipidemia, hypertension, body mass index, chronic kidney disease, prior coronary revascularization (including percutaneous or surgical intervention), valvular heart disease, and presence of cardiac resynchronization therapy and/or implantable cardioverter-defibrillator.

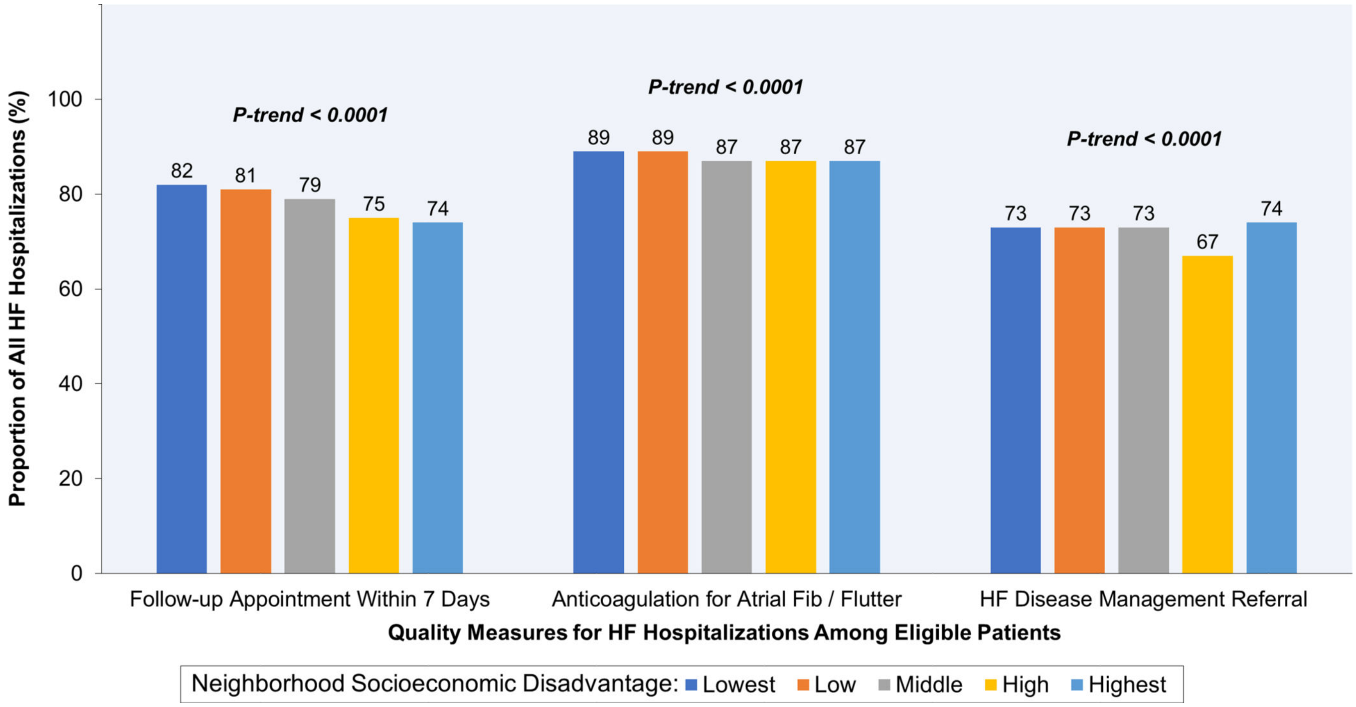

Figure 2: Trends in Quality Measures for All Heart Failure Hospitalizations by Neighborhood Socioeconomic Disadvantage.

Heart failure (HF) hospitalization quality measures for patients alive at discharge are displayed. Follow-up appointments within 7 days and anticoagulation for atrial arrhythmias among eligible patients trended lower with greater neighborhood disadvantage. Differences were clinically small for HF disease management programs (referral to HF disease management, 60 minutes' patient education, HF interactive workbook) among neighborhood disadvantaged groups.

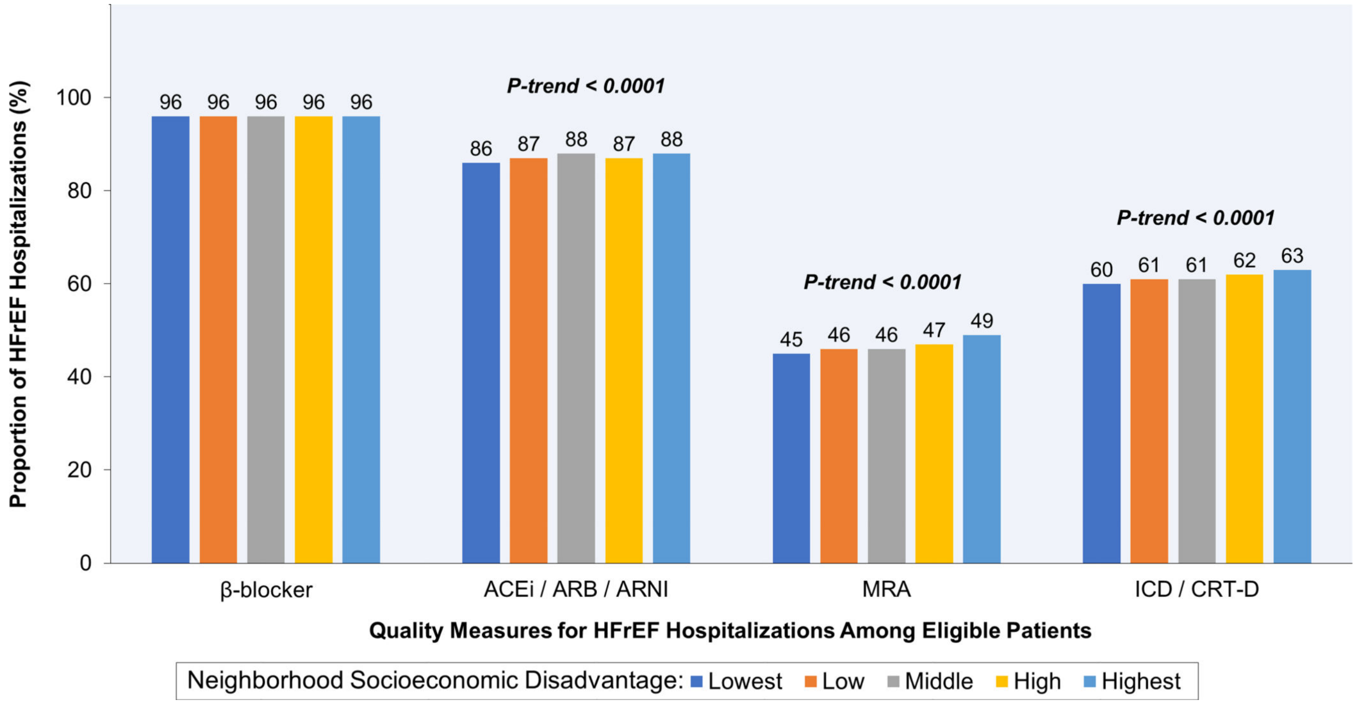

Figure 3: Trends in Quality Measures for Hospitalizations for Heart Failure with Reduced Ejection Fraction by Neighborhood Socioeconomic Disadvantage.

Among eligible patients alive at discharge with heart failure with reduced ejection fraction (HFrEF), prescriptions for β-blocker at discharge were overall similar across neighborhood disadvantage groups. Whereas, angiotensin-converting enzyme inhibitor (ACEi), angiotensin receptor blocker (ARB), or angiotensin receptor-neprilysin inhibitor (ARNI), mineralocorticoid receptor antagonist (MRA), and composite prescription or counseling for implantable cardioverter-defibrillator (ICD) / Cardiac Resynchronization Therapy Defibrillator (CRT-D) at discharge trended higher with increasing neighborhood disadvantage, yet differences were small.

Table 1:

Characteristics of Hospitalized Patients with Acute Heart Failure by Neighborhood Socioeconomic Disadvantage between 2017 to 2020 in the Get With The Guidelines-Heart Failure Registry

Patient Characteristics	Neighborhood Socioeconomic Disadvantage (Based on National Quintiles)					*P*-Trend
	Lowest	Low	Middle	High	Highest	
	N=67,881	*N=69,302*	*N=63,427*	*N=58,926*	*N=61,778*	
Demographics						
6-Item SES Score	4.8 (2.6 – 14.4)	1.5 (0.5 – 2.6)	−0.2 (−0.9 to 0.5)	−1.7 (−2.6 to −0.9)	−4.2 (−11.5 to −2.6)	
Age (years)	76 ± 14	73 ± 14	71 ± 14	69 ± 15	67 ± 15	<0.0001
Female sex	31,616 (47%)	32,149 (46%)	29,368 (46%)	27,686 (47%)	28,762 (47%)	0.4
Race / ethnicity						
White	53,862 (79%)	52,665 (76%)	45,665 (72%)	38,165 (65%)	25,511 (41%)	<0.0001
Black	6328 (9%)	9453 (14%)	10,725 (17%)	15,335 (26%)	25,732 (42%)	<0.0001
Hispanic	3108 (5%)	3657 (5%)	4713 (7%)	3494 (6%)	8418 (14%)	<0.0001
Asian	2281 (3%)	1453 (2%)	847 (1%)	485 (<1%)	322 (<1%)	<0.0001
Other	2220 (3%)	2028 (3%)	1429 (2%)	1390 (2%)	1729 (3%)	<0.0001
Presenting Vitals and Laboratories						
Heart rate (bpm)	85 ± 20	86 ± 20	86 ± 20	87 ± 20	88 ± 20	<0.0001
Systolic blood pressure (mmHg)	139 ± 28	141 ± 39	141 ± 30	142 ± 30	144 ± 31	<0.0001
Creatinine (mg/dL)	1.3 (1.0 – 1.8)	1.3 (1.0 – 1.9)	1.3 (1.0 – 1.9)	1.3 (1.0 – 1.9)	1.3 (1.0 – 2.0)	0.6
Sodium (mEq/L)	138 ± 6	138 ± 5	138 ± 6	138 ± 5	138 ± 6	<0.0001
Ejection fraction (%)	45 ± 17	44 ± 17	43 ± 17	43 ± 17	41 ± 18	<0.0001
Medical History						
Ejection fraction (≤40%)	25,968 (40%)	27,790 (42%)	27,060 (44%)	26,481 (47%)	30,378 (51%)	<0.0001
Anemia	16,076 (24%)	17,366 (25%)	15,641 (25%)	13,242 (23%)	13,958 (23%)	<0.0001
Atrial fibrillation	31,774 (48%)	30,103 (44%)	25,655 (41%)	21,737 (38%)	18,544 (31%)	<0.0001
Atrial flutter	3334 (5%)	3193 (5%)	2809 (4%)	2440 (4%)	2518 (4%)	<0.0001
COPD	20,827 (31%)	24,210 (35%)	23,284 (37%)	21,979 (38%)	23,835 (39%)	<0.0001
Diabetes mellitus	26,741 (40%)	31,411 (46%)	30,361 (48%)	28,305 (50%)	31,494 (52%)	<0.0001
Hyperlipidemia	38,405 (58%)	40,566 (59%)	37,399 (60%)	31,593 (55%)	32,193 (53%)	<0.0001

Patient Characteristics	Neighborhood Socioeconomic Disadvantage (Based on National Quintiles)					*P*-Trend
	Lowest	**Low**	**Middle**	**High**	**Highest**	
	N=67,881	***N=69,302***	***N=63,427***	***N=58,926***	***N=61,778***	
Hypertension	55,044 (83%)	57,744 (85%)	53,283 (85%)	48,758 (85%)	52,760 (87%)	<0.0001
Prior PCI	11,538 (17%)	12,748 (19%)	12,330 (20%)	11,159 (20%)	10,798 (18%)	<0.0001
Prior coronary artery bypass graft	11,322 (17%)	12,253 (18%)	11,366 (18%)	9763 (17%)	8882 (15%)	<0.0001
Chronic kidney disease	16292 (24%)	18,978 (28%)	16,923 (27%)	13,955 (24%)	16,306 (27%)	0.002
Smoking (in past 12 months)	7061 (11%)	9779 (14%)	11,131 (18%)	11,475 (21%)	14,859 (25%)	<0.0001
Valvular heart disease	14,279 (21%)	12,943 (19%)	11,491 (18%)	9428 (17%)	9345 (15%)	<0.0001
CRT (pacing only)	658 (1%)	783 (1%)	703 (1%)	634 (1%)	1015 (2%)	<0.0001
CRT with ICD	3880 (6%)	3956 (6%)	3834 (6%)	3596 (6%)	4163 (7%)	<0.0001
Guideline-Directed Medical Therapy Prescribed Prior to Admission for HFrEF						
β-blocker	9316 (67%)	9055 (69%)	9454 (69%)	9502 (69%)	11,284 (70%)	<0.0001
ACEi	3761 (27%)	3739 (28%)	4006 (29%)	4091 (30%)	5232 (32%)	<0.0001
ARB	2034 (15%)	1934 (15%)	1857 (14%)	1784 (13%)	2325 (14%)	0.03
ARNI	817 (6%)	851 (7%)	851 (6%)	935 (7%)	1068 (7%)	0.008
ACEi/ARB/ARNI	5519 (47%)	6431 (49%)	6606 (48%)	6712 (49%)	8479 (52%)	<0.0001
MRA	2212 (16%)	2360 (18%)	2633 (19%)	2581 (19%)	3332 (21%)	<0.0001

Data are presented as mean (± standard deviation) for continuous variables or number (%) for categorical variables. Serum creatinine presented as median (25% - 75%). Medical history missing in 5999 (2%); ejection fraction missing in 6582 (2%); medications missing for patients with heart failure with reduced ejection fraction in 62,515 (19%).

Abbreviations: ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor; COPD, chronic obstructive pulmonary disease; CRT, cardiac resynchronization therapy; GDMT, guideline-directed medical therapy; HFrEF, heart failure with reduced ejection fraction; ICD, implantable cardioverter-defibrillator; MRA, mineralocorticoid receptor antagonist; PCI, percutaneous coronary intervention; SES, socioeconomic status.

Table 2:

In-hospital Characteristics among Patients with Acute Heart Failure by Neighborhood Socioeconomic Disadvantage between 2017 to 2020 in the Get With The Guidelines-Heart Failure Registry

	Neighborhood Socioeconomic Disadvantage (Based on National Quintiles)					*P*-Trend
	Lowest	Low	Middle	High	Highest	
In-hospital Care Metrics						
Transferred in (from other hospital)	2901 (4%)	3681 (5%)	5126 (8%)	5582 (10%)	4785 (8%)	<0.0001
Transferred out (to acute care facility)	1446 (2%)	1303 (2%)	1098 (2%)	1006 (2%)	852 (1%)	<0.0001
Length of stay (days, excluding transfers)	5.2 ± 5.6	5.2 ± 5.6	5.2 ± 4.9	5.3 ± 5.7	5.6 ± 6.9	<0.0001
Discharge destination or disposition						
Expired (in-hospital death)	1923 (3%)	1914 (3%)	1632 3%)	1444 (3%)	1325 (2%)	<0.0001
Home	45,785 (68%)	49,040 (71%)	46,132 (73%)	43,769 (74%)	48,224 (78%)	<0.0001
Hospice - home	1783 (3%)	1718 (2%)	1579 (2%)	1249 (2%)	1171 (2%)	<0.0001
Hospice - health care facility	1395 (2%)	1275 (2%)	1027 (2%)	852 (1%)	665 (1%)	<0.0001
Acute care facility	1446 (2%)	1303 (2%)	1098 (2%)	1006 (2%)	852 (1%)	<0.0001
Other health care facility	14,372 (21%)	12,867 (18%)	10,919 (17%)	9553 (16%)	7971 (13%)	<0.0001

Data are presented as mean (± standard deviation) for continuous variables or number (%) for categorical variables.

Table 3:

Association between Neighborhood Socioeconomic Disadvantage and In-Hospital Mortality among Patients Hospitalized for Acute Heart Failure by Sex, Race, and Heart Failure Subtype

	Neighborhood Socioeconomic Disadvantage (Based on National Quintiles)						
	Lowest	**Low**	**Middle**	**High**	**Highest**	***P*-Trend***	***P*-Interaction***
Overall	Ref.	1.11 (1.00 – 1.23)	1.19 (1.06 – 1.34)	1.21 (1.06 – 1.37)	1.28 (1.12 – 1.48)	0.0003	
Sex							0.6
Female	Ref.	1.14 (0.99 – 0.32)	1.21 (1.02 – 1.43)	1.17 (0.99 – 1.39)	1.23 (1.02 – 1.48)	0.03	
Male	Ref.	1.09 (0.96 – 1.24)	1.18 (1.03 – 1.36)	1.24 (1.06 – 1.45)	1.33 (1.13 – 1.56)	0.0003	
Race							0.6
White	Ref.	1.10 (0.99 – 1.22)	1.23 (1.08 – 1.39)	1.21 (1.05 – 1.38)	1.25 (1.08 – 1.44)	0.0007	
Non-White	Ref.	1.15 (0.92 – 1.45)	1.08 (0.85 – 1.37)	1.20 (0.94 – 1.54)	1.31 (1.00 – 1.72)	0.05	
HF Type							0.7
HFrEF	Ref.	1.00 (0.87 – 1.14)	1.18 (1.03 – 1.36)	1.17 (1.01 – 1.39)	1.25 (1.06 – 1.48)	0.002	
HFpEF	Ref.	1.23 (1.09 – 1.39)	1.20 (1.03 – 1.39)	1.22 (1.05 – 1.42)	1.32 (1.11 – 1.56)	0.002	

Model adjusted for demographics (age, sex, race, geographic region, and hospital), heart failure with reduced ejection fraction, atrial fibrillation, chronic obstructive pulmonary disease, diabetes mellitus, body mass index, smoking within last year, atrial flutter, hyperlipidemia, hypertension, chronic kidney disease, prior percutaneous coronary intervention and coronary artery bypass grafting, valvular heart disease, cardiac resynchronization therapy, implantable cardioverter-defibrillator.

Abbreviations: HF, heart failure; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction.

* P-trend testing increase in mortality odds ratios across worsening neighborhood deprivation quintiles. P-interaction testing the multiplicative interaction of sex, race, or HF type with neighborhood deprivation quintile.