FACTORS UNDERLYING RACIAL DISPARITIES IN HOSPITAL CARE OF CONGESTIVE HEART FAILURE

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Objective: To examine relationships between race and five aspects of hospital care.

Methods: Cross-sectional data of 373,158 discharges with heart failure in the 1995–1997 National Inpatient Sample were used to measure severity, care-seeking patterns, processes, resource consumption, and outcomes.

Results: Compared to White patients, African American and Hispanic patients were more likely to seek care through the emergency department (ED) but less likely to receive clinical procedures or die in the hospital. Interactions of African American race with patient co-morbidity status, admission through the ED, and receipt of intensive services were associated with lower mortality as was interaction between admission to teaching hospitals and Hispanic race.

Conclusions: Lack of access to ambulatory care among minority patients and hospital care via the safety net may contribute to racial discrepancies as a result of healthier patient selection among minority groups. (*Ethn Dis*. 2007;17:206–213)

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INTRODUCTION

Racial disparities in health outcomes are well documented.[1–5] Race has been used as the surrogate for differences between ethnic populations including biological, socioeconomic/cultural, or in relation to health service delivery.[6–12] The recent publication of the sequence of the human genome indicates that the biological basis of race is less plausible.[13–14] For example, although African Americans are at higher risk for hypertension and diabetes mellitus,[15–17] this disparity may be primarily explained by socioeconomic status and lifestyle, rather than biological differences.[17–20] Alternatively, racial differences in health outcomes emanate from different patterns of interactions with the health delivery system,[3,21–23] which may also result from patients' socioeconomic status and/or race.

Because of the complex range of attributes encompassed by race as a single descriptor, results of studies about racial disparities have been mixed.[2,6–7,17,21,24–49] The inconsistency may, in part, result from not controlling for socioeconomic and cultural factors other than race and failing to analyze interactions between race and other factors.[7,12,24] Although race has clearly been demonstrated to be a major predictor of variations in multiple aspects of hospital care such as severity of illness,[25–30,45,50–52] care-seeking patterns,[28,37,53–61] receipt of clinical procedures,[21,30–44,47,49] resource consumption,[28,30,47–48] and outcomes,[2,17,21–23,25,26,28–30,33,36,41–48,62–64] from the perspective of the episode-of-care,[65] limited research has examined the interactive effect of these aspects on underlying disparities. Such research is critical to achieving the vision of a high-quality healthcare system that addresses the myriad causes of disparities.[66–69]

We selected heart failure (HF), a common disease that is associated with substantial morbidity and mortality, as the focus of this study. Approximately four million Americans have HF, and 400,000 new cases are diagnosed each year. An estimated 19.4 billion dollars are spent on treating HF each year, 75% of which are used on hospitalization.[70] Studies on racial differences in HF demonstrate highly mixed findings. Various studies on HF have found that African American or Hispanic patients experience worse outcomes than,[41,44,63–64] similar outcomes to,[60] or better outcomes than[2,36,47–48,62] Whites.

We attempted to explore relationships between five aspects of hospital care (severity, care-seeking patterns, process, resource consumption, and outcome) for a more in-depth understanding of the causes of racial disparities as related to HF. Policy driven by an understanding of the root causes behind such complex interrelationships can contribute to moving toward the type of healthcare system that is evi-

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dence-based, safe, efficient, and of high quality and that contributes to optimal access to care, outcomes, and patient satisfaction.

METHODS

Data

A total of 373,158 adult HF discharges were abstracted from the 1995, 1996, and 1997 National Inpatient Sample (NIS). The NIS data represent ≈20% of hospital discharges in the United States. Heart failure discharges were identified as those who had a principal discharge International Classification of Diseases, Ninth Revision, Clinical Modification code of 428.0 (left heart failure), 428.1 (right heart failure), or 428.9 (heart failure unspecified).[70]

Measures

Self-reported race was categorized as White, African American, or Hispanic. Patients of other races were excluded because of their relatively small representation in the administrative data (1.7%).

Severity was measured by an HF-specific case-mix index.[71] Our preliminary analysis found that this approach predicted outcomes better than both the Charlson index[72–73] and a co-morbidity model developed by Agency for Healthcare Research and Quality researchers.[74] This approach incorporated risk factors such as age, admission status (eg, transfer from another hospital), and 10 co-morbidities, including cerebrovascular disease, chronic obstructive lung disease, hyponatremia, other electrolyte disturbance, metastatic disease, moderate-to-severe renal disease, ventricular arrhythmia, mild liver disease, malignancy, and hypotension and shock. Each of the risk factors was assigned a weight, and these weights then were summed to a single index to reflect the severity of illness of a HF patient.[71] We calculated the case-mix index for each patient that ranged from 0 to 16.

Care-seeking patterns were measured by admission through the emergency department (ED) and admission to the teaching hospital.[75] Since HF is an ambulatory care-sensitive condition, its hospitalization, especially admission through the ED, may indicate lack of adequate ambulatory care. Teaching hospitals in general have better facilities and capability than non-teaching hospitals.

Process was measured by receipt of invasive cardiac services. The invasive cardiac services included cardiac catheterization, percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass graft (CABG), permanent pacemaker implantation, and automatic implanted cardioverter and/or defibrillator (AICD). In general, patients with more severe illness are more likely to receive those procedures. Use of invasive procedures has been positively associated with better outcomes[76] and with White patients.[21,30–44,47,49]

Resource consumption was measured by length of stay (LOS) and total hospital charges. Finally, outcome was measured by a discharge status indicating death, which has been widely used to measure short-term hospital care outcome.

Analytical Techniques

The logic relationships of the five dimensions were hypothesized as follows: 1) severity = f_1 (race); 2) care-seeking patterns = f_2 (race, severity); 3) process = f_3 (race, severity, care-seeking patterns); 4) resource consumption = f_4 (race, severity, care-seeking patterns, process); 5) outcome = f_5 (race, severity, care-seeking patterns, process).

We controlled covariates, such as age and sex, health insurance status (Medicare, Medicaid, private insurance, and uninsured), median household income level by zip code of residence, hospital characteristics (hospital bed size, rural/urban areas, and geographic location or region), and year of discharge.

According to Hosmer and Lemeshow, interactions between race and other exploratory variables were also identified.[77] Logistic regression was used for dichotomous dependent variables to predict the adjusted odds ratios. For the purpose of expanding the age to a meaningful interval, six age groups were divided as 18–40, 40–49, 50–59, 60–69, 70–79, and ≥80. The least square regression was used for continuous dependent variables. Because of skewed data distribution, a natural logarithmic transformation was performed for continuous dependent variables.

RESULTS

Unadjusted descriptive results of patients' demographic characteristics and the five dimensions of hospital care are summarized in Table 1. As compared to White patients, both minority groups were younger, had slightly lower co-morbidity indices, had higher percentages of admissions through ED and higher percentages of admissions to teaching hospitals, and had lower mortality rates.

As shown in Table 2, race was associated with severity, care-seeking patterns, process, resource consumption, and outcome. The co-morbidity index was negatively associated with African American and Hispanic patients (regression coefficients [RC] -.063 for African Americans and -.060 for Hispanics, respectively). Compared to White patients, both African American and Hispanic patients were more likely to be admitted through ED (odds ratio [OR] [95% confidence interval (CI)], 1.84 [1.79, 1.90], 1.30 [1.25, 1.34]) and to a teaching hospital (OR [CI], 2.99 [2.92, 3.06], 2.00 [1.9, 2.06]). Further, both African American and Hispanic patients were less likely to receive invasive cardiovascular services (OR [CI], .66 [.63, .69], .70 [.66, .75]),

Table 1. Patients' demographic characteristics and the five care-related dimensions by race*

	White (*n*=302,366)	African American (*n*=49,543)	Hispanic (*n*=21,249)
Demographic characteristics			
Female	161,613 (53.5)	28,384 (57.3)	11,497 (54.1)
Age, mean (SD), years	75.8 (11.6)	65.2 (15.4)	70.3 (14.5)
Age group			
<40	2,423 (.8)	2,892 (5.8)	632 (3.0)
40–49	6,084 (2.0)	4,997 (10.1)	1,087 (5.1)
50–59	17,275 (5.7)	8,406 (17.0)	2,412 (11.4)
60–69	48,508 (16.0)	12,030 (24.3)	5,042 (23.7)
70–79	101,772 (33.7)	12,203 (24.6)	6,041 (28.4)
≥80	126,304 (41.8)	9,015 (18.2)	6,035 (28.4)
Severity of illness			
Co-morbidity index, mean (SD)	2.1 (2.9)	1.9 (2.7)	2.0 (2.8)
Care-seeking patterns			
Admission through ED	195,460 (64.6)	39,264 (79.3)	15,034 (70.8)
Admission in teaching hospital	72,109 (23.9)	25,455 (51.4)	7,471 (35.2)
Process			
Use of invasive cardiovascular services	22,645 (7.5)	3,519 (7.1)	1,318 (6.2)
Resource consumption			
Length of stay, mean (SD), days	5.8 (4.5)	5.7 (4.6)	5.7 (4.5)
Total charges, mean (SD), $	10,779 (11,947)	10,999 (12,526)	13,037 (13,836)
Outcome			
Discharge status equals death	16,740 (5.5)	1,460 (3.0)	877 (4.1)

* Data are expressed as number and percentage unless otherwise indicated.
ED=emergency department

Table 2. Relationships between race and severity of illness, care-seeking patterns, process, resource consumption, and outcome: adjusted without interactions (*n*=373,158)

	African American		Hispanic	
Dependent Variable	Odds Ratio	95% CI for Odds Ratio	Odds Ratio	95% CI for Odds Ratio
Severity of illness				
Co-morbidity index* (R^2=.06), parameter estimate, SE	−.063†	.004	−.060†	.006
Care-seeking patterns				
Admission through emergency department	1.84†	1.79–1.90	1.30†	1.25–1.34
Admission in teaching hospital	2.99†	2.92–3.06	2.00†	1.93–2.06
Process				
Use of invasive cardiovascular services	.66†	.63–.69	.70†	.66–.75
Efficiency				
Length of stay† (R^2=.10) , parameter estimate, SE	.008†	.003	.033†	.004
Total charges† (R^2=.27), parameter estimate, SE	.035†	.004	.050†	.005
Outcome				
Discharge status equals death	.68†	.64–.72	.87†	.81–.94

* Results of the least square regression, dependent variables transformed by the natural logarithm during regression.
† P<.01.

Table 3. Relationships between race and mortality (n=373,158)

	Model A: Without Interactions			Model B: With Interactions		
	Odds Ratio	95% CI for Odds Ratio	*P* Value	Odds Ratio	95% CI for Odds Ratio	*P* Value
Race						
African American (AA)	.68	.64–.73	<.01	.73	.55–.97	.03
Hispanic American (HA)	.87	.81–.94	<.01	.77	.51–1.17	.22
Demographic characteristics						
Female (FEM)	.94	.91–.97	<.01	.93	.90–.96	<.01
Age group (AGE)	1.54	1.51–1.57	<.01	1.55	1.52–1.58	<.01
Severity of illness						
Co-morbidity index (CMI)	1.17	1.16–1.17	<.01	1.16	1.16–1.17	<.01
Care-seeking patterns						
Admission through emergency department (ED)	1.07	1.03–1.10	<.01	1.08	1.04–1.12	<.01
Admission in teaching hospital (ATH)	.97	.93–1.00	.08	.97	.94–1.01	.18
Process						
Use of invasive cardiovascular services (ICS)	.95	.89–1.01	.09	.93	.87–.99	.02
Interactions						
AA*AGE	-	-	-	.93	.92–1.01	.13
AA*FEM	-	-	-	1.05	.94–1.18	.41
AA*CMI	-	-	-	1.03	1.02–1.05	<.01
AA*ED	-	-	-	.88	.76–1.02	.08
AA*ATH	-	-	-	1.04	.92–1.16	.55
AA*ICS	-	-	-	1.21	.98–1.50	.08
HA*AGE	-	-	-	.99	.92–1.07	.84
HA*FEM	-	-	-	1.09	.94–1.27	.27
HA*CMI	-	-	-	1.05	1.03–1.07	<.01
HA*ED	-	-	-	.95	.81–1.13	.58
HA*ATH	-	-	-	.81	.69–.95	.01
HA*ICS	-	-	-	1.27	.95–1.68	.10

stay in the hospital longer (RC, .008, .033), and encounter higher total charges (RC, .035, .050). Finally, compared to White patients, African American patients and Hispanic patients were less likely to die in hospital (OR [CI], .68 [.64, .72]) and (OR [CI], .87 [.81, .94]), respectively.

Table 3 shows results of logistic regression where discharge status equals death as the dependent variable. Model A (without interaction terms) shows that the main effect of all exploratory variables was at least marginally significant. Therefore, 14 interaction terms between race and the seven exploratory variables were added into model A to form model B, which identified three significant interaction terms (P<.01) with African American patients: case-mix index, ED admission, and intensive care services. Interactions of Hispanic patient status with case-mix index and academic teaching hospitals were also identified (P<.01).

The significance of the five interactive terms indicated that racial differences in mortality risk varied across different levels of the five original exploratory variables, and five new groups of mortality odds ratios were calculated (Table 4). For patients who did not receive invasive services, African Americans had a lower mortality risk than their White counterparts. For patients with co-morbidities, the mortality risk was comparable between African Americans and Whites. For patients who received invasive cardiovascular services, no difference in mortality risk was observed between African Americans and Whites; for patients who did not receive invasive services African Americans had a lower mortality risk.

Mortality odds ratios between Hispanic and White patients varied with respect to the co-morbidity index and admission into a teaching hospital. No significant difference in mortality risk was observed between Hispanic and White patients until reaching the highest co-morbidity index score of 16, at which point Hispanic patients were more likely to die. Among patients who did not go to teaching hospitals, the mortality risk between Hispanics and Whites was comparable; as for patients admitted into teaching hospitals, Hispanics had a lower mortality risk.

DISCUSSION

African Americans and Hispanics more often lack regular physician care

Table 4. Interactive effects of race and other factors on mortality (n=373,158)

	African American		Hispanic	
	Odds Ratio	95% CI for Odds Ratio	Odds Ratio	95% CI for Odds Ratio
Co-morbidity index				
0	.73	.55–.97	.77	.51–1.17
2	.78	.59–1.04	.85	.57–1.28
4	.83	.63–1.11	.94	.62–1.41
6	.89	.67–1.18	1.03	.69–1.55
8	.95	.72–1.27	1.14	.75–1.71
10	1.02	.76–1.36	1.25	.83–1.90
12	1.09	.81–1.47	1.38	.90–2.11
14	1.16	.85–1.59	1.52	.98–2.35
16	1.24	.90–1.72	1.67	1.07–2.63
Admission through emergency department				
Y	.64	.49–.84	-	-
N	.73	.55–.97	-	-
Admission in teaching hospital				
Y	-	-	.63	.41–.96
N	-	-	.77	.51–1.17
Use of invasive cardiovascular services				
Y	.88	.63–1.24	-	-
N	.73	.55–.97	-	-

sources and routine referral channels because of financial restrictions (eg, uninsured or Medicaid, low income) or sociocultural barriers (eg, less education, weaker language skills, lack of information and communication, or racial segregation).[58] Therefore, some of the ED visits and hospitalizations, in these populations, may have been preventable if ambulatory and preventive care had been accessed in a timely fashion.[53,56,57,59] In addition, minorities, especially African Americans, disproportionately live in inner cities or metropolitan areas,[78] where teaching hospitals are located,[54–55] so that geographic convenience may be a potential contributor to better outcomes.[47–48,62,74] On the other hand, Whites might be more likely to go to teaching hospitals through physician referral.

Consistent with other results, both African American and Hispanic patients were found to utilize fewer invasive cardiovascular services.[76] Potentially, this finding is related to a lower degree of illness severity and a lower risk of coexistent coronary artery disease. Conceivably, this lower risk for coronary artery disease may have resulted in fewer indications for invasive procedures. With other research demonstrating higher prevalence of diabetes, hypercholesterolemia, and atherosclerosis in minority populations,[78] the finding of fewer co-morbid conditions in this population must be related to selection of a healthier cohort because of excessive hospital/ED utilization and potentially inadequate access to ambulatory care. Finally, some studies have found that, compared to Whites, African Americans may ''prefer'' fewer clinical procedures.[34]

From the perspective of resource consumption, both African American and Hispanic patients stayed in the hospital longer and incurred higher total charges. First, African Americans are more likely to experience readmission following original admissions for the treatment of heart disease.[41] This higher frequency of readmission may be due to inadequate followup once the patient is discharged, which could contribute to longer hospital length of stay if the physician postpones discharge while follow-up care is being arranged or until the underlying condition is more stable than what would be required if adequate outpatient follow up was available. This theory requires further substantiation through research. Another possible explanation relates to practice patterns of teaching hospitals, which, in general, have a longer average length-of-stay and higher charges than do non-teaching hospitals.[76] Patients of different races disproportionately present to different types of hospitals,[53–55] which results in different length of stay and total charges. Those identified by physician referral would be more likely to have higher illness severity than those who presented to the ED as a result of their symptoms alone. In addition, emergen-

Consistent with other results, both African American and Hispanic patients were found to utilize fewer invasive cardiovascular services.[76]

cy care is generally more expensive than non-ED care.[75] Racial differences in hospital care-seeking patterns appeared to largely determine resource consumption in the hospital and play a major role in selecting patients of different illness severity levels among different ethnic groups.

Limitations related to the use of the NIS data existed. The NIS did not provide information on postdischarge outcomes, specific clinical characteristics that could affect outcomes (eg, blood pressure, ejection fraction), and use of medications (eg, beta-blockers) known to affect outcomes. In addition, the NIS did not allow us to link data to individual patients in order to examine multiple admissions and readmission. Finally, since several states participating in the NIS data collection did not provide race information, ≈23% of the discharges with a missing value for race were excluded.

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