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Race and place differences in patients hospitalized with an acute coronary syndrome: Is there double jeopardy? Findings from TRACE-CORE☆,☆☆

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ABSTRACT

The objectives of this longitudinal study were to examine differences between whites and blacks, and across two geographical regions, in the socio-demographic, clinical, and psychosocial characteristics, hospital treatment practices, and post-discharge mortality for hospital survivors of an acute coronary syndrome (ACS). In this prospective cohort study, we performed in-person interviews and medical record abstractions for patients discharged from the hospital after an ACS at participating sites in Central Massachusetts and Central Georgia during 2011–2013. Among the 1143 whites in Central Massachusetts, 514 whites in Central Georgia, and 277 blacks in Central Georgia, we observed a gradient of socioeconomic position with whites in Central Massachusetts being the most privileged, followed by whites and then blacks from Central Georgia; similar gradients pertained to psychosocial vulnerability (e.g., 10.7%, 25.1%, and 49.1% had cognitive impairment, respectively) and to the hospital receipt of all 4 evidence-based cardiac medications (35.5%, 18.1%, and 14.4%, respectively) used in the acute management of patients hospitalized with an ACS. Multivariable adjusted odds ratios (95% confidence intervals) for the receipt of a percutaneous coronary intervention for whites and blacks in Georgia vs. whites in Massachusetts were 0.57 (0.46–0.71) and 0.40(0.30–0.52), respectively. Thirty-day and one-year mortality risks exhibited a similar gradient.
The results of this contemporary clinical/epidemiologic study in a diverse patient cohort suggest that racial and geographic disparities continue to exist for patients hospitalized with an ACS.

1. Introduction

Racial differences in the treatment and outcomes of patients with cardiovascular disease have long been acknowledged (Peterson et al., 1997; Kiefe et al., 1997). These disparities have drawn significant national attention and many calls for intervention to address them have been issued by influential organizations (Yancy et al., 2011; American Heart Association Report, n.d.; *Institute of Medicine Report: Unequal Treatment: Understanding Racial and Ethnic Disparities in Health*, n.d.; *Healthy People 2020 Disparities Report*, n.d.). Regional variability in healthcare delivery is widely understood to occur and has sometimes been interpreted as a marker of variability in the quality of care leading to regional health disparities (Yeh et al., 2012; Gebreab and Diez Roux, 2012; Kulshreshtha et al., 2014; Gillum et al., 2012; Casper et al., 2016; Spertus et al., 2009). Interpreting regional variability as indicative of variable health care quality is particularly warranted when variability is observed in the delivery of evidence-based, guideline-recommended, practices, as is the case for patients who develop an acute coronary syndrome. Whether and how potential regional disparities in healthcare delivery and psychosocial/sociocultural factors are related to racial disparities in health status and outcomes is less well understood.

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A limited number of observational studies in different regional settings have examined differences in the characteristics, treatment practices, and prognosis between African Americans (blacks) and European Americans (whites) who are discharged from the hospital after an acute coronary event (Spertus et al., 2009; Mathews et al., 2014; Sonel et al., 2005; Sabatine et al., 2005; Mehta et al., 2006; Ding et al., 2003; Vaccarino et al., 2005); even fewer of these studies have had access to detailed psychometric data.

Using data from the TRACE-CORE (Transitions, Risks, and Actions in Coronary Events Center for Outcomes Research and Education) study (Waring et al., 2012; Goldberg et al., 2015; McManus et al., 2016; Cook et al., 2013), we examined differences in the socio-demographic, clinical, and psychosocial characteristics, hospital treatment practices, and 30 day and 1 year death risks between white and black patients living in Central Massachusetts and Central Georgia following hospital discharge for an acute coronary syndrome (ACS).

2. Methods

Details of the study design, patient recruitment practices, and data collection activities used in this longitudinal study have been described previously (Waring et al., 2012; Goldberg et al., 2015; McManus et al., 2016; Cook et al., 2013).

In brief, TRACE-CORE used a multi-site prospective cohort design to recruit and follow a cohort of socioeconomically diverse adult men and women hospitalized with an ACS at 6 hospitals at study sites in Central Massachusetts and Georgia which served a heterogeneous and diverse patient population (Waring et al., 2012; Goldberg et al., 2015). There were 2 major teaching hospitals and 1 community hospital in Worcester, MA, two Kaiser Permananete hospitals in Atlanta, GA, and a large teaching hospital in Macon, GA. There are a total of approximately 1100 licensed beds associated with the hospitals we recruited patients from in Central Massachusetts while the single hospital from which we recruited patients from in Macon, Georgia, is a 630 bed tertiary care community teaching hospital. Each of our study sites were affiliated with major teaching institutions including the University of Massachusetts Medical School (Worcester, Massachusetts) and the Mercer University School of Medicine (Mercer, Georgia). The University of Massachusetts Memorial Medical Center and Worcester Medical Center all have the capability of performing cardiac catheterization, percutaneous coronary interventions and coronary artery bypass surgery with similar cardiac diagnostic and interventional capabilities available at the Medical Center of Central Georgia. The city of Worcester, which is centrally located in Massachusetts, has a population of approximately 185,000 persons, 69% of whom are white, with a median household income of approximately $45,000 based on recent census data; 22% of residents of this urban community are considered to be poor. The city of Macon lies centrally in Georgia and the population is approximately 150,000; 29% of residents of this more rural site are white. Based on recent census estimates, the median household income of city residents was approximately $28,000 and 31% of the population was below the poverty line. All eligible and consenting adult patients discharged from participating hospitals after an ACS were enrolled between April 2011 and May 2013. Since there were so few black patients ($n = 15$) recruited from our Massachusetts site, we excluded these patients from the present analysis. We further excluded patients from our Atlanta site due to their relatively small number of eligible and consenting patients.

Trained study staff abstracted extensive socio-demographic, clinical, laboratory, physiologic, and treatment related data from the medical records of patients discharged from the hospital with an independently validated ACS. Standard definitions of ST-segment elevation acute myocardial infarction (STEMI) and Non ST-segment elevation myocardial infarction/unstable angina (NSTEMI/UA) were used (Waring et al., 2012; Goldberg et al., 2015; Jneid et al., 2012).

Trained staff performed structured interviews using validated instruments about patients' general and condition-specific quality of life, behavioral and lifestyle characteristics, and a variety of social factors. We queried patients using standardized instruments about a variety of psychosocial factors which would not be routinely available or collected and recorded in hospital charts. These factors included cognitive status, depression, anxiety, measures of perceived stress and social support, and health literacy (Waring et al., 2012). Interviews were performed face-to-face during the index ACS hospitalization.

Information was also collected from the review of hospital charts about the in-hospital use of several evidence-based cardiac medications. These included the guideline recommended therapies of angiotensin converting enzyme inhibitors/angiotensin receptor blockers, anticoagulants, aspirin, and beta blockers during the initial 24 h of hospitalization while the use of anticoagulant agents was replaced by the receipt of lipid lowering medications at the time of hospital discharge; we also determined whether the patient underwent cardiac catheterization, a percutaneous coronary intervention (PCI), or coronary artery bypass graft (CABG) surgery during their index ACS admission. Follow-up of all study patients for post-discharge mortality was carried out through the review of hospital discharge medical records, standardized telephone calls, and state and local review of death records.

3. Data analysis

We categorized our study sample into 3 categories: whites in Central Massachusetts and whites and blacks in Central Georgia. Given the socioeconomic gradient observed across these 3 categories, we treated the 3-value race/place variable as an ordinal variable. Differences in selected factors and study endpoints across these categories were examined using linear tests for trend and Cochran-Armitage trend tests for continuous and categorical variables, respectively.

We assumed that it was reasonable to consider the 3 level race/place variable as ordinal based on our conceptual understanding of the link between socio-economic status and the health outcomes under study in our patient population. We postulated a null hypothesis of no linear relationship between patient-level factors and our principal study endpoints with the 3 level race/place variable at the population level. We then used the Cochrane-Armitage trend statistic to test these null hypotheses of no linear association. This trend test statistic is equivalent to the score statistics from a linear logit model testing the null hypothesis of zero slope. Inasmuch, it is possible to have a significant test result rejecting the null hypothesis of zero slope even when the level of the outcome variable does not increase in lock-step with the predictor variable (Agresti, 2002).

Ordinal logistic regression analysis accounted for a number of potentially confounding factors in examining differences in the hospital receipt of evidence-based cardiac medications, as well as 30 day and 1 year all-cause death risks, in white patients from Georgia, and black patients from Georgia, in comparison to the referent group of white patients from Massachusetts (see table footnotes for a list of covariates). We grouped the block of potential confounders into two blocks; first, we adjusted for demographic and socioeconomic factors and for comorbidities present at the time of hospital admission. The second block of controlling variables included physiologic parameters and psychosocial factors.

IRB approval was obtained from the Committee for the Protection of Human Subjects in Research at the University of Massachusetts Medical School and the other study sites and participating subjects provided written informed consent.

4. Results

4.1. Study population characteristics

The study population consisted of 1143 whites discharged alive from three hospitals in Central Massachusetts and 514 whites and 277 blacks discharged after an ACS from the single hospital in Central Georgia.

Among both whites and blacks, the majority was diagnosed with an NSTEMI/UA. The average hospital stay was 3.5 days for whites in MA and 5.3 and 5.0 days, respectively, for whites and blacks in Georgia.

The mean age of whites from both of our study sites was 5 years higher, these individuals were more frequently male and married, had higher levels of education, and were currently working than blacks hospitalized at the Medical Center of Central Georgia; the latter two factors also differed between whites in Massachusetts and Georgia as did differences in insurance coverage and body mass index between whites and blacks at our respective study sites (Table 1). Whites in Georgia had lower educational attainment, health insurance coverage, and current employment than whites residing in Massachusetts but ranked higher on all these factors than blacks from Georgia; for body mass index, this ordering across the 3 race-region categories was reversed.

Table 1
Population baseline characteristics according to race and place: TRACE-CORE.

Characteristic	Central MA Whites (n = 1143)		Central GA Whites (n = 514)		Central GA Blacks (n = 277)		p for trend
	n	%	n	%	n	%	
Age (mean, yrs (std))	1143	62.3 (11.6)	514	61.8 (10.7)	277	57.1 (10.3)	<0.001
Male	803	70.3	342	66.5	137	49.5	<0.001
Married	703	61.5	311	60.5	102	36.8	<0.001
Education							
High school or less	454	39.8	273	53.1	194	70.0	<0.001
Some college	346	30.3	142	27.6	62	22.4	<0.001
College graduate	342	30.0	99	19.3	21	7.6	
Currently working	541	47.3	166	32.3	78	28.2	<0.001
Insurance type							
Medicaid	92	8.1	36	7.0	54	19.5	<0.001
Medicare	153	13.4	111	21.6	53	19.1	<0.01
Self-pay/no insurance	59	5.2	68	13.2	44	25.7	<0.001
Body mass index							
<25	205	18.0	99	19.4	44	16.0	0.68
25–29.9	430	37.8	164	32.2	67	24.4	<0.001
≥30	503	44.2	247	48.4	164	59.6	<0.001
Medical history							
ACS/MI	485	42.4	331	64.4	168	60.7	<0.001
Revascularization procedure	358	31.3	255	49.6	112	40.4	<0.001
Atrial fibrillation	96	8.4	53	10.3	16	5.8	0.50
Chronic kidney disease	108	9.5	60	11.7	48	17.3	<0.001
Chronic lung disease	200	17.5	112	21.8	48	17.3	0.46
Depression	175	15.3	52	10.1	18	6.5	<0.001
Diabetes	312	27.3	165	32.1	115	41.5	<0.001
Heart failure	108	9.5	104	20.2	68	24.6	<0.001
Hyperlipidemia	800	70.0	351	68.3	188	67.9	0.40
Hypertension	810	70.9	414	80.5	246	88.8	<0.001
Stroke	36	3.2	34	6.6	32	11.6	<0.001
Admission physiologic factors (mean (std))							
Systolic blood pressure (mm Hg)	1132	141.3 (25.0)	512	138.5 (25.3)	277	146.5 (30.7)	<0.001
Diastolic systolic blood pressure (mm Hg)	1129	80.2 (25.3)	510	78.0 (17.6)	277	83.7 (19.7)	<0.05
eGFR (ml/min/1.73m^2)	1129	79.9 (24.6)	487	77.4 (33.0)	270	79.3 (36.8)	0.77
Heart rate (bpm)	1132	77.3 (19.1)	510	78.4 (18.1)	276	79.6 (19.9)	0.07
Serum cholesterol (mg/dl)	882	173.7 (46.1)	433	168.5 (55.8)	235	176.7 (52.1)	0.42
Serum glucose (mg/dl)	1080	152.1 (72.7)	496	152.4 (80.8)	275	149.4 (72.4)	0.60
Maximum troponin I (ng/mL)	847	22.7 (36.7)	454	12.6 (27.3)	250	11.3 (27.2)	<0.001
Presenting symptoms							
Chest pain/pressure	815	71.3	318	61.9	171	61.7	<0.001
Diaphoresis	263	23.0	81	15.8	55	19.9	<0.05
Dizziness	128	11.2	39	7.6	22	7.9	<0.05
Dyspnea	425	37.2	199	38.7	138	49.8	<0.001
Nausea/vomiting	216	18.9	125	24.3	78	28.2	<0.01
Palpitations	42	3.7	26	5.1	17	6.1	<0.05
Weakness/fatigue	84	7.4	62	12.1	34	12.3	<0.01

eGFR – estimated glomerular filtration rate.

The 3-category ordinal gradient in terms of education, employment status, and receipt of Medicaid benefits was paralleled for many of the comorbidities noted at the time of hospital admission. Chronic kidney disease, coronary heart disease, prior receipt of a coronary revascularization procedure, diabetes, heart failure, hypertension, and stroke were least prevalent among whites in Central Massachusetts and most prevalent among blacks in Central Georgia.

In terms of physiologic factors, a three category ordinal gradient was not apparent, but blacks presented with higher mean blood pressures than whites (average of 5 to 8 mmHg higher) whereas whites had higher peak troponin findings than blacks; whites in Massachusetts had consistently higher levels of each of these factors than whites from Georgia (Table 1).

Whites in Massachusetts were more likely than blacks or whites in Georgia to have chest pain/pressure as a presenting symptom (71% vs 62%). Black patients were more likely to have complained of dyspnea, nausea/vomiting, and fatigue than whites who were more likely to have complaints of diaphoresis and dizziness at hospital presentation (Table 1).

There was considerable psychosocial distress manifest in our study population and less than desirable health literacy (Table 2). In terms of race/place differences, there appeared to be a 3-category ordinal gradient for moderate/severe anxiety and depression, though blacks and whites in Georgia had relatively similar findings with regards to moderate/severe anxiety and depression, cognitive impairment (observed in almost 50% of blacks), perceived stress (>56% of blacks compared with approximately one third of whites in Massachusetts and 47% of whites in Georgia), health literacy, physical and mental health scores on the SF-36 assessment, social support, and alcohol consumption (Table 2); while statistically significant, the mean differences in social support were relatively small, however, and of uncertain clinical significance

4.1.1. Hospital treatment practices

Whites from Massachusetts were more likely to have been treated with aspirin, anticoagulants, and antiplatelet therapy during the first 24 h of hospitalization than whites in Georgia, who were more likely to have been treated with these medications than blacks in Georgia. This race/place gradient was apparent for anticoagulants and antiplatelet therapy and for the prescription of all four evidenced-based cardiac therapies (36% of whites in Massachusetts, 18% of whites in Georgia, and approximately 1 in every 7 blacks in Georgia) (Table 3). Differences in these medication prescribing practices at the time of hospital discharge also displayed the 3-category gradient observed previously; relatively similar differences were observed in the use of pre-ACS medications.

The gradient observed for other variables was noted for patients undergoing diagnostic cardiac catheterization and for the receipt of a percutaneous coronary intervention (PCI), though not for CABG surgery (Table 3). White patients from Georgia were the most likely to have undergone CABG surgery during their acute hospitalization, whereas whites from Massachusetts were the least likely to have undergone this procedure.

We examined possible race/ethnicity and/or geographic differences in the receipt of all evidence-based cardiac medications and coronary interventional procedures while controlling for a variety of factors that could affect the receipt of these treatment strategies (Table 4). The results of these analyses suggested that blacks and whites in Georgia were less likely than whites in Massachusetts to have been sent home on all four evidence-based cardiac medications and were less likely to have undergone a PCI. Blacks and whites in Central Georgia were more likely to have undergone CABG surgery

Table 2
Baseline psychosocial factors according to race and place: TRACE-CORE.

Psychosocial and lifestyle factors	Central MA Whites (n = 1143)		Central GA Whites (n = 514)		Central GA Blacks (n = 277)		p for trend
	n	%	n	%	n	%	
Moderate/severe anxiety[a]	226	19.8	157	30.5	78	28.2	<0.001
Moderate/severe depression[b]	186	16.3	151	29.4	83	30.0	<0.001
Cognitively impaired[c]	122	10.7	129	25.1	136	49.1	<0.001
High perceived stress[d]	360	32.3	240	47.2	153	56.3	<0.001
Health literacy (good)[e]	777	68.3	297	58.0	142	51.5	<0.001
Low social support	63	5.5	27	5.3	22	7.9	0.22
PCS (mean(std))[f]	1143	44.0(10.3)	514	36.7(10.9)	277	37.5(10.3)	<0.001
MCS (mean(std))[f]	1143	49.3(11.3)	514	45.1(14.3)	277	44.6(13.1)	<0.001
Social support (mean(std))	1128	20.6(4.5)	510	20.0(4.0)	275	18.6(4.7)	<0.001
No Alcohol consumption	380	33.3	285	55.6	167	60.3	<0.001
Rare/occasional drinker	457	40.1	147	28.7	74	26.7	<0.001
Moderate/heavy alcohol consumption	304	26.6	81	15.8	36	13.0	<0.001
Current smoker	231	20.2	155	30.2	80	28.9	<0.001
Prior smoker	563	49.3	223	43.4	92	33.2	<0.001
Nonsmoker	349	30.5	136	26.5	105	37.9	0.17

MCS - mental health component summary score.
PCS - physical health component summary score.
[a] GAD7 general anxiety disorder 7 item score: 5–9 mild, 10–14 moderate, ≥15 severe anxiety.
[b] PHQ-9 patient health questionnaire 9 item score: 5–9 mild, 10–14 moderate, 15–19 moderately severe, and ≥20 severe depression.
[c] TICS – telephone interview for cognitive status: ≤28 impaired cognition.
[d] Perceived stress scale: ≥20 high perceived stress.
[e] Somewhat/not at all confident/little confidence in filling out medical forms.
[f] SF-36 – mental health and physical health components.

during their hospitalization, but were less likely to have undergone any coronary revascularization procedure during their acute hospitalization than whites in Central Massachusetts. Virtually identical findings were observed when we controlled for the use of several pre-ACS medications.

We also compared blacks in Georgia with whites in Georgia (last column of Table 4). After controlling for similar factors, blacks in Georgia were as likely as whites in this region to have been discharged on all four evidence-based cardiac medications. Blacks were less likely than whites to have undergone a PCI or CABG surgery in our unadjusted analyses, but these differences were attenuated after controlling for several medical history, clinical, physiologic, and psychosocial factors. However, receipt of any coronary revascularization approach (PCI and/or CABG surgery) during the patient's index admission was less frequent for blacks than whites in Georgia.

Table 3
Hospital treatment practices according to race and place: TRACE-CORE.

Medications administered within 24 h of hospital arrival	Central MA Whites (n = 1143)		Central GA Whites (n = 514)		Central GA Blacks (n = 277)		p for trend
	n	%	n	%	n	%	
Aspirin	949	83.0	413	80.4	208	75.1	<0.01
Anticoagulants	762	66.7	246	47.9	128	46.2	<0.001
Antiplatelets	763	66.8	283	55.1	137	49.5	<0.001
Beta blockers	873	76.4	383	74.5	203	73.3	0.23
All 4 evidence-based cardiac therapies	406	35.5	93	18.1	40	14.4	<0.001
Discharge medications							
Aspirin	1121	98.1	466	90.7	234	84.5	<0.001
ACE inhibitors	623	54.5	196	38.1	120	43.3	<0.001
Beta blockers	1053	92.1	433	84.2	227	82.0	<0.001
Lipid lowering medications	1105	96.7	452	87.9	234	84.5	<0.001
All 4 evidence-based cardiac therapies	565	49.4	141	27.4	73	26.4	<0.001
Diagnostic/interventional procedures							
Cardiac catheterization	1106	96.8	490	95.3	251	90.6	<0.001
Percutaneous coronary intervention	836	73.1	313	60.9	144	52.0	<0.001
Coronary artery bypass surgery	117	10.2	94	18.3	41	14.8	<0.001
Percutaneous coronary intervention or coronary artery bypass surgery	945	82.7	397	77.2	181	65.3	<0.001

ACE – angiotensin-converting enzyme.

4.1.2. Thirty day and one year post discharge death risks

The 30-day and 1 year all-cause death risks were 0.4% and 2.9%, respectively, among whites in Massachusetts; 1.0% and 6.1% among whites in Georgia; and 1.4% and 6.0%, respectively, among blacks in Georgia (Table 5).

After controlling for several previously described characteristics of prognostic importance, whites in Georgia had an increased odds of dying during the subsequent 30 days than whites in Massachusetts whereas blacks in Georgia experienced a higher odds of dying during the first 30 days after hospital discharge than whites in Massachusetts (Table 5); similar findings were observed when we controlled for the receipt of hospital treatment practices and pre-ACS medications.

In terms of 1 year all-cause death risks, whites and blacks in Georgia had an increased odds of dying at this time point than whites in Massachusetts, both in our unadjusted analyses and after simultaneously controlling for a number of factors in our final regression model. One year post hospital discharge death risks were not different between whites and blacks at our Georgia site after controlling for several factors of prognostic importance (Table 5).

5. Discussion

The present findings illustrate a complex interplay of race and place with regard to differences in hospital presentation, hospital treatment practices/process measures, and 30 day and 1 year death risks for patients discharged from the hospital after an ACS. We observed a gradient in socio-demographic characteristics and access

Table 4
Crude and multivariable adjusted odds ratios (95% confidence intervals) for hospital treatment practices according to race and place: TRACE-CORE.

	Central MA Whites (n = 1143)	Central GA Whites (n = 514)	Central GA Blacks (n = 277)	Central GA Blacks vs. Central GA Whites[c]
Receipt of all evidence-based medications at hospital discharge (%)	49.4	27.4	26.4	27.1
Unadjusted odds ratios (OR's)	1.0 (Reference group)	0.39 (0.31,0.49)	0.37 (0.27,0.49)	0.95 (0.68,1.32)
Regression Model 1[a]	1.0	0.37 (0.29,0.47)	0.33 (0.24,0.46)	0.90 (0.63,1.27)
Regression model 2[b]	1.0	0.38 (0.29,0.50)	0.35 (0.24,0.50)	0.91 (0.63,1.32)
Receipt of PCI (%)	73.1	60.9	52.0	57.8
Unadjusted OR's	1.0 (Reference group)	0.57 (0.46,0.71)	0.40 (0.30,0.52)	0.70 (0.52,0.93)
Regression model 1[a]	1.0	0.63 (0.50,0.80)	0.47 (0.34,0.64)	0.75 (0.54,1.03)
Regression model 2[b]	1.0	0.68 (0.52,0.88)	0.52 (0.37,0.74)	0.77 (0.54,1.08)
Receipt of CABG surgery (%)	10.2	18.3	14.8	17.1
Unadjusted OR's	1.0 (Reference group)	1.96 (1.46,2.63)	1.52 (1.04,2.23)	0.78 (0.52,1.16)
Regression model 1[a]	1.0	2.19 (1.59,3.02)	1.56 (1.00,2.43)	0.71 (0.46,1.10)
Regression model 2[b]	1.0	1.99 (1.40,2.83)	1.50 (0.93,2.43)	0.75 (0.47,1.21)
Receipt of PCI or CABG surgery (%)	82.7	77.2	65.3	73.7
Unadjusted OR's	1.0 (reference group)	0.71 (0.55,0.92)	0.40 (0.30,0.53)	0.56 (0.40,0.77)
Regression model 1[a]	1.0	0.87 (0.66,1.15)	0.49 (0.35,0.70)	0.57 (0.40,0.81)
Regression Model 2[b]	1.0	0.91 (0.67,1.24)	0.55 (0.38,0.81)	0.61 (0.41,0.89)

CABG – coronary artery bypass grafting.
PCI – percutaneous coronary intervention.
[a] For each row, the first 3 columns present the multivariable adjusted odds ratios (95% confidence intervals) for an ordinal logistic regression model adjusting for age, sex, marital, education, health insurance, and employment status, body mass index, and medical history of chronic kidney disease, coronary heart disease, depression, diabetes, heart failure, hypertension, myocardial infarction, stroke, and prior coronary revascularization procedure. The last column presents the multivariable adjusted odds ratios (95% CIs) for a logistic regression model comparing blacks vs. whites in Central Georgia, adjusting for the same covariates.
[b] For each row, the first 3 columns present the adjusted odds ratios (95% confidence intervals) for an ordinal logistic regression model adjusting for covariates listed above plus type of acute coronary syndrome, admission systolic and diastolic blood pressure and pulse findings, alcohol consumption, cigarette smoking, anxiety, depression, cognitive impairment, perceived stress, living situation, health literacy, and SF-36 scores. The last column presents the multivariable adjusted odds ratios (95% CIs) for a logistic regression model comparing blacks vs. whites in Central Georgia, adjusting for the same covariates.
[c] Reference category = Central Georgia whites.

to care in which Georgia whites were intermediate between the most privileged (Massachusetts whites) and the least privileged (Georgia blacks). This gradient was paralleled by a similar gradient regarding the receipt of evidence-based care, with disparities remaining even after adjustment for multiple factors. Blacks and whites in Central Georgia fared worse than whites in Central

Table 5
Crude and multivariable adjusted odds ratios (95% confidence intervals) for post discharge death rates according to race and place: TRACE-CORE.

	Central MA Whites (n = 1143)	Central GA Whites (n = 514)	Central GA Blacks (n = 277)	Central GA Blacks vs Central GA Whites[c]
30 Day all-cause mortality (%)	0.4	1.0	1.4	1.10
Unadjusted OR's	1.0 (reference group)	2.80 (0.75,10.46)	4.17 (1.04,16.79)	1.49 (0.40,5.60)
Regression model 1[a]	1.0	3.52 (0.86,14.44)	7.83 (1.36,45.00)	2.22 (0.46,10.75)
Regression model 2[b]	1.0	5.71 (0.94,34.65)	8.82 (1.03,75.86)	1.55 (0.25,9.69)
1 year All-cause mortality (%)	2.9	6.1	6.0	6.1
Unadjusted OR's	1.0 (Reference group)	2.21 (1.29,3.77)	2.16 (1.14,4.10)	0.98 (0.51.1.88)
Regression model 1[a]	1.0	1.78 (0.97,3.26)	1.65 (0.75,3.63)	0.93 (0.44,1.96)
Regression model 2[b]	1.0	1.48 (0.76,2.88)	1.61 (0.67,3.85)	1.09 (0.47,2.52)

[a] Adjusted for age, sex, marital, education, health insurance, and employment status, body mass index, and medical history of chronic kidney disease, coronary heart disease, depression, diabetes, heart failure, hypertension, myocardial infarction, stroke and prior coronary revascularization procedure.
[b] Adjusted for covariates listed above plus type of acute coronary syndrome, admission systolic and diastolic blood pressure and pulse findings, alcohol consumption, cigarette smoking, anxiety, depression, cognitive impairment, perceived stress, living situation, health literacy, and SF-36 scores.
[c] Reference category = Central Georgia whites.

Massachusetts with regard to 30 day and 1 year post discharge all-cause death risks. One needs to be careful, however, in the interpretation of the present findings since we did not have a comparison group of blacks from central Massachusetts, we lacked broader geographic representation of whites and blacks from other regions of the U.S., and our event rates were relatively low.

5.1. Patient characteristics

Black patients discharged from the hospital after an ACS in Georgia were relatively young, a lower proportion attended college, and a higher proportion had been previously diagnosed with several important comorbidities as compared with white patients at our Georgia and Massachusetts sites.

Similar differences in these characteristics between black and white patients were observed in the CRUSADE study (Mathews et al., 2014). The >3000 black patients with an NSTEMI included in this investigation were several years younger than whites, and had a higher prevalence of previously diagnosed cardiovascular disease related comorbidities (Mathews et al., 2014). Similar findings were reported among those included in five large randomized clinical trials of patients with acute coronary disease carried out between 1990 and 2001 (Mehta et al., 2006).

While the reasons for these differences are unknown, it was of interest to note the higher blood pressure findings and peak troponin levels among whites hospitalized with an ACS in Central Massachusetts as compared with whites in Central Georgia. This could have been due to differences in patient's care seeking behavior, number, timing, and accuracy of these measurements, or to the severity of the acute coronary episode.

In comparing our results to these and other investigations, it is important to note that the other cited studies are somewhat dated and one study included a narrowly defined patient population. The TRACE-CORE investigation is a contemporary prospective cohort study that included patients across the spectrum of an ACS, with a wide range of socioeconomic diversity.

5.2. Psychosocial and behavioral characteristics

There was considerable psychosocial distress and vulnerability reported by our study population. A considerable proportion of patients had anxiety and depression and poor health literacy and a wide range of cognitive impairment was observed. It needs to be noted, however, that in many of the study patients, their psychological distress may have been transient and a reaction to their acute illness and hospitalization while in others, their anxiety and depression may persist after hospital discharge; it is unknown how these psychosocial patterns may have differed according to race and study location.

Black patients were more likely to have moderate/severe symptoms of depression, be cognitively impaired, have higher levels of perceived stress, have poorer health literacy, be current smokers, and reported consuming either none or more moderate amounts of alcohol as compared with white patients. On the other hand, white patients discharged from the hospital after an ACS reported a higher quality of life but higher prevalence of lifetime depression than blacks.

Few clinical/epidemiologic studies have examined differences in various psychosocial factors or lifestyle characteristics between white and black patients hospitalized with an ACS (Spertus et al., 2009; Mathews et al., 2014; Mehta et al., 2006). In the PREMIER study of >1800 patients hospitalized with an acute myocardial infarction (AMI) in 10 hospitals in California and Missouri, black patients presented with a worse psychosocial profile and poorer quality of life than white patients (Spertus et al., 2009). Similarly, in the TRIUMPH study, patients with higher scores on the perceived stress scale were more likely to be non-white (Agresti, 2002).

With regard to lifestyle factors, we found that a lower proportion of patients from Georgia reported consuming alcohol but a higher proportion were current smokers as compared with whites in Massachusetts. Investigators in the CRUSADE, GUSTO/ASSENT, and PREMIER studies found a higher proportion of current smokers in black than in white patients (Spertus et al., 2009; Mathews et al., 2014; Mehta et al., 2006).

Given the high frequency and associated burden of psychosocial vulnerability demonstrated in our relatively young study population, health care providers should consider screening for these important lifestyle and psychosocial factors in all patients who develop an ACS. These factors have been associated with failure to understand post-discharge medication and lifestyle change instructions, the progressive nature of the patient's underlying disease process, long-term adherence to effective cardiac medications, and worse long-term outcomes.

5.3. Hospital treatment practices

We observed a relatively lower utilization of effective cardiac medications in patients from Georgia during the initial 24 h of their hospitalization for an ACS and at the time of hospital discharge with no differences noted between blacks and whites at our Georgia site. A lower proportion of patients from Georgia underwent some form of coronary revascularization than whites from Massachusetts with black patients from Georgia being less likely to have undergone either a PCI or CABG surgery during their index hospitalization than whites from this region. While the reasons for these differences are unknown, the hospital length of stay was considerably longer for patients hospitalized with an ACS in Central Georgia as compared with Central Massachusetts, on average nearly 2 days longer. This may reflect differences in the severity of disease, hospital discharge policies and timing of admission and/or discharge, or in other factors between the 2 study sites.

In the CRUSADE study, black patients were less likely to have been prescribed evidence-based cardiac medications than whites and to have undergone cardiac catheterization and a PCI during their hospitalization (Sonel et al., 2005). Black patients in the PREMIER study were significantly less likely to have undergone cardiac catheterization, PCI, and CABG surgery than whites and were also less likely to have been treated with evidence-based medications at hospital discharge (Spertus et al., 2009).

Geographic differences have been observed with regards to the receipt of various cardiac medications and coronary interventional procedures among patients with cardiovascular and cerebrovascular disease in the U.S. (Gebreab and Diez Roux, 2012; Arnold et al., 2012; Glasser et al., 2008; Yong et al., 2014) In the REGARDS study of middle-aged and older adults living in the U.S. stroke belt (Glasser et al., 2008), one third of study participants reported prophylactic aspirin use, with this usage being significantly more common among whites than blacks.

These and other findings that have been observed with regards to race and place in terms of the descriptive epidemiology of CHD need to be cautiously interpreted, however, given the effects of assessing one acute illness episode in a complex disease process. Racial as well as geographic disparities in the management and outcomes of patients hospitalized with an ACS may be due to patient's health insurance coverage and extent of financial resources, socio-cultural and racial biases and response to the underlying and acute disease state, acute presenting symptoms, extent of delay in seeking acute medical care, residual confounding by other factors, differences in the severity of acute coronary disease, or to the reluctance of certain patient subgroups to undergo cardiac interventional procedures or be medically treated in an aggressive manner (Graham, 2014).

5.4. Post discharge mortality risks

Researchers in the ARIC study, GUSTO, ASSENT, and PREMIER failed to find significant differences in the in-hospital, 30-day, or 1-year mortality rates between whites and blacks after adjusting for several potential confounding variables of prognostic importance (Spertus et al., 2009; Ding et al., 2003). In the CRUSADE study, blacks had lower 30-day multivariable adjusted death rates but similar 1-year death rates (Sonel et al., 2005).

Both black and white patients from our site in Georgia were at higher risk for dying at 30 days and 1 year post hospital discharge than patients hospitalized for an ACS in Massachusetts. While there were no differences noted between blacks and whites at our Georgia site with regard to post hospital discharge death rates, blacks in Georgia were at greater odds for dying at 30 days after hospital discharge than whites in Massachusetts.

The present findings need to be cautiously interpreted, however, since a myriad of post discharge factors that may influence patient's downstream outcomes need to be considered in the interpretation of race and/or geographic differences in post discharge death risks after hospital discharge for an ACS. Moreover, the 30 day and 1 year risks of dying observed in the present study were relatively low and, as such, any between group/site differences need to be cautiously interpreted.

Factors to consider in explaining any possible race/place differences in the prognosis of patients after an ACS include the trajectory of the patient's underlying condition prior to the index event, adherence to cardiac medications prescribed and receipt of subsequent cardiac interventional procedures, physician follow-up after hospital discharge, social and financial support, and changes in psychosocial and lifestyle factors over time.

5.5. Study strengths and limitations

The strengths of the present prospective study include the large and diverse sample of patients hospitalized with an ACS and use of standardized data collection instruments to ascertain various measures of psychosocial and lifestyle characteristics. As mentioned previously, however, our findings need to be carefully interpreted with appropriate reservation. The role of multimorbidity in these patients and studying a single clinical event in a complex condition and its natural history need to be considered in the evaluation of our study results. Unfortunately, the demographic characteristics of residents of Central Massachusetts are such that we could not conduct meaningful analyses on racial disparities within Massachusetts. We also cannot exclude the possible roles of information bias in eliciting possible differential responses to our baseline, in-hospital, study questionnaires according to race and place, possible selection bias in the characteristics of participating study subjects, and the role of other potentially confounding factors that we either did not collect information on, or were inadequately measured, such as health insurance or socioeconomic status, family support and situational factors, and extent of knowledge about ACS and its treatment.

6. Conclusions

The results of this contemporary cohort study provide insights into the presenting symptoms, socio-demographic, psychosocial, and clinical characteristics, hospital medical practices, and risk of dying in white and black patients discharged from the hospital after an ACS. Whites in Georgia were more socially disadvantaged and underwent less evidence-based care than whites in Massachusetts, and blacks in Georgia were even worse off than whites in Georgia, thus perhaps placing them in "double jeopardy". These findings reinforce the need for more broadly based contemporary data and for additional research to try to understand what may be causal explanations including system and physician level variables as well as financial factors.

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