

Acute Coronary Syndrome

The Influence of Race on Health Status Outcomes One Year After an Acute Coronary Syndrome

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OBJECTIVES	The goal of this study was to compare health status (symptoms, function, and quality of life) outcomes of whites and blacks one year after an acute coronary syndrome (ACS).
BACKGROUND	Although racial differences in the use of angiography and revascularization after ACS are known to exist, differences in health status outcomes have not been described.
METHODS	We conducted a prospective registry of 1,159 consecutive ACS patients treated between February 1, 2000 and October 31, 2001. One-year health status was quantified with the Seattle Angina Questionnaire (SAQ) and Short Form-12 Physical Component Score (SF-12 PCS). Multivariable models were used to adjust for racial differences in sociodemographic, clinical, and treatment characteristics.
RESULTS	Mortality rates were similar among the 196 black and 963 white patients (7.1% vs. 7.0%, $p = 0.93$); 81 died during follow-up, and 199 (17%) could not be interviewed. At one year, blacks had a higher prevalence of angina (43.4% vs. 27.1%), worse quality of life (SAQ score = 70.6 ± 28.3 vs. 83.9 ± 20.8), and poorer physical function (SF-12 PCS = 36.8 ± 12.3 vs. 43.2 ± 11.4 ; $p < 0.0001$ for all). Multivariable models, including hospital treatments, revealed a trend for more angina (odds ratio 1.46 [95% confidence interval 0.91 to 2.34]) and significantly worse quality of life (mean difference = -7.7 ± 2.4 , $p = 0.002$) and physical function (-3.6 ± 1.3 , $p = 0.005$).
CONCLUSIONS	Blacks have more angina, worse quality of life, and worse physical function one year after an ACS than do whites. Closer surveillance of black ACS patients is needed to determine whether additional treatment can improve their outcomes. (J Am Coll Cardiol 2005;46: 1838–44) © 2005 by the American College of Cardiology Foundation

Understanding and rectifying racial disparities in healthcare is a national priority (1) and a primary goal of the Department of Health and Human Services' Healthy People 2010 agenda (2). Much of the impetus for addressing racial disparities has arisen from studies documenting that black and white patients with coronary artery disease are treated

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differently. For example, numerous investigations have demonstrated that blacks have lower rates of angiography and revascularization (3–5). Yet, understanding whether these *differences* in care result in racial *disparities* requires demonstrating that adverse consequences (i.e., worse clinical outcomes) result from these different treatment patterns.

When previous investigators have examined outcomes associated with differences in care, they have focused upon mortality and have demonstrated few significant differences in the survival of black and white patients (6,7). While a

study of patients who had undergone angiography demonstrated lower use of revascularization and worse survival in blacks (8), the only study to suggest a mortality difference after myocardial infarction (MI) found a *lower* adjusted mortality rate for blacks as compared to their white counterparts (9). Yet no prior study has examined racial differences in health status outcomes (symptoms, function, and quality of life) after treatment for an acute coronary syndrome (ACS). This is a particularly glaring omission because patients are at least as concerned with the quality of their life as its quantity (10,11). More importantly, the therapies shown to be applied differently to black and white patients, most notably coronary revascularization, are primarily used to improve patients' health status and not their survival (12–14).

To provide new insights into potential racial disparities in care, we prospectively studied the one-year outcomes of a consecutive cohort of ACS patients. By documenting and adjusting for patients' presenting sociodemographic, clinical, health status, and treatment characteristics, we sought to determine whether one-year health status outcomes differed between white and black patients. Documenting differences would underscore the need for future investigations to determine why such differences exist and to define strategies for overcoming these disparities in outcome.

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Abbreviations and Acronyms

ACS	= acute coronary syndromes
CABG	= coronary artery bypass grafting
MI	= myocardial infarction
PCI	= percutaneous coronary intervention
SAQ	= Seattle Angina Questionnaire
SF-12 PCS	= Short Form-12 Physical Component Score
VA	= Veterans Affairs

METHODS

Study population. Patients were prospectively enrolled into an ACS registry at two Kansas City hospitals, the Mid America Heart Institute and Truman Medical Center. All 10,911 consecutive patients admitted between March 1, 2001 and October 31, 2002 who had had a troponin blood test ordered were screened for a possible ACS. Standard definitions were used to diagnose ACS patients with either MI (15) or unstable angina (16). Myocardial infarction patients were defined by a positive troponin blood test in the setting of symptoms or electrocardiogram changes (both ST-segment elevation and non-ST-segment elevation changes) consistent with an MI. Unstable angina was diagnosed if the patient had a negative troponin blood test and any one of the following: new onset angina (<2 months) of at least Canadian Cardiovascular Society Classification class III, prolonged (>20 min) rest angina, recent (<2 months) worsening of angina, or angina that occurred within 2 weeks of an MI (16). All potential unstable angina patients who were found to have a diagnostic study that excluded obstructive coronary disease (i.e., coronary angiography, nuclear or echocardiographic stress testing) or who had an additional diagnostic study confirming an alternative explanation for patients' presentation (i.e., esophagogastroduodenoscopy) were subsequently excluded. Three physicians reviewed the charts of all patients for whom diagnostic uncertainty remained and attained consensus on the final diagnosis.

Each participating patient was prospectively interviewed as early as possible during their admission to ascertain their sociodemographic, economic, and health status (symptoms, function, and quality of life) characteristics. Detailed chart abstractions were performed to ascertain patients' medical history, laboratory results, disease severity, and the processes of inpatient care. Approval from the institutional review boards of both institutions was obtained before the conduct of the study, and an informed consent to participate in the interviews and chart abstractions was signed by each participant.

Classification of patients' race. Congruent with the Congressional Office of Management and Budget, race was classified by investigators as white, black, Asian, East Indian, or other. Ethnicity was classified as Hispanic or not. These analyses focus upon the differences in health status outcomes between black and white patients. Patients of

other races and ethnicities (e.g., Pacific Islander, Asian, and Native American; n = 40) were excluded. To examine the potential for misclassification of race, we conducted a prospective study of 410 acute MI patients in which a data collector abstracted patients' race from the chart and compared this to patients' self-reported racial designation. Using patients' designation as the gold standard, only three (0.7%) patients were misclassified (one patient who classified themselves as black was considered white by chart abstraction, and two patients who considered themselves to be white were classified as black). Because the same data collectors and same hospitals were used for both studies, race classification in this study was considered accurate.

Follow-up data collection. The Social Security Administration Death Master File was queried to determine patients' vital status one year after enrollment. Surviving patients were contacted by telephone for a follow-up interview that reassessed their clinical and health status. A minimum of 12 attempts to contact patients were made (including contacting up to two additional individuals designated by patients at the time of their baseline interview as people who would know their whereabouts).

Quantification of health status. Health status assessments were performed with the Seattle Angina Questionnaire (SAQ), a 19-item disease-specific measure for patients with coronary artery disease that has well-established validity, reproducibility, sensitivity to clinical change, and prognostic value (17-19). The SAQ quantifies five clinically relevant dimensions of coronary artery disease: physical limitation, anginal stability, angina frequency, treatment satisfaction, and quality of life. A 5-point difference in mean SAQ scores is considered clinically significant. The scales used in these analyses range from 0 to 100, where higher scores indicate better functioning, fewer symptoms, and higher quality of life. The Short Form-12 (SF-12) Version 1, a generic health status measure that generates physical and mental component scores, was also administered. A score of 50 on these scales reflects the U.S. population mean, and each 10 points reflects 1 SD from the mean.

The primary health status outcomes, chosen *a priori* for these analyses, were the SAQ Angina Frequency scale, the SAQ Quality of Life scale, and the SF-12 Physical Component Summary (SF-12 PCS). The SF-12 was chosen instead of the SAQ Physical Limitation scale because a substantial number of patients reported that they either did not perform the activities described in the SAQ or that their limitations were due to reasons other than angina. Approximately 70% of patients had no angina symptoms at one year; to accommodate this distribution, and to improve scale interpretability, the Angina Frequency scale was dichotomized into presence or absence of angina. The Quality of Life and Physical Component scales were analyzed as continuous variables.

Statistical analysis. Black and white patients' baseline and follow-up characteristics were compared. Categorical data are reported as frequencies, and differences between groups were compared with chi-square tests. Continuous data are

reported as the mean \pm SD, and differences between groups were tested using analysis of variance.

To describe the effect of race on patients' one-year health status outcomes, the following approach was used. First, statistical models of outcomes by race, controlling for baseline health status, were conducted (general linear models for the Quality of Life and Physical Component scales, logistic regression model for the presence of angina). Then, to define the independent effect of race on outcome, multivariable models were constructed that sequentially added to the base model selected sociodemographic, clinical (both non-cardiac and cardiac disease severity), and treatment characteristics that differed by race ($p < 0.10$). Analyses were performed with SAS version 8.2 (SAS Institute, Inc., Cary, North Carolina) and R version 1.8.0.

Several potential sources of missing data were present. First, patients who died within 12 months of follow-up ($n = 81$) could not have 1-year health status assessments made. These patients were excluded from all analyses of health status, and the presented results should be interpreted as representative of those who survive for at least one year after presenting with an ACS. In addition, 199 patients (17%) were not interviewed at one year, because they were unable to be contacted ($n = 144$) or refused to complete a one-year interview ($n = 55$). Baseline characteristics of patients who were not interviewed were compared to those who were.

To examine whether a bias in our observed results might have occurred due to missing follow-up, propensity scores were computed using logistic regression analyses to predict the likelihood of an unsuccessful interview. Predictor variables included patient demographic, socioeconomic, and lifestyle factors; clinical characteristics; vitals and labs; disease severity; baseline health status; medications; and acute and non-acute treatments received during patients' initial ACS hospitalization. Among the patients with available one-year data, analyses were replicated within tertile of propensity score—that is, within subgroups of increasing risk of an unsuccessful interview—to examine the potential for bias due to unobserved follow-up data. Tertiles were chosen to provide sufficient subgroup sizes for examining trends. In addition, a race-by-propensity score interaction term was added to the regression models to test the consistency of the race effect across risk for missing assessments. No significant trend by risk of an unsuccessful follow-up interview was found in the race effects of the three one-year outcomes (p value for trend >0.4 for all), suggesting that incomplete follow-up did not substantially influence our results.

For patients with follow-up who had partially complete data (e.g., missing baseline covariates or partially completed questionnaires), multiple imputation methods were used to estimate the missing variables, and the analyses were replicated on the imputed data ($n = 5$ datasets). No significant differences in effect sizes or statistical significance were found in the imputed datasets, so only the primary data are presented.

RESULTS

A total of 196 black and 963 white patients participated in this prospective registry. Black patients were younger (55 ± 11 vs. 63 ± 13 , $p < 0.001$), more likely to be female (51% vs. 36%, $p < 0.001$) and to have greater numbers of comorbid medical conditions, including diabetes, hypertension, renal failure, current tobacco use, and obesity (Table 1). In contrast, white patients were more likely to have had prior revascularization procedures and to have had higher Thrombolysis In Myocardial Infarction (TIMI) risk scores among those with unstable angina or non-ST-segment elevation MI (3.0 ± 1.4 vs. 2.4 ± 1.3 , $p < 0.001$). White patients were less likely to have a history of heart failure (6% vs. 14%, $p < 0.001$), but had a higher heart rate on admission (81 ± 19 vs. 77 ± 17 , $p < 0.001$). With regards to invasive treatments, whites were more likely to be treated with primary percutaneous coronary intervention (PCI) (32% vs. 10%, $p < 0.001$), to undergo diagnostic angiography (86% vs. 55%, $p < 0.001$), to have non-primary PCI (33% vs. 13%) and bypass surgery (11% vs. 6%).

Racial differences in one-year outcomes. One year after admission for an ACS, 7.1% of black patients and 7.0% of white patients had died ($p = 0.93$). Figure 1 describes the health status outcomes by race. One year after their ACS, 43.4% of black patients had angina as compared with only 27.1% of white patients ($p < 0.0001$), and the mean SAQ Angina Frequency score was significantly lower for black patients (83.4 ± 25.6 vs. 90.5 ± 20.0 , $p < 0.0001$). The distribution of patients with daily, weekly, monthly, and no angina was significantly worse among blacks (7.4% vs. 4.1% had daily angina, 11% vs. 7.3% had weekly angina, 25% vs. 15.6% had monthly angina, and only 56.6% of blacks compared to 73% of whites were without angina; $p < 0.0001$). Similarly, the one-year SF-12 PCS scores were significantly lower among black as compared with white patients (36.8 ± 12.3 vs. 43.2 ± 11.4 , $p < 0.0001$). Finally, the one-year SAQ quality of life scores were also significantly lower in black patients (70.6 ± 28.3 vs. 83.9 ± 20.8 , $p < 0.0001$) with 10.3% of blacks versus 3.2% of whites being quite-to-severely limited, 12.1% versus 6.7% being moderately-to-quite limited, 29.3% versus 19% being slightly-to-moderately limited, and 48.3% versus 71.1% being slightly-to-not-at-all limited. Replication of these analyses by type of ACS (i.e., ST-segment elevation MI, non-ST-segment elevation MI, or unstable angina) did not change the magnitude or direction of the observed disparities in outcome.

Multivariable models of one-year outcomes. Even after adjustment for sociodemographic, clinical, and treatment differences between white and black patients, the one-year health status outcomes were worse for black patients. Figure 2A diagrams the odds ratio of having angina one year after admission. After controlling for baseline angina frequency, blacks were 2.3-fold (95% confidence interval 1.6 to 3.4) more likely to have residual angina. By sequen-

Table 1. Baseline Patient Characteristics by Race

Characteristics	White (n = 963)	Black (n = 196)	p Value
Sociodemographics			
Age	63 ± 13	55 ± 11	<0.001
Male	616 (64%)	96 (49%)	<0.001
No insurance	59 (30%)	93 (107%)	<0.001
Insurance for medications	97 (50%)	702 (74%)	<0.001
Clinical			
Presenting syndrome			
ST-segment elevation MI	269 (28%)	32 (16%)	<0.001
Non-ST-segment elevation MI	296 (31%)	54 (28%)	
Unstable angina	398 (41%)	110 (56%)	
Hypertension	609 (63%)	152 (78%)	<0.001
Prior MI	308 (32%)	66 (34%)	0.64
Prior percutaneous coronary intervention	373 (39%)	22 (11%)	<0.001
Prior coronary artery bypass surgery	206 (21%)	18 (9%)	<0.001
Prior heart failure	53 (6%)	28 (14%)	<0.001
Diabetes	231 (24%)	78 (40%)	<0.001
Hyperlipidemia	611 (63%)	91 (46%)	<0.001
History of renal failure	10 (1%)	13 (7%)	<0.001
Chronic lung disease	95 (10%)	32 (16%)	0.008
Cigarette smoking status			<0.001
Current (≤30 days)	283 (30%)	93 (48%)	
Former (>30 days)	387 (40%)	57 (29%)	
Never (or <100 cigarettes total)	287 (30%)	45 (23%)	
Body mass index	29 ± 6	31 ± 8	0.004
Exercising ≥3 times/week before admission	47 (24%)	306 (32%)	0.028
Disease severity			
Systolic blood pressure	135 ± 24	149 ± 31	<0.001
Heart rate on admission	77 ± 17	81 ± 19	<0.001
Most recent ejection fraction	48 ± 13	49 ± 13	0.32
TIMI risk score for UA/NSTEMI patients	3.0 ± 1.4	2.4 ± 1.3	<0.001
TIMI risk score for STEMI patients	3.3 ± 2.1	3.0 ± 2.0	0.55
Hospital procedures			
Coronary angiography	831 (86%)	107 (55%)	<0.001
Primary angioplasty/stent	310 (32%)	20 (10%)	<0.001
Non-acute treatment*			<0.001
Medical	540 (56%)	158 (81%)	
Percutaneous	313 (33%)	26 (13%)	
Surgical	110 (11%)	12 (6%)	

*Non-acute treatment refers to nonprimary revascularization performed after 24 h of admission.

MI = myocardial infarction; NSTEMI = non-ST-segment elevation myocardial infarction; STEMI = ST-segment elevation myocardial infarction; TIMI = Thrombolysis In Myocardial Infarction; UA = unstable angina.

tially controlling for sociodemographic factors (age, gender, medical insurance), clinical factors (presenting syndrome, hypertension, heart failure, diabetes, hyperlipidemia, renal failure, lung disease, smoking status, exercise patterns, prior revascularization procedures, vitals, and TIMI risk scores), and hospital procedures (catheterization, primary reperfusion, non-primary PCI vs. coronary artery bypass grafting [CABG] vs. medical therapy alone), the relative odds of blacks having persistent angina at one year versus whites decreased. In the final model, blacks had a 46% greater odds of having angina at one year (odds ratio 1.46) after adjustment for all other factors, but the confidence interval crossed 1.0 (95% confidence interval 0.91 to 2.34, $p = 0.11$).

Figures 2B and 2C diagram the racial differences in quality of life and physical function after controlling for the same variables described above. After adjustment for all

measured differences between black and white patients, disparities in health status outcomes persisted. Controlling for baseline quality of life but without adjustment for demographic, clinical, disease severity, and treatment characteristics, the mean (\pm SEM) one-year SAQ Quality of Life score was 13.2 ± 2.2 points lower for blacks than whites ($p < 0.001$). After full adjustment, the quality of life of blacks at one year was 7.7 ± 2.4 points lower than whites ($p = 0.002$). Similarly the SF-12 PCS scores of blacks in baseline-adjusted and fully adjusted models were 4.6 ± 1.2 and 3.6 ± 1.3 points lower than whites ($p < 0.001$ and $p = 0.005$, respectively).

DISCUSSION

Using a consecutive cohort of ACS patients, we found that black patients have worse health status one year after

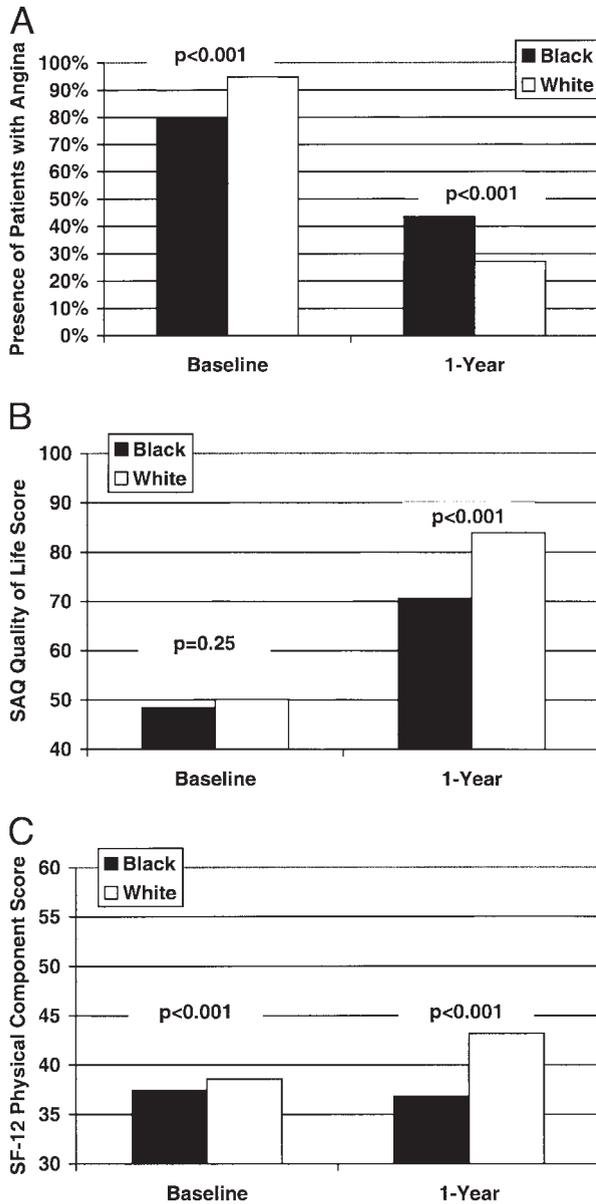


Figure 1. (A) Prevalence of angina at baseline and one year by race. (B) Quality of life at baseline and one year by race. (C) Physical function at baseline and one year by race.

treatment than whites. They were more than twice as likely as whites to have angina at one year and had significantly worse quality of life and physical function. Although adjustment for clinical and treatment differences between black and white patients removed the statistical significance of the 46% increased risk of angina, fully adjusted models revealed that black patients had significantly worse quality of life and greater physical limitations than whites one year after their ACS. These are the first data to find clinically important differences in the health status of black and white patients after ACS treatment and provide new insights into racial disparities in care and outcomes.

Initial insights into racial differences in procedure use were demonstrated in 1988 when Wenneker and Epstein (20) reported that African Americans admitted to Massa-

chusetts hospitals for cardiovascular disease or chest pain were 72% (95% confidence interval 70% to 75%) as likely as Caucasians to receive coronary angiography. Since this report, numerous investigators have documented racial differences in the use of coronary angiography, PCI, and CABG (3-5). For racial differences in procedure use to be meaningful, however, it is important to determine that observed differences in treatment exist even after controlling for other clinically important patient factors. Only if differences in care persist after controlling for these patient characteristics can they be attributed to the system that delivers care rather than the clinical features of individual patients. Unfortunately, health services research have consistently demonstrated, even after controlling for clinical characteristics, mechanisms of reimbursement, organization of healthcare services, and availability of technology at individual hospitals, that racial differences in care persist (3-5). While such data are extremely useful in understanding that the process of care varies by race, these studies cannot address whether one group is receiving too many procedures or another group is receiving too few.

To understand whether true disparities (as opposed to differences) in care are occurring, it is critically important to document that adverse consequences (i.e., worse clinical outcomes) occur as a result of differential treatment. A few studies have examined the outcomes associated with different patterns of treatment. The first was a study by Peterson and colleagues (6) that examined both treatment and outcomes within the Veterans Affairs (VA) healthcare system. By examining all acute MI discharges from the VA in 1988, 1989, and 1990, they showed that African Americans were 32% less likely to have angiograms, 42% less likely to undergo PCI, and 54% less likely to undergo CABG than Caucasians. Despite these differences, no difference in one-year or two-year mortality was observed. More recent work in the VA examined the processes of MI care, in addition to procedure use (7). This study revealed that African Americans were less likely to receive thrombolytic therapy (32.4% vs. 48.2%, $p < 0.01$) and CABG (6.9% vs. 12.5%, $p < 0.001$), but, interestingly, no differences in the use of angiography (49% vs. 50.3%, $p = 0.54$) or PCI (15.4% for both groups) were found. Again, no differences in adjusted mortality were observed at 90 days (odds ratio 0.99 [95% confidence interval 0.74 to 1.3]), 1 year (odds ratio 0.86 [95% confidence interval 0.68 to 1.09]), or 3 years (odds ratio 0.93 [95% confidence interval 0.76 to 1.15]). In fact, the only study to suggest a mortality difference after MI was reported by Chen *et al.* (9). While this study found that African American Medicare patients were less likely to undergo angiography after an MI, the adjusted mortality rates of African Americans were lower than those of Caucasian patients (hazard ratio 0.87 [95% confidence interval 0.81 to 0.93] at one year and hazard ratio 0.89 [95% confidence interval 0.84 to 0.95] at three years). Thus, despite obvious differences in the process of treating white and black patients, there are few data to support that

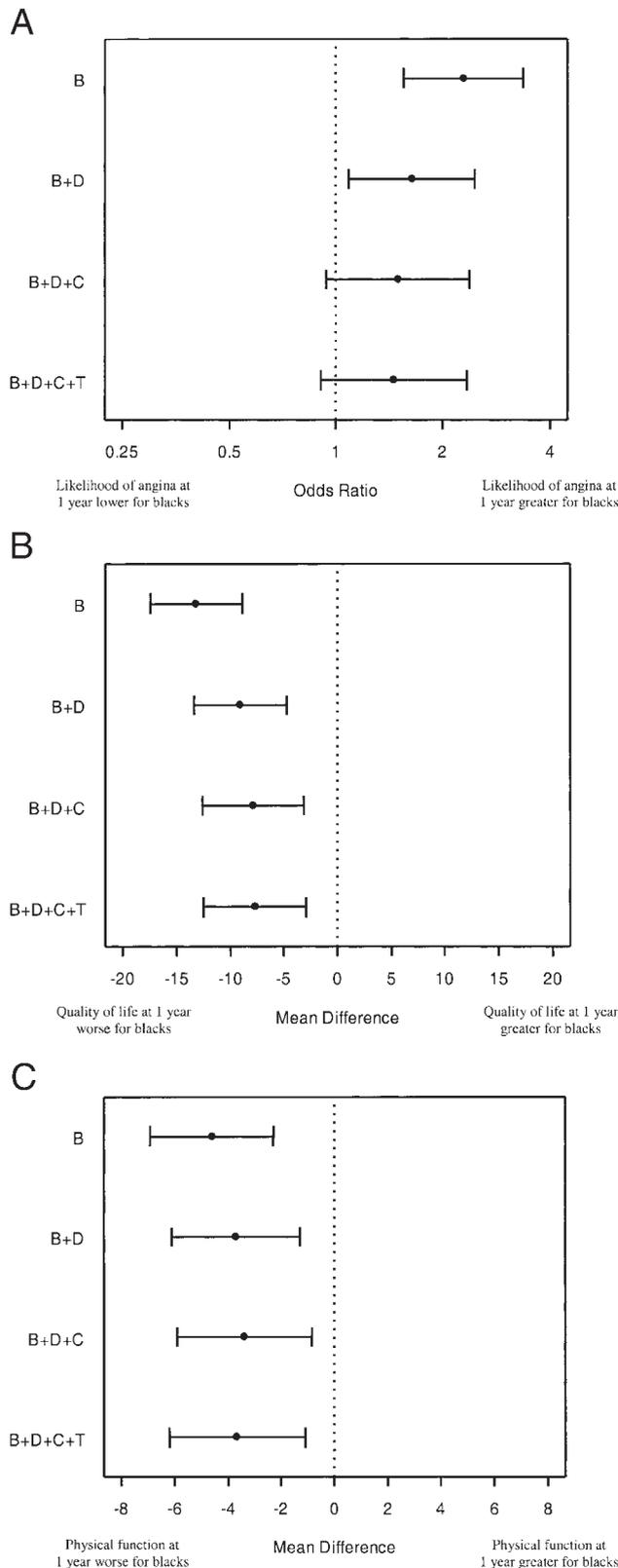


Figure 2. (A) Multivariable-adjusted probabilities of angina at one year in blacks versus whites. See Table 1 for variables in each category. (B) Multivariable-adjusted difference in one-year Seattle Angina Questionnaire Quality of Life score. See Table 1 for variables in each category. (C) Multivariable-adjusted difference in one-year Short Form-12 Physical Component score. See Table 1 for variables in each category. B = baseline health status; C = clinical characteristics; D = demographic characteristics; T = treatment characteristics.

meaningful differences in survival exist. It therefore appears from these previous studies that true disparities (i.e., meaningful differences in outcome due to differences in care) are not present.

A critical limitation in these previous studies has been the complete omission of health status outcomes. After an acute MI, over 90% of patients survive, and the most relevant considerations to these survivors are their symptoms, function, and quality of life. While substantial differences in the use of angiography and revascularization may exist, the primary purpose of these procedures is to improve long-term symptom control and quality of life (excluding primary revascularization with PCI, where a survival advantage may exist [21]). This is the first study to report the health status outcomes of a consecutive cohort of ACS patients to determine the influence of racial differences in treatment on these critically important outcomes.

In light of the substantial data documenting differences in the use of angiography and revascularization between white and black patients, we anticipated that this would account for most of the observed differences in health status outcomes. Surprisingly, adjusting for in-hospital treatment did not eradicate the racial differences in health status outcomes. While adjustment for in-hospital revascularization removed the statistically significant association of race and the presence of angina at one year, the effect sizes in the unadjusted and fully adjusted models were quite similar. In fact, larger studies may identify a persistent statistically significant difference. Furthermore, the important differences in quality of life and physical function were not eliminated by adjustment for the use of revascularization. These insights suggest that other factors in the care of patients between discharge and one year may be responsible for this disparity in outcome. Recently scientists have clearly articulated the challenges in the conduct of clinical research of racial variations (22,23); thus, we are cautious in ascribing our observed differences to race alone. Because many factors contribute to one-year health status apart from patients' clinical characteristics and hospital care, and now that we have documented the presence of important disparities, future investigations will need to examine outpatient treatments, compliance with antianginal medications, and biologic (e.g., genetic and metabolic) mechanisms that might affect these outcomes.

The principal limitation of this study is that it represents the experience of only two Kansas City hospitals. However, in light of these findings, important justification for examining the influence of race on health status outcomes from a more nationally representative population exists because differences in care patterns at other settings may alter the prevalence of angina after an ACS and the impact of these symptoms on patients' health status. A second concern is that 144 of our patients were lost to follow-up. Our propensity analyses suggest, however, that no significant bias exists in our estimates of the racial differences in outcome. Finally, we only followed patients for one year.

Longer-term studies would be a valuable complement to this work.

In conclusion, we have observed significant racial differences in health status outcomes after treatment for an ACS. More research is needed to better understand these differences and should specifically include an examination of the outpatient processes of care as well as biologic determinants (metabolic and genetic) of outcome. In the meantime, greater surveillance of the health status of black patients appears warranted so that those who are symptomatic, physically limited, or suffering a significant impairment in their quality of life can be identified and reevaluated for further treatment options.

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