Survival Advantage of Black Patients with Kidney Disease after Acute Myocardial Infarction

Britt B. Newsome,*†‡‡‡ William M. McClellan,*‡‡‡ Christopher S. Coffey,‖ Jeroan J. Allison,*†‡¶ Catarina I. Kiefe,*§ and David G. Warnock‡††

*Center for Outcomes Effectiveness Research and Education, Divisions of †Preventive Medicine, ‡Renal Outcomes Research and Epidemiology Section, †Nephrology, and §General Internal Medicine, Department of Medicine, ‖Department of Biostatistics, School of Public Health, and ‡‡‡Birmingham Veterans Affairs Medical Center, University of Alabama at Birmingham, Birmingham, Alabama; and **Renal Division, Department of Medicine, Emory University School of Medicine, Atlanta, Georgia

Black individuals have a disproportionate incidence of ESRD when compared with white individuals, and among patients with ESRD, black patients experience better survival. The aim of this analysis is to assess, in a nationally representative sample of patients with cardiovascular disease, ethnic differences in survival among predialysis patients with kidney disease. A retrospective cohort analysis was conducted of Cooperative Cardiovascular Project data of Medicare patients who were aged >65 yr and admitted for incident acute myocardial infarction and had 3 yr of mortality follow-up. Cox regression models and Kaplan Meier estimates were performed to examine differences in survival between black and white patients stratified by severity of kidney disease. Of 57,942 patients, 7.3% were black. Black patients were younger and more likely to be female and were less likely to have decreased kidney function. A significant interaction between race and kidney function existed with respect to mortality among patients who survived to discharge. The adjusted hazard ratios for death, black compared with white patients, were 1.00 (95% confidence interval 0.90 to 1.11) among patients with a GFR ≥60 ml/min per 1.73 m² and decreased monotonically among patients with lower GFR to 0.79 (95% confidence interval 0.61 to 0.97) among patients with a GFR 15 to 29 ml/min per 1.73 m². Among patients with incident acute myocardial infarction, black patients with more severe kidney disease, when compared with their white counterparts, experience better survival. Further investigation into the reasons for ethnic differences in survival and progression of kidney disease is warranted.


N ational estimates demonstrate that a racial “dialysis paradox” exists: Black individuals in the United States have a disproportionate incidence of ESRD when compared with white individuals (1,2) despite a lower prevalence of predialysis kidney disease (3–5). This racial difference in incident ESRD and prevalent predialysis kidney function may be explained by more rapid deterioration of kidney function among black individuals with predialysis kidney disease (3,6,7). An additional hypothesis suggests that black patients with predialysis kidney disease may experience better survival when compared with white patients and therefore may be more likely to reach ESRD (8).

Cardiovascular disease (CVD) is the leading cause of death among patients who are on dialysis (9), and among patients with predialysis kidney disease, the severity of renal dysfunction has a direct relationship with excess mortality after acute myocardial infarction (AMI) (10,11). Many patients with kidney disease, therefore, will die of CVD before reaching ESRD. Racial differences in CVD mortality may contribute to observed CVD burden among patients with ESRD: Black patients with incident ESRD have been shown consistently to have a lower prevalence of CVD than white patients (12,13). An explanatory hypothesis for this observation is that black patients with CVD may experience worse survival than white patients and therefore be less likely to reach ESRD. The aim of this analysis is to assess, in a nationally representative sample of elderly patients, the influence of reduced kidney function on black–white differences in survival among predialysis patients with incident AMI.

Materials and Methods

Patient Population and Data Collection

The Cooperative Cardiovascular Project (CCP) was a quality improvement project sponsored by the Health Care Financing Administration (currently Centers for Medicaid and Medicare Services) to improve the care of patients who are hospitalized with AMI (14,15). The original CCP analytic data set contained 234,754 separate hospital admissions for 210,981 individual patients who were randomly selected Medicare beneficiaries from all 50 states who were hospitalized for

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Published online ahead of print. Publication date available at www.cjasn.org.

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Address correspondence to: Dr. Britt B. Newsome, 1530 3rd Avenue South, Mount 401E2, Birmingham, AL 35294-0007. Phone: 205-996-2186; Fax: 205-996-6465; E-mail: bnewsome@uab.edu

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ISSN: 1555-9041/105-0993
AMI between February 1994 and July 1995 (16). Hospital bills (UB-92 Clams Form Data) in the Medicare National Claims History File were used to identify eligible patients. Patients with an *International Classification of Diseases, Ninth Revision, Clinical Modification* (17) principal discharge diagnosis code of 410 (AMI) were sampled from 6684 hospitals, comprising virtually all acute care hospitals in the United States. Data from hospital charts were abstracted by trained abstractors at a central location with extensive data quality monitoring (16).

**Exclusions**

We used only the first hospitalization during the study period for each patient (the index hospitalization) and excluded interhospital transfers because of the potential for incomplete reporting during the initial and subsequent hospitalizations. The analytic data set that was used in this study was derived from the original CCP analytic data set, which contained 234,754 separate hospital admissions for 210,981 individual patients, using the following exclusion criteria, many of which we based on previous analyses using the CCP (18–20): AMI not confirmed by clinical criteria \((n = 29,885)\), age \(<65\) yr \((n = 17,591)\), transferred to an index hospital \((n = 39,025)\), transferred from an index hospital within 24 h of admission \((n = 42,176)\), ethnicity other than black or white \((n = 9007)\), and missing or invalid data \((n = 14,660)\). We also excluded patients with previous coronary artery bypass grafting (CABG) or myocardial infarction \((n = 86,514)\) to avoid any potential survival bias related to previous coronary artery disease (21,22). Because the focus of this analysis was racial differences among pre-ESRD patients, we excluded patients who met the National Kidney Foundation Kidney Disease Outcomes Quality Initiative criteria for kidney failure (stage 5 kidney disease), which included patients with an estimated GFR \(\leq 15\) ml/min per 1.73 m\(^2\) \((n = 14,088)\) as well as those who received either peritoneal dialysis or hemodialysis during hospitalization \((n = 3058)\).

**Study Variables**

The racial designation that was used for this study was taken from direct chart review, the validity of which within the CCP was described previously (20). Clinical criteria listed by Marciniak et al. (16) were used to confirm patients as having AMI and included a creatinine kinase-MB fraction >0.05, a lactate dehydrogenase (LDH) level exceeding 1.5 times the upper limit of normal with LDH1 greater than LDH2, or two of the following conditions: Chest pain, a two-fold elevation of creatinine fraction to confirm patients as having AMI and included a creatinine kinase-MB fraction above 5 times the upper limit of normal, hypotension, and previous stroke (Table 1). Black patients were more ill upon presentation: A greater percentage had cardiac arrest, higher average APACHE II score, and anemia. As reported in previous studies, black patients were less likely to receive reperfusion during hospitalization and \(\beta\) blocker and angiotensin-converting enzyme inhibitor at discharge (20).

Compared with white patients, black patients had a higher average serum creatinine level and GFR at presentation (Table 2); however, a greater percentage of black patients had preserved renal function as defined by GFR >60 ml/min per 1.73 m\(^2\) (66.9 *versus* 61.1%; *P* < 0.0001). Black patients were less likely to have mild (16.3 *versus* 22.5%; *P* < 0.0001) or moderately (10.8 *versus* 11.9%; *P* < 0.0001) reduced GFR. However, more black than white patients had a GFR from 15 to 29 ml/min per 1.73 m\(^2\) (6.1 *versus* 4.5%; *P* < 0.0001).

**Mortality**

The unadjusted Kaplan-Meier curves illustrate the interaction between race/ethnicity and renal function (Figure 1). Within the two best categories of renal function, unadjusted posthospital discharge mortality at 3 yr was greater for black patients compared with white patients within the two best categories of kidney function. However, within the two worst categories of renal function, survival was more favorable for black patients.

After adjustment, the overall black *versus* white risk for death was 0.95 (95% confidence interval [CI] 0.87 to 1.03). There was a significant interaction of borderline statistical significance (*P* = 0.04) between race and kidney function with respect to 3-yr mortality (Figure 2). The black *versus* white hazard ratio for mortality decreased monotonically from 1.00 (95% CI 0.90 to 1.11) among patients with a GFR \(\geq 60\) ml/min per 1.73 m\(^2\) to 0.79 (95% CI 0.61 to 0.97) among patients with a GFR from 15 to 30 ml/min per 1.73 m\(^2\). Covariates that violated the propor-
tionality assumption were race, receipt of reperfusion during hospitalization, and receipt of angiotensin-converting enzyme inhibitor upon discharge.

**Discussion**

We found that within a nationally representative population of elderly patients after AMI, black patients were more likely to have preserved kidney function and less likely to have mild to moderate kidney dysfunction. In addition, although the overall risk for death after hospital discharge was not significantly associated with race, the presence of reduced GFR affected this relationship, with white patients having a survival advantage for the two best categories of kidney function and black patients having a survival advantage for the two worst categories.

### Table 1. Patient characteristics by race, CCP, 1994 to 1995a

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Black ( n = 4,226 )</th>
<th>White ( n = 53,716 )</th>
<th>All ( N = 57,942 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (average [SD])</td>
<td>76.1 (7.7)b</td>
<td>77.3 (7.6)</td>
<td>77.2 (7.6)</td>
</tr>
<tr>
<td>Female gender (%)</td>
<td>59.4c</td>
<td>54.1</td>
<td>54.5</td>
</tr>
<tr>
<td>Smoker</td>
<td>19.5c</td>
<td>15.0</td>
<td>15.3</td>
</tr>
<tr>
<td>Medical history (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diabetes</td>
<td>37.4c</td>
<td>25.9</td>
<td>26.7</td>
</tr>
<tr>
<td>hypertension</td>
<td>77.3c</td>
<td>59.7</td>
<td>61.0</td>
</tr>
<tr>
<td>CHF</td>
<td>20.8c</td>
<td>15.9</td>
<td>16.2</td>
</tr>
<tr>
<td>stroke</td>
<td>16.5c</td>
<td>12.1</td>
<td>12.5</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hematocrit (average [SD])</td>
<td>38.4 (5.7)b</td>
<td>40.3 (5.6)</td>
<td>40.1 (5.6)</td>
</tr>
<tr>
<td>Initial presentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac arrest (%)</td>
<td>2.2</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>APACHE II score (average [SD])</td>
<td>9.9 (4.5)b</td>
<td>9.2 (4.1)</td>
<td>9.2 (4.1)</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reperfusion during hospitalization</td>
<td>15.7c</td>
<td>23.3</td>
<td>22.8</td>
</tr>
<tr>
<td>aspirin prescribed at discharge</td>
<td>66.4</td>
<td>67.4</td>
<td>67.3</td>
</tr>
<tr>
<td>β blocker prescribed at discharge</td>
<td>34.4c</td>
<td>38.5</td>
<td>38.2</td>
</tr>
<tr>
<td>ACE inhibitor prescribed at discharge</td>
<td>36.4c</td>
<td>31.6</td>
<td>32.0</td>
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<tr>
<td>Hospital technology index (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>level 0</td>
<td>29.8c</td>
<td>33.3</td>
<td>33.0</td>
</tr>
<tr>
<td>level 1</td>
<td>17.1</td>
<td>17.5</td>
<td>17.5</td>
</tr>
<tr>
<td>level 2</td>
<td>5.6c</td>
<td>4.3</td>
<td>4.4</td>
</tr>
<tr>
<td>level 3</td>
<td>40.9</td>
<td>39.9</td>
<td>40.0</td>
</tr>
</tbody>
</table>

aACE, angiotensin-converting enzyme; APACHE, Acute Physiology and Chronic Health Evaluation; CHF, congestive heart failure; CCP, Cooperative Cardiovascular Project.

b\( P < 0.0001 \) according to \( t \) test.

c\( P < 0.0001 \) according to \( \chi^2 \) test.

d\( P < 0.04 \) according to \( \chi^2 \) test.

### Table 2. Baseline kidney function by race, CCP, 1994 to 1995a

<table>
<thead>
<tr>
<th></th>
<th>Black ( n = 4,226 )</th>
<th>White ( n = 53,716 )</th>
<th>All ( N = 57,942 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine (mg/dl; average [SD])</td>
<td>1.37 (0.63)c</td>
<td>1.21 (0.47)</td>
<td>1.22 (0.5)</td>
</tr>
<tr>
<td>GFR(^b) (ml/min per 1.73 m(^2); average [SD])</td>
<td>73.8 (30.9)c</td>
<td>68.0 (24.8)</td>
<td>68.4 (25.4)</td>
</tr>
<tr>
<td>K/DOQI strata (ml/min per 1.73 m(^2); %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFR ≥ 60</td>
<td>66.9d</td>
<td>61.1</td>
<td>61.5</td>
</tr>
<tr>
<td>GFR 45 to 59</td>
<td>16.3d</td>
<td>22.5</td>
<td>22.1</td>
</tr>
<tr>
<td>GFR 30 to 44</td>
<td>10.8e</td>
<td>11.9</td>
<td>11.8</td>
</tr>
<tr>
<td>GFR 15 to 29</td>
<td>6.1d</td>
<td>4.5</td>
<td>4.6</td>
</tr>
</tbody>
</table>

\(^a\)K/DOQI, Kidney Disease Outcomes Quality Initiative.

\(^b\)As measured by the Modification of Diet in Renal Disease equation.

\(^c\)\( P < 0.0001 \) according to \( t \) test.

\(^d\)\( P < 0.0001 \) according to \( \chi^2 \) test.

\(^e\)\( P < 0.04 \) according to \( \chi^2 \) test.
Previously, the black dialysis paradox, or the finding of greater incident end-stage kidney disease and less prevalent mild to moderate kidney dysfunction, has been explained by risk factor differences, societal factors, and differences in susceptibility to kidney disease, suggesting more rapid progression of predialysis kidney disease among black individuals (3,6,7). One potential alternative explanation for the black dialysis paradox is that a survivor effect exists, such that black individuals may be more likely to survive to reach ESRD, as a result, in part, of better survival in the predialysis state. This hypothesis is consistent with the observation that among patients with ESRD, black patients exhibit better survival than do white patients (28–32). Although we saw no racial differences in survival in the absence of stratification, this analysis demonstrates that the preferential survival of black patients with ESRD also is observed among patients with less severe kidney disease, specifically in this study, patients with a GFR 15 to 29 ml/min per 1.73 m². Although the modest racial differences in survival as affected by kidney function observed here may be contributory, it is unlikely that they can account entirely for the almost four-fold risk for ESRD observed among black patients (1,33).

The reasons for better survival of black patients with kidney disease described here are unknown. These results may reflect racial differences in prehospital mortality: Black patients with kidney disease may experience higher mortality before hospital admission as a result of inadequate access to medical care or insufficient knowledge of the symptoms of myocardial infarction (34). A “selection bias” therefore may result, and black patients who survive to the point of hospital presentation actually may be less ill than their white counterparts. This explanation is less likely because our analysis provides extensive adjustment for disease severity at presentation, including Acute Physiology and Chronic Health Evaluation (APACHE) II score and cardiac arrest; more important, such an explanation of the interaction between race and kidney function would require that level of kidney function also affect any existing racial
differences in prehospital mortality. Another explanation for our findings may be that black individuals tolerate the deleterious effects of renal failure better than do white individuals. This hypothesis is supported by better survival of black patients with ESRD, which has been described (28,35).

To our knowledge, no previous work has found that black patients with kidney disease after AMI experience better survival than white patients. Manjunath et al. (36) reported an interaction trend \( P = 0.08 \) for GFR and race in predicting mortality for participants in the Atherosclerosis Risk in Communities (ARIC) cohort (a regional sample of patients aged 45 to 64 yr). Black patients experienced worse outcomes in the presence of more severe kidney disease during 8 yr of follow-up. The analysis presented here differs by using nationally representative data, by examining all-cause mortality among patients who were older than 65 yr after the specific event of myocardial infarction, and by including shorter follow-up. Similar to this study, an analysis of patients who were admitted to the hospital with congestive heart failure demonstrated better 1-yr survival among black patients with worse kidney function (8). Our analysis with approximately 3 yr of follow-up demonstrates that better survival among black patients with kidney disease is not unique only to patients with heart failure but can be extended to patients with coronary artery disease as well. Further analyses among various patient populations is merited, and, notably, Weiner et al. (37) described worse survival for black patient with kidney disease within a sample of younger patients without the uniform CVD present in the CCP.

Most studies that have compared racial differences in survival after myocardial infarction have done so without stratification by kidney function and have demonstrated equivalent short-term mortality between the two ethnic groups but worse overall long-term mortality among black patients. Maynard et al. (38), in an analysis of the Myocardial Infarction Triage and Intervention Registry (MITI), and Roig et al. (39), using data from the National Hospital Discharge Survey, found no significant difference in inpatient hospital mortality between blacks and white patients. Previous analyses of the CCP have demonstrated better short-term survival among black patients, as reflected in our analysis (19). Both Tofler et al. (40) and Haywood (41) have demonstrated higher postdischarge mortality among black patients after AMI.

The finding of a lower prevalence of decreased kidney function among black patients observed in this nationally representative population reflects racial differences in prevalence estimates described in previous analyses of population-based national samples. According to analyses of the National Health and Nutrition Examination Surveys, black individuals were actually more likely than white individuals to have preserved kidney function, exhibiting higher mean estimated GFR (90.8 \textit{versus} 87.8 ml/min per 1.73 m\(^2\)) and lower odds for reduced GFR (4,5). The results described in this study bolster confidence in these previous national estimates of racial differences in prevalence of decreased kidney function.

Our results also provide further insight into racial differences in prevalent CVD among patients with ESRD. Stack et al. (12) noted that, among incident patients with ESRD, the adjusted prevalence of coronary artery disease was 43 and 37% for white and black patients, respectively. Similar patterns of CVD prevalence have been observed among participants in the Hemodialysis (HEMO) Study as well as the US Renal Data System (13,29). The results presented here suggest that the lower prevalence of CVD among black patients with ESRD cannot be explained by preferential survival of white patients with concomitant kidney disease and CVD.

Our study has a number of limitations that should be addressed. First, the CCP data are approximately 10 yr old; this attribute is of minimal significance in the context of an epidemiologic analysis such as ours, in which the relationships under study are unlikely to have changed in the time elapsed since the data’s inception. Second, this is a retrospective analysis of previously existing data, and, as a result, the findings are hypothesis generating, do not establish a causal relationship, and are subject to unmeasured bias. The CCP, however, provides the opportunity for extensive adjustment of demographic and clinical covariates, minimizing the risk for unmeasured bias. Third, our analysis is based on a serum creatinine level collected at the beginning of a hospital admission and may reflect, in part, the influence of the patient’s acute presentation on these serologic parameters. However, we adjust for the severity of hospital presentation in the multivariate models to help account for the effects of disease acuity on serum creatinine level. Fourth, we are unable to provide calibration of serum creatinine to the laboratory that developed the equation (42). In our analysis, we would expect this limitation not to be related systematically to race and therefore would result in attenuation of the risk estimates toward the null. Fifth, we did not have access to measures of socioeconomic status, such as income or education, which might have influenced access to medical care or survival after discharge, and we expect that the influence of lower socioeconomic status among black patients would have attenuated the black survival advantage that we observed.

**Conclusion**

In a nationally representative data set of patients with AMI, black patients are more likely to have preserved kidney function. Furthermore, black patients with worse kidney function, when compared with their white counterparts, experience better survival. These findings are provocative given the higher ESRD incidence among black individuals within the general population as well as the lower prevalence of CVD among black patients with ESRD. Further investigation into the reasons for racial differences in survival and progression of kidney disease are urgently needed given the high morbidity and mortality of this condition.

**Acknowledgments**

The analyses on which this article is based were performed under contract 500-02-AL02, Utilization and Quality Control Peer Review Organization for the State (Commonwealth) of Alabama, sponsored by the Centers for Medicare and Medicaid Services, Department of Health and Human Services. This article is a direct result of the Health Care Quality Improvement Program initiated by the Centers for Medicare
and Medicaid Services, which has encouraged identification of quality improvement projects derived from analysis of patterns of care, and therefore required no special funding on the part of this contractor.

A version of the results discussed here was presented in abstract form at the Southern Society for Clinical Investigation; New Orleans, LA; February 22, 2005.

References


27. Iron deficiency anemia. WHO Tech Rep Ser 182: 4, 1959


Factors occurring in utero may foretell racial differences in cardiovascular disease mortality such as those reported by Newsome *et al.* See the editorial by Powe in this issue of CJASN (pp. 905–906), as well as the report by Hemachandra *et al.* (pp. 2577–2582) and the editorial by Bagby (pp. 2356–2358) in this month’s JASN.