Effect of Race on Survival Following In-hospital Cardiopulmonary Resuscitation

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Background. Race has been shown to be a significant predictive factor in a number of treatment decisions and outcomes, including survival following out-of-hospital cardiopulmonary resuscitation (CPR). The goal of this study was to determine whether race is associated with the rate of survival to discharge following in-hospital CPR.

Methods. Consecutive adult patients undergoing attempted CPR at three teaching hospitals were identified. Demographic, clinical, and laboratory data from the time of admission, information about the resuscitation attempt, and the outcome of CPR were recorded for each patient. The characteristics of black and nonblack patients were compared. Logistic regression was used to determine whether race was a significant independent predictor of CPR outcome.

Results. A total of 656 patients were identified. Black patients had a higher mean severity of illness as measured by the Acute Physiology and Chronic Health Evaluation (APACHE) III score, were more likely to have an initial rhythm of electromechanical dissociation or asystole, were less likely to have an admitting diagnosis of myocardial infarction or a history of coronary artery disease, and had a higher serum creatinine level, lower serum albumin value, and lower 24-hour urine output for the first 24 hours. There was no difference between black and nonblack patients regarding the rate of survival of the resuscitative effort itself. However, black patients were significantly less likely than nonblack patients to survive to discharge following resuscitation (Mantel-Haenszel odds ratio, 0.31; 95% confidence interval, 0.15 to 0.68). This relationship persisted after adjusting for potential confounders such as age, sex, initial cardiac rhythm, diagnosis of pneumonia, serum creatinine level, hospital, and APACHE III score.

Conclusions. Black race is significantly associated with a lower rate of survival to discharge following in-hospital CPR. Further work is needed to explore this association in other settings; to examine the effect of other possible confounding variables, such as tobacco use, socioeconomic status, and marital status; and to further study the determinants of physician decision-making about resuscitation.

Key words. Race; resuscitation; cardiopulmonary resuscitation; survival. (*J Fam Pract 1995; 40:571-577*)

Previous studies have described the effect of a number of variables on the rate of survival to discharge following in-hospital cardiopulmonary resuscitation (CPR).[1–5] While four studies have examined the relationship between race and survival following out-of-hospital CPR,[6–9] the relationship between race and in-hospital CPR has not been characterized. Two of four studies of out-of-hospital CPR did not find a significant relationship between race and survival to discharge,[6,7] although one of these had an inadequate sample size.[6] The two largest and most recent studies found that black patients who undergo out-of-hospital CPR are significantly less likely than white patients to survive both to hospital admission and to hospital discharge.[8,9]

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Race has been found to be a significant predictive factor in a number of other treatment decisions and outcomes. For example, black women with advanced stages of breast cancer are less likely to undergo surgery.[10] Black patients are also less likely to undergo coronary bypass graft surgery than white patients,[11] and long-term survival among blacks following acute myocardial infarction is lower than that among whites in some populations.[12,13] Finally, nonwhite patients are only one half as likely to receive renal transplantation as white patients of the same age and sex.[14]

A number of explanations for these discrepancies in treatment and outcome have been proposed. A lower average level of education could result in less informed decision-making, less trust in the medical system, and less willingness to undergo procedures perceived as risky or invasive.[14] Differences in socioeconomic status could reduce a patient's access to care, reduce the likelihood of admission to the hospital, and increase the chance of receiving inadequate care.[11] In addition, the possibility that black patients are treated differently solely on the basis of race cannot be disregarded.[14]

The relationship between race and the rate of survival to discharge following in-hospital CPR has not been previously studied, perhaps partly because of a lack of access to racially diverse patient populations. In addition, studies in the prehospital setting have not been able to control for differences in patient morbidity, diagnosis, and severity of illness before cardiac arrest. The purpose of this study was to determine whether the race of the patient (black or nonblack) is an independent predictor of survival to discharge following in-hospital CPR.

Methods

Patients who underwent in-hospital CPR during the period from April 1990 through June 1993 (hospital A) and from April 1990 through June 1992 (hospitals B and C) were identified from each institution's log of cardiopulmonary arrests. These lists were supplemented by an additional search of all patients with a discharge diagnosis of cardiac arrest or CPR. Patients were excluded if the use of chest compressions, artificial ventilation or rescue breathing, or cardiac medications were not documented. Patients who were resuscitated in the operating room were excluded, as were patients whose only episode of resuscitation occurred in the hospital emergency department. If a patient was resuscitated in the emergency department, stablized, admitted, and then underwent resuscitation as an inpatient, the latter effort was included in the study population.

Hospital A is an urban trauma center, hospital B is an urban teaching hospital, and hospital C is a university hospital. Each hospital has 24-hour coverage by house staff physicians, attending emergency department physician(s), and anesthesiologist(s). All house staff, emergency department physicians, and attending anesthesiologists have received training in advanced cardiac life support. Because of these similarities, the similar time frame for data collection, and data abstraction techniques that were identical to as great a degree as possible, data from the three institutions were aggregated. Doing so increased both the statistical power of the study and its external validity.

A research assistant reviewed each medical record and abstracted the following demographic information: age, race, sex, date of admission, length of stay, and discharge disposition. The research assistants who abstracted data were a senior nursing student (hospitals A and B) and two physicians in the division of critical care medicine (hospital C). All three were trained by one of the investigators, and the accuracy of review for the initial 10 charts was compared with the investigator's review of the same charts.

The following data were recorded from the day of the initial resuscitation attempt: site of the attempt, initial cardiac rhythm during that attempt, whether the patient survived the attempt itself long enough to be stabilized, length of the resuscitative attempt, and whether the patient survived to discharge. This information was usually available on a special form that was routinely used at each institution to document the events of each resuscitative effort and that subsequently became part of each patient's medical record. In the event that a patient underwent resuscitation more than one time, only the initial effort was used in this analysis.

The presence or absence of an admitting diagnosis of acute myocardial infarction or pneumonia, or a history of cerebrovascular accident within the most recent month, was recorded. In addition, based on the patient's history, physical examination, or admission note, evidence of the following conditions was noted: congestive heart failure, coronary artery disease, acquired immune deficiency syndrome (AIDS), immunosuppression, nonmetastatic malignancy, metastatic malignancy, cirrhosis, or use of dialysis on the day of admission. (The Appendix contains detailed definitions of the these conditions.) Sepsis with fever was defined as clinical evidence suggestive of infection, plus tachypnea (>20 breaths per minute), tachycardia (>90 beats per minute), and either hyperthermia (>38.4°C) or hypothermia (<35.6°C). Using this definition of sepsis, positive blood cultures are not required. Since the former definition may not be appropriate for older patients, sepsis without fever was defined as above excluding the abnormal body temperature criterion.

If obtained within the first 24 hours of admission, the following clinical and laboratory information was recorded: serum albumin, total bilirubin, blood urea nitrogen, creatinine, and glucose levels; hematocrit and white blood count; presence or absence of a third cardiac sound, urine output for the first 24 hours; and vital signs. If one or more arterial blood gas studies were performed within the first 24 hours, the results of the first one were recorded, along with whether the patient was endotracheally intubated at the time the blood gas was obtained. The rhythm identified at the beginning of the resuscitative effort also was recorded.

The Acute Physiology and Chronic Health Evaluation (APACHE) III score,[1] a measure of illness severity, was calculated for each patient based on the above data. A dichotomous variable was created to distinguish patients who had been resuscitated in the intensive care unit, a monitored bed, or a procedure room, from those resuscitated in a general hospital ward. Another dichotomous variable was created so that patients could be categorized as either black (African American) or nonblack (white, Asian American, or Hispanic). Finally, a dichotomous variable was created to divide patients into high-risk (asystole or electromechanical dissociation) and low-risk (ventricular fibrillation, ventricular tachycardia, bradycardia or other) rhythm groups.

Statistical Methods

Descriptive and univariate statistics were analyzed using SAS for Windows, version 6.08 (SAS Institute, Cary, NC). Normality of continuous variables was assessed using normal probability plots. Black and nonblack patient groups were compared using odds ratios with 95% confidence intervals for dichotomous variables, Student's *t* test for normally distributed continuous variables, and the Mann-Whitney *U* test for non-normally distributed continuous variables. Using the Bonferroni correction for multiple comparisons, and considering that the independent variables were partially correlated, $P=.005$ was chosen as an appropriate level of significance for univariate comparisons.

The percentages of black and nonblack patient groups surviving to discharge were compared using odds ratios for individual hospitals, and the Mantel-Haenszel statistic was used to combine data from the three hospitals studied. Multivariate relative-risk estimates approximated as odds ratios were calculated using unconditional logistic regression with the EGRET statistical package (Statistics and Epidemiologic Research Corporation, Seattle, Wash). The regression adjusted for possible confounders and the effect of race, using survival to hospital discharge as the outcome, and black compared with nonblack race as the main effect.

Variables were considered as possible confounders if they were associated with both the outcome and main effect, based on an examination of the univariate statistics and previous work in the literature. For example, while cancer and metastatic cancer are strongly associated with survival to discharge in the literature, the distribution of these diagnoses did not differ between black and nonblack patients, and this variable was not considered as a possible confounder. On the other hand, the presence of an unfavorable initial cardiac rhythm was associated with both survival to discharge and race in this study, and therefore was considered a possible confounder.

Results

Patient Characteristics and Prearrest Variables

A total of 656 patients were identified at the three participating institutions (398 black, 250 white, 5 Hispanic, and 3 Asian). Demographic and laboratory characteristics of the black and nonblack patient groups are compared in Table 1. Univariate analyses revealed that black patients were less likely to have an admitting diagnosis of myocardial infarction, less likely to have a history of coronary artery disease identified, and also had a higher serum creatinine clearance, a lower serum albumin level, and a lower urine output for the first 24 hours. Black patients also had a higher mean APACHE III score, consistent with a greater severity of illness, than did nonblack patients.

Arrest Characteristics

Characteristics of the initial resuscitative effort by patient race are shown in Table 2. Black patients were more likely to have an initial rhythm of asystole or electromechanical dissociation. Although there was a trend for fewer black patients to be resuscitated while in a monitored bed and for black patients to have a shorter duration of hospitalization after a successful initial resuscitation, these differences did not achieve statistical significance after correcting for multiple comparisons. There was no significant difference between black and nonblack patients with respect to the hospital day on which the first resuscitation effort took place or the length in minutes of the resuscitative effort.

The total number of patients who died, and their breakdown by race, was determined for hospital B for 1991. Of 568 black patients who died during that year, 118 (20.8%) underwent CPR, while of 190 white, Hispanic, and Asian American patients who died, 42 (22.1%)

Table 1. Characteristics of the Black and Nonblack Patient Groups

Patient Characteristics	Black Patients (n=398)	Nonblack Patients (n=258)	Odds Ratio (95% CI)	*P* Value*
Demographics				
Age, y	61	64	NA	.03†
Male, %	55	61	0.76 (0.55–1.04)	.09‡
Nursing home resident, %	10	12	0.77 (0.47–1.28)	.31‡
Admitting diagnoses, %§				
Myocardial infarction	4	15	0.22 (0.12–0.39)	<.001‡
Pneumonia	15	10	1.61 (0.99–2.62)	.05‡
Diagnoses and comorbidities, %§				
Sepsis with elevated temperature	8	6	1.25 (0.66–2.35)	.49‡
Sepsis without elevated temperature	19	12	1.63 (1.04–2.54)	.03‡
Congestive heart failure	24	31	0.72 (0.51–1.02)	.06‡
Coronary artery disease	14	42	0.24 (0.16–0.34)	<.001‡
Cerebrovascular accident	3	2	1.64 (0.51–5.22)	.41‡
Malignancy	14	13	1.07 (0.67–1.70)	.77‡
Metastatic malignancy	6	4	1.44 (0.69–2.99)	.33‡
Dialysis	6	4	1.50 (0.73–3.10)	.27‡
Cirrhosis	5	3	2.0 (0.85–4.70)	.11‡
Immunosuppressed	6	7	0.74 (0.39–1.39)	.34‡
Acquired immune deficiency syndrome	2	<1	4.60 (0.68–31.2)	.12‖
Laboratory and clinical values				
Hematocrit	0.35	0.36	NA	.07†
Serum albumin (g/L)	29.7	32.4	NA	.0001†
Serum creatinine (μmol/L)	201	153	NA	.0005¶
Serum glucose (mmol/L)	10.4	9.4	NA	.12¶
Serum urea nitrogen (mmol/L of urea)	13.2	11.9	NA	.737¶
Urine output in first 24 hours (mL)	1468	2015	NA	.0001¶
White blood count (10^9/L)	13.6	12.3	NA	.33†
Acute Physiology and Chronic Health Evaluation (APACHE) III score	63.7	56.6	NA	.0005†

**Level of significance preset at P=.0005.*
†Student's t test.
‡Pearson chi-square.
§Patients may have more than one comorbidity, and not all admitting diagnoses were categorized. Diagnoses and comorbidities are defined in the Appendix.
‖Fisher's exact test, two-tailed.
¶Mann-Whitney U test.
CI denotes confidence interval; NA, not applicable.

underwent CPR. This difference was not statistically significant.

Overall Survival Rates

The percentage of patients surviving the resuscitation effort long enough to be stabilized was not significantly different between black and nonblack patients. These data are summarized by race and hospital in Table 3. Survival to discharge following CPR, by race and hospital, is shown in Table 4. Overall, black patients were less likely to survive to discharge following CPR than were nonblack patients (Mantel-Haenszel odds ratio [OR], 0.31; 95% confidence interval [CI], 0.15 to 0.68).

Table 2. Characteristics of the Initial Resuscitative Effort, by Patient Race

Characteristic	Black Patients (n=398)	Nonblack Patients (n=258)	Odds Ratio (95% CI)	*P* Value*
Initial rhythm (% asystole or electromechanical dissociation)	51	35	1.89 (1.37–2.61)	<.001†
Site of CPR (% ICU, procedure room, or other monitored bed)	51	59	0.69 (0.51–0.95)	.023†
First resuscitative effort (day of hospitalization)	11	9	NA	.08‡
Survival after first resuscitative effort, d	3	5	NA	.04§
Length of resuscitative effort, min	27	32	NA	.12‡

**Level of significance preset at P=.005.*
†Pearson chi-square.
‡Mann-Whitney U test.
§Student's t test.
CPR denotes cardiopulmonary resuscitation; ICU, intensive care unit; NA, not applicable.

Table 3. Univariate Analyses of Rates of Patients Surviving Long Enough To Be Stabilized Following CPR, by Race and Hospital

Hospital	Patients Surviving CPR: Black No. (%)	Patients Surviving CPR: Nonblack No. (%)	Odds Ratio (95% CI)	*P* Value*
A	59/153 (39)	9/29 (31)	1.40 (0.60–3.27)	.442†
B	77/213 (36)	32/83 (39)	0.90 (0.53–1.52)	.700†
C	9/32 (28)	62/146 (42)	0.53 (0.23–1.22)	.135†
Total	145/398 (36)	103/258 (40)	0.88 (0.59–1.30)	.509‡

**Level of significance preset at P=.005.*
†Pearson chi-square.
‡Mantel-Haenszel statistic.
CPR denotes cardiopulmonary resuscitation; CI, confidence interval.

Logistic Regression Using Survival to Discharge as the Dependent Variable

The difference between the rates of survival to discharge for black and nonblack patients was further investigated using logistic regression. Variables examined as possible confounders or effect modifers were hospital, sex, age, unfavorable initial rhythm, pneumonia as an admitting diagnosis, serum creatinine level, and APACHE III score. Ten cases did not have a serum creatinine measurement and were dropped during analysis of the model containing black race and serum creatinine level as predictors.

Regression using only race as an effect and survival to discharge as the outcome resulted in an odds ratio for survival among black patients of 0.36 (95% CI, 0.18 to 0.73). The addition of age, sex, APACHE III score, pneumonia, or serum creatinine level did not appreciably change this odds ratio. An appreciable change was defined as an increase or decrease in the odds ratio of 10% or more. The addition of hospital to the model reduced the odds ratio to 0.27 (95% CI, 0.12 to 0.62), and the addition of unfavorable initial cardiac rhythm increased it to 0.43 (95% CI, 0.21 to 0.88). A model that included black race, unfavorable initial rhythm, and hospital resulted in a final odds ratio for black race and survival to discharge of 0.30 (95% CI, 0.13 to 0.66). The interaction term "cardiac rhythm × hospital" was examined but did not significantly affect the odds ratio for race and survival to discharge. Thus, black race was significantly and independently associated with a lower rate of survival to discharge, even after adjusting for possible confounding variables.

Table 4. Univariate Analyses of Rates of Patients Surviving to Discharge Following CPR, by Race and Hospital

Hospital	Patients Surviving to Discharge: Black No. (%)	Patients Surviving to Discharge: Nonblack No. (%)	Odds Ratio (95% CI)	*P* Value*
A	9/153 (6)	4/29 (14)	0.39 (0.12–1.32)	.13†
B	2/213 (1)	8/83 (10)	0.09 (0.02–0.32)	.0008†
C	2/32 (6)	10/146 (7)	0.91 (0.19–4.37)	1.0†
Total	13/398 (3)	22/258 (9)	0.31 (0.15–0.68)	.001‡

**Level of significance preset at P=.005.*
†Fisher's exact test, two-tailed.
‡Mantel-Haenszel statistic.
CPR, denotes cardiopulmonary resuscitation; CI, confidence interval.

Discussion

In this study of three teaching hospitals, black race was found to be associated with failure to survive to discharge following in-hospital CPR. This association persisted even after using logistic regression to adjust for possible confounding variables. The finding parallels work done in the prehospital setting,[8,9] although since all patients in the current study were inpatients, differences in ambulance response time, access to telephones, or other community-based factors would not affect the outcome.

It should be noted that there was no significant difference between black and nonblack patients in the rate of success of the resuscitative effort. It follows, therfore, that the difference in survival to discharge is related to medical care occurring after resuscitation. Possible causes for this difference include differences in the intensity of care afforded to black patients; a greater likelihood for black patients to choose do-not-resuscitate (DNR) orders after the initial resuscitative effort; the presence of a greater severity of illness or chronic morbidity not measured by the APACHE III score; and the presence of other confounding variables not measured in this study.

It is unclear why the difference in survival rate by race was statistically significant only in the univariate analysis at hospital B (Table 4). One possible explanation is an insufficient sample size. The number of patients per group needed to detect a difference in survival of 5% is 341 (α=.05, β=.20, one-tailed). Hospital B had both more patients and a more even ratio of black to nonblack patients (226:88) than did either hospital A (155:29) or hospital C (33:152), giving it greater statistical power. For example, one fewer black patient surviving to discharge at hospital C would have halved the percentage of black patients surviving to discharge at that institution.

Although the above data suggest that there is an association between race and survival to discharge after in-hospital CPR, a number of possible confounders of this

association were not measured. One is socioeconomic status; it is possible that race is merely a proxy for the patient's income, employment status, educational level, or other factors. Hallstrom and associates[15] recently described an inverse relationship between socioeconomic status and survival following ventricular fibrillation in a racially homogeneous population. However, even if their findings applied also to our study, it would still be of concern, since it would suggest that care was allocated to patients based on their socioeconomic status.

Measurement of health behaviors or psychosocial factors, or both, also may have helped clarify the relationship between race and severity of illness, the hospital, and survival after CPR. For example, data from the National Health Interview Surveys showed that 1985 smoking rates were higher for blacks than whites (35.6% compared with 29.4%) despite a decline in smoking for both groups.[16] Psychosocial factors have long been observed to have a significant impact on health and mortality. One of the earliest prospective studies, in which nearly 10,000 adult Israeli men were followed from 1963 to 1968, reported that anxiety and family problems were both independent risk factors in subsequent development of angina.[17] For the subgroup of men who reported high anxiety, a positive report of the wife's love and support was found to be protective. Depression has also been associated with a significantly higher mortality rate at 6 months following myocardial infarction.[18]

Marriage, particularly for men, is associated with physical health, psychological well-being, and low mortality, whereas social isolation predicts high subsequent mortality.[19–22] Employment also appears to have positive effects on health. In a study by Davis,[23] those who were not working at baseline had a higher mortality risk than those who were working. Thus, the measurement of these behavioral, psychological, and social factors might have diminished or eliminated the apparent effects of race and might have been more accurate predictors of survival.

Another limitation of the study was the retrospective nature of data collection. This was minimized by using identical criteria for inclusion of patients; using a standardized format for recording information about resuscitative efforts at all three institutions; choosing abstractors who were trained health care providers; giving them adequate instruction and validating their accuracy. Finally, the measure of severity used may not have adequately captured the severity of illness in this population. However, the APACHE III score, which was originally developed using data gathered from a wide variety of patients with respect to age, race, and diagnosis from 42 medical centers, has been well validated.[24]

Conclusions

Black race is an independent predictor of failure to survive to discharge after in-hospital CPR. This important conclusion merits further study, to more closely examine these findings in nonurban populations, to look at the interaction between patient and physician race or ethnicity, to further characterize the relationship between socioeconomic status, race, and survival following CPR, and to search for other possible confounding variables. Finally, the determinants of physician decision-making regarding resuscitation require further study to determine whether physicians are using appropriate criteria when recommending DNR orders to patients or their families.

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Appendix: Definitions Used for the Diagnostic Categories and Comorbidities

Sepsis with fever. Evidence of infection (eg, sputum production or dysuria, not necessarily positive blood culture) and heart rate >90 beats per minute and respiratory rate >20 breaths per minute and either temperature >101.0°F or temperature <96.0°F.

Sepsis without fever. Evidence of infection (eg, sputum production or dysuria, not necessarily positive blood culture), heart rate >90 beats per minute and respiratory rate >20 breaths per minute.

Pneumonia. Admitting diagnosis of pneumonia.

Congestive heart failure (CHF). Diagnosis of moderate to severe CHF (New York Heart Association Class III or IV) based on evidence described in the admitting history and physical examination.

Coronary artery disease. Preexisting diagnosis of stable angina or previous myocardial infarction, or admitting diagnosis of unstable angina or myocardial infarction.

Myocardial infarction. Admitting diagnosis of myocardial infarction; does not include "rule out myocardial infarction" or history of infarction during a previous admission.

Malignancy. Diagnosis of solid or hematologic malignancy (not including basal cell carcinoma of skin or premalignant conditions, such as cervical intraepithelial neoplasia) without evidence of metastasis. Patients with a disease-free interval of 5 years and no evidence of malignancy or its complications were considered free of malignancy.

Metastatic malignancy. Diagnosis of solid tumor as above with evidence of metastatic spread at the time of admission.

Dialysis. Patient receiving hemodialysis or chronic ambulatory peritoneal dialysis at the time of admission.

Immunosuppressed. Immunosuppressive illness (eg, hematologic malignancy, acquired immune deficiency syndrome [AIDS], other immunodeficiency), long-term steroid use, or current chemotherapy or radiation therapy.

Cirrhosis. Patient with diagnosis of hepatic cirrhosis as either admitting diagnosis or a comorbidity at the time of admission.

Cerebrovascular accident. Admitting diagnosis of cerebrovascular accident based on radiologic evidence or physical examination.

AIDS. Known diagnosis of AIDS based on criteria of the Centers for Disease Control and Prevention (ie, infection with human immunodeficiency virus [HIV] and a previous atypical infection or malignancy).