Clinical Study

# The influence of race on outcome following subarachnoid hemorrhage

Brad E. Zacharia [a,*], Bartosz T. Grobelny [a], Ricardo J. Komotar [a], E. Sander Connolly [a], J. Mocco [b]

[a] Department of Neurological Surgery, Columbia University, 710 West 168th Street, New York, New York 10032, USA
[b] Department of Neurosurgery, University of Florida, Gainesville, Florida, USA

## ARTICLE INFO

## ABSTRACT

The goal of this study was to examine the relationship between race and outcome following subarachnoid hemorrhage (SAH). We identified all SAH discharges in New York City during 2003. An adverse outcome was defined as in-hospital death or discharge other than to home. While correcting for age and gender, we examined the effect of race and payor status on outcome following SAH. Forty-four percent of patients with SAH were white. Being white had a significant relationship with outcome when controlled for payor status (odds ratio 0.56). Among self-pay/Medicaid patients, fewer white (52%) individuals suffered poor outcomes than non-white (66%, $p = 0.03$). Our results establish that white patients in New York City with SAH have better outcomes than non-whites. While it is unclear whether this discrepancy is secondary to pathophysiological differences or unidentified social factors, our findings demonstrate that this effect is independent of insurance status, and emphasize the need for further investigation into racial disparities in outcome following SAH.

## 1. Introduction

Subarachnoid hemorrhage (SAH) affects nearly 30,000 individuals each year.[1–3] Although early surgical or endovascular protection of ruptured aneurysms and aggressive postoperative management has improved overall outcomes, it remains a devastating disease, with mortality approaching 50% and less than 60% of survivors eventually returning to functional independence.[1–4]

With the percentage of racial/ethnic minority populations doubling to about 50% by the year 2050, there is an increasing need to understand racial/ethnic disparities in SAH outcome.[5] This relationship has been the focus of numerous prior studies, which drew varied conclusions.[6–10] Epidemiological studies, including a 2001 study by Ayala et al., have demonstrated that the national SAH mortality rate is about 50% higher in African Americans.[6,11] Since the study of Ayala et al. utilized coding from death certificates to determine death rates and risk ratios, it remains unclear whether their findings are the result of a higher incidence of SAH in select populations (i.e. African Americans) or these results are due to worse outcomes following the occurrence of SAH.

Race was not a factor in outcome following SAH for patients who had been recruited into two North American, prospective, randomized, double-blind, placebo-controlled clinical trials of the drug tirilazad mesylate,[12,13] suggesting that an increased incidence in the racial/ethnic subgroups accounted for disparities in SAH

mortality rates.[14] Unfortunately, the source data for this study was collected as part of prospective, randomized, double-blind, placebo-controlled drug trial and may thus be subject to selection bias, and not reflective of the general population. Therefore, to better understand the relationship between race and outcome following SAH, we performed a population-based study examining discharge records for all New York City hospitals in 2003.

## 2. Methods

We analyzed data during 2003 provided by New York State from SPARCS, its statewide database of hospital discharges.[15] The SPARCS data set codes procedures and diagnoses according to the *International Classification of Diseases*, 9th revision (ICD-9),[16] and provides patient demographic information (including race) and discharge destination. Patient discharges with a diagnosis of subarachnoid hemorrhage (ICD-9 430) were selected from the SPARCS data set. Patients were included in the analysis regardless of whether they had a procedure performed on their aneurysm. Initially all races were considered separately, but after initial analysis only the "white" subgroup demonstrated a significant relationship with discharge status, and thus patients were dichotomized as "white" or "non-white" for further analyses. The SPARCS data set is similar to the US Census in that the Hispanic/Latino designation is coded separately as ethnicity. For the purposes of our study, patients identified as Hispanic were included in the non-white category.

An adverse outcome was defined as an in-hospital death or a discharge other than to home. Discharge to a nursing home or

* Corresponding author. Tel.: +1 212 305 4679.
E-mail address: bez2103@columbia.edu (B.E. Zacharia).

**Table 1**
Demographics of patients in New York City during 2003 discharged with a diagnosis of subarachnoid hemorrhage

|  | White | Non-white | Total |
|---|---|---|---|
| N | 445 | 570 | 1015 |
| Age (years) | 58 ± 17[*] | 54 ± 17[*] | 56 ± 17[*] |
| % Female | 65% | 62% | 62% |
| % Poor outcome | 57% | 67% | 63% |

[*] Mean ± standard deviation.

rehabilitation hospital is well correlated with the Modified Rankin Scale score,[17] and this method of dichotomization of outcome based on discharge status is a utilized and accepted technique.[18]

Age, a universally accepted risk factor for outcome following SAH, and gender were evaluated as covariates. Payor data was also evaluated as a possible confounder as reimbursement may not only affect quality of care, but can also provide a surrogate for socioeconomic status. Chi-squared and logistic regression methods were used to study the impact of these demographic variables on outcome following admission for SAH. Models of outcome were constructed using a forward-stepwise multiple logistic regression, including all variables with $p < 0.25$ in a univariate analysis. Significance was set as $p < 0.05$ for all analyses. Any patients with missing data were excluded from multiple logistic regression models that utilized the data they lacked. Additionally, given that 1015 SAH patients are registered in the data set, we found that, with an alpha of 0.05 and a beta of 0.8, our study was able to detect an 8.6% difference in outcome. All statistical analysis was performed using Statistical Analysis System software (Version 9.0; SAS Institute, Cary, NC, USA).

## 3. Results

In New York City during 2003 there were 1015 discharge records for patients with a diagnosis of SAH (Table 1). Forty-four percent of patients were white, and 56% were non-white, including 21% African-American. The mean age of all patients was 56 years (white: 58 versus [vs.] non-white: 54; $p < 0.001$). About 62% of patients were female (white: 65% vs. non-white: 62%, $p = 0.34$). Poor outcomes occurred in 62.4% of patients (white: 57% vs. non-white: 67%, $p = 0.001$). Payor status for 28% of patients was either self-pay or Medicaid (white: 18% vs. non-white: 35%, $p < 0.001$), both of which demonstrate non-commercial insurance status and are typical indicators of lower socioeconomic class.

The impacts of demographic variables including age, gender, ethnicity/race, and payor status on patients' discharge outcome following SAH were analyzed using logistic regression (Table 2). Poor outcome was established as the dependent variable and coded as a binomial response: good outcome (coded as 0) defined as discharge to home, or poor outcome (coded as 1) defined as discharge other than to home (i.e. long-term care facility, rehabilitation hospital, home with health agency care, or in-hospital death).

An initial model using age, gender, and race was utilized to evaluate the contribution of these independent variables to outcome following SAH. Age was a highly significant predictor of outcome

(odds ratio [OR], 95% CI: 1.04, 1.035–1.054) and remained so through all further permutations of analysis. Gender demonstrated no significant relationship with outcome and remained insignificant through all subsequent analyses. White patients, however, were almost half as likely to have a poor outcome (OR, 95% CI: 0.56, 0.34–0.94). No other race demonstrated a significant relationship with discharge status. As being white was the only relevant racial category, we repeated the analysis with patients being dichotomized as white or non-white. Being white maintained its significant relationship with outcome in this more parsimonious model (OR, 95% CI: 0.51, 0.39–0.67).

To control for the possibility that the effect of race was a surrogate for socioeconomic status, and therefore a marker of overall health and a possible modulator of available services/interventions due to payor status, we performed a logistic regression with race and all payor subtypes to see if the association of white race with better outcome was modified. This proved not to be the situation, as being white maintained a significant relationship with outcome, and had minimal reduction in the magnitude of the OR (OR, 95% CI: 0.56, 0.42–0.74). Interestingly, having a health maintenance organization (HMO) provider was the only significant relationship among the insurance subtypes, with HMO patients being half as likely to be discharged with a poor outcome (OR, 95% CI: 0.50, 0.29–0.85). To control for the possibility that the effect of payor status was being diluted among the numerous categories and to segregate them so as to provide a better surrogate for socioeconomic status, we stratified all patients into two payor groups, those patients who were self-pay or had Medicaid and those who had an alternative payor (i.e. commercial insurance or Medicare). Statistical analysis of white versus non-white patients demonstrated that race maintained a significant association with discharge status even when analyzed independently within these two stratified subgroups. Among self-pay/Medicaid patients fewer white individuals suffered poor outcomes (white: 52% vs. non-white: 66%, $p = 0.03$). Within this subset, white patients maintained a 50% lower likelihood of having a poor outcome (OR, 95% CI: 0.49, 0.28–0.86). Furthermore, among commercial insurance/Medicare patients non-white patients still suffered poorer outcomes (white: 58% vs. non-white: 66%, $p < 0.001$). Within this subanalysis of commercial insurance/Medicare patients, white patients continued to demonstrate a significant reduction in the odds of having a poor outcome (OR, 95% CI: 0.54, 0.39–0.74). Finally, a logistic regression model with age, gender, white versus non-white, and self-pay/Medicaid versus commercial/Medicare still resulted in white patients maintaining an almost 50% reduction in the likelihood of a poor outcome (OR, 95% CI: 0.53, 0.40–0.70), while insurance status had no independent effect.

## 4. Discussion

We reviewed hospital discharges coded for SAH from New York State during 2003. We found that being white predisposed to better outcome following SAH when compared to non-white. There have been numerous epidemiological studies of SAH,[8,11,19] but few specifically examining the relationship between race and

**Table 2**
Multiple logistic regression results for patients in New York City during 2003 discharged with a diagnosis of subarachnoid hemorrhage

| Model | Odds ratio |
|---|---|
| Poor outcome as a function of age, gender, and all races | Age – 1.04 White – 0.56 |
| Poor outcome as a function of age, gender, and dichotomized race | White – 0.51 |
| Poor outcome as a function of age, dichotomized race, and all payors | White – 0.56 HMO – 0.50 |
| Poor outcome as a function of age, dichotomized race, and dichotomized payor | White and self-pay – 0.49 White and insured – 0.54 |

HMO = Health maintenance organization.