Greater healthcare utilization and costs among Black persons compared to White persons with aphasia in the North Carolina stroke belt

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1. Introduction

Aphasia, a negative consequence of stroke, occurs in approximately 100,000 individuals annually in the US [1]. The condition is a higher order disturbance of language that results in deficits in communication including: language comprehension, language expression, reading, writing, attention, memory and other cognitive domains requiring treatment by Speech-Language Pathologists (SLPs) [2]. Many persons with aphasia (PWA) experience significant community-based limitations even in its mildest form [3]. In addition, aphasia is an independent predictor of longer hospital stays and poorer overall stroke-related outcomes [4].

Although there is a substantial literature related to aphasia treatment outcomes, less is known about healthcare service utilization and the cost of treating PWA [5]. To date, few studies have considered the complex range of non-clinical economic factors (insurance, availability of services, costs of services, etc.) influencing healthcare utilization and specifically the provision of specialized clinical services. Additionally, the current literature suggests that significant racial-ethnic disparities exist among US Non-Hispanic Blacks (Blacks) compared to Non-Hispanic Whites (Whites) in incidence, initial stroke severity, access to specialized treatments for stroke, access to rehabilitation care, rehabilitation outcomes, and long-term outcomes in the US [6–12].

Whereas these disparities are well established in the stroke literature (the primary cause of aphasia), less is known about whether the same racial disparities exist in aphasia outcomes [13]. Anecdotal evidence in the field of Speech-Language Pathology (SLP) suggests racial disparities exist among PWA, yet few, if any, studies have offered data supported evidence [14,15]. Additionally, little is known about service utilization or cost of treatment among PWA and how this might contribute to suspected racial disparities in outcomes. The objective of this study was to examine healthcare service utilization and costs of treating PWA in the acute care hospitals in the state of North Carolina (NC). NC is
located in the southeastern part of the US “stroke belt” where stroke deaths are significantly higher than the rest of the US [16–17]. In addition, NC has a high number of racial-ethnic minority residents who are subject to the differential negative outcomes of stroke and stroke-related conditions such as aphasia [18]. As a result, understanding the disparities in stroke and stroke-related outcomes are of interest to NC providers and other stakeholders striving to improve care delivery and clinical outcomes.

2. Methods

Data for this study were obtained from the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project State Inpatient Database (HCUP-SID) [19]. The NC HCUP-SID includes longitudinal discharge data from all acute care licensed hospitals, as well as rehabilitation, psychiatric, and substance abuse facilities located in NC. This analysis used 2011 and 2012 discharges of patients who were identified as White or Black. To identify patients with ischemic stroke, International Classification of Diseases and Health Related Problems (ICD-9) codes for stroke and aphasia were used [20]. ICD-9 codes 434.xx, 436.xx were used for ischemic stroke while ICD-9 codes 784.3 and 438.11 were used to identify those with aphasia. Stroke severity was classified using a previously published proxy measure utilizing ICD-9 codes based on the following: (1) mild if no major stroke-related diagnoses (e.g. dysarthria), (2) moderate if one stroke-related diagnosis (excluding hemiplegia), and (3) severe if hemiplegia or two or more other stroke-related diagnoses [5]. We limited the sample to Non-Hispanic Blacks (Blacks) and Non-Hispanic Whites (Whites) because of the limited number of Hispanics and other racial-ethnic categories.

The primary outcomes of this study were length of stay and cost of care. Costs were calculated by multiplying submitted charges by the hospital’s cost-to-charge ratio (CCR). We also computed costs using a hospital group average CCR as a sensitivity analysis [21]. We controlled for five patient age categories (19–44, 45–54, 55–64, 65–74, 75+); gender; primary insurance (Medicare, Medicaid, Private Insurance, Self-pay, and other); stroke severity (Mild, Moderate, and Severe); and the urbanicity of patient counties (Urban with population ≥1 million; Urban-fringe, population ≥1 million; metro population 250,000–999,999; metro population 50,000–249,999; micropolitan, or rural). Overall illness severity was measured using the Charlson index [22]. Additional hospital characteristics were obtained from the Centers for Medicare and Medicaid Services Provider of Service files [23].

2.1. Data analyses

Prior to examining racial differences in the outcomes of interest, baseline comparisons of demographic characteristics were conducted using a t-test for continuous variables and Chi-square for categorical variables. Unadjusted means of length of stay, charges, and costs were calculated for Black and White patients and t-tests were used to test for differences in the means. Adjusted means were computed using generalized linear models (GLM). The analysis of length of stay was modeled using a two-part model. A probit model was used to model the probability of an overnight stay and then a GLM with log link and inverse Gaussian family distribution was used to model the length of stay conditional on length of stay > 0. Total costs were modeled using a GLM with log link and inverse Gaussian family distribution [24]. The distributional assumptions were based on the results of a Modified Park test and Pregibon’s link test [24].

Four separate specifications were estimated to understand the influence of key variables known to influence the outcomes: Model 1 adjusted for patient demographic and residential characteristics; Model 2 added stroke severity & illness severity; and Model 3 added observed hospital characteristics. These observed characteristics included nonprofit status of the hospital, dedicated trauma services, total hospital beds, ICU services, audiology services, and number of speech pathologists at the hospital. Finally, Model 4 included hospital fixed effects to control for unobserved hospital characteristics [25]. We report the association of race and each outcome by computing average marginal effects. Robust standard errors with hospital clustering were computed. All analyses were performed using Stata 14 software [26]. The study was reviewed and approved by the East Carolina University Institutional Review Board (IRB).

3. Results

The total sample of individuals with post-stroke aphasia in NC (2011–2012) was 4331. Seventy percent of the sample was age 65 and older, 55% were female and Medicare was the primary insurance type. Approximately 50% of the sample experienced a stroke that was considered mild and ~40% were considered severe. The largest percentage of the sample (44%) resided in metro areas with populations of 250,000–1 million (see Table 1). Black patients were younger and less likely to have Medicare coverage; however they were more likely to be covered by Medicaid or Self-Pay compared to White patients.

3.1. Hospital length of stay and costs

Table 2 presents the unadjusted mean lengths of stay, total charges, and total costs computed using alternative CCRs of PWA seen in NC hospitals in 2011–2012 for Black and White patients. On average, Blacks with aphasia experienced acute hospital stays that were two days longer than Whites and accumulated ~$9000 in hospital charges which translated into about a $2800 cost difference. The alternative CCR yielded a comparable estimate of the difference in costs of $3509.00.

### Table 1


<table>
<thead>
<tr>
<th>Residence</th>
<th>Total Sample</th>
<th>White</th>
<th>Black</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central counties, metro areas ≥ 1 million</td>
<td>7.07%</td>
<td>6.05%</td>
<td>9.78%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fringe counties of metro areas ≥ 1 million</td>
<td>7.34%</td>
<td>8.09%</td>
<td>5.36%</td>
<td></td>
</tr>
<tr>
<td>Counties in metro areas of 250,000–999,999</td>
<td>44.11%</td>
<td>45.38%</td>
<td>40.73%</td>
<td></td>
</tr>
<tr>
<td>Counties in metro areas of 50,000–249,999</td>
<td>9.20%</td>
<td>7.68%</td>
<td>13.27%</td>
<td></td>
</tr>
<tr>
<td>Micropolitan counties</td>
<td>24.00%</td>
<td>24.27%</td>
<td>23.30%</td>
<td></td>
</tr>
<tr>
<td>Not Metropolitan or Micropolitan counties</td>
<td>8.27%</td>
<td>8.54%</td>
<td>7.57%</td>
<td></td>
</tr>
</tbody>
</table>

Note: Chi square tests used to determine significance.
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