The Role of Ethnicity, Sex, and Language on Delay to Hospital Arrival for Acute Ischemic Stroke

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Background and Purpose—Use of emergency medical services has been shown to decrease transport and triage times for stroke. Mexican Americans and women experience a large stroke burden. The objective of this study was to compare time to hospital arrival and emergency medical services use for stroke care by ethnicity, sex, and language preference among Mexican American and non-Hispanic white ischemic stroke patients.

Methods—The Brain Attack Surveillance in Corpus Christi (BASIC) project is a population-based study in south Texas. All stroke cases were identified by active or passive surveillance and validated by neurologists. Logistic regression models assessing time to hospital arrival and emergency medical services use were analyzed.

Results—There were 1134 ischemic stroke cases ascertained between January 1, 2000, and December 31, 2006. Mexican Americans were less likely than non-Hispanic whites to arrive by emergency medical services (odds ratio, 0.6; 95% CI, 0.4, 0.8). Men were more likely than women to present to the hospital within 3 hours (odds ratio, 0.7; 95% CI, 0.5, 0.9); language was not associated with study outcomes.

Conclusions—Sex and ethnic differences in hospital presentation were found in this community. There is a need to promote an urgent response to stroke symptoms, especially in groups that experience the greatest stroke burden. (Stroke. 2010;41:905-909.)

Key Words: acute stroke ■ epidemiology ■ women and minorities

Stroke is the leading cause of adult disability in the United States and the third leading cause of death.1 Stroke disproportionately affects certain subgroups of the population. Women have a greater lifetime risk of stroke compared with men and also experience worse poststroke outcomes.2,3 In the United States, 62% of stroke deaths occur in women.1 Mexican Americans (MAs) are the largest subgroup of the largest minority population in the United States and have an increased risk of stroke compared with non-Hispanic whites (NHWs), especially at younger ages.4 Prompt medical attention for stroke reduces mortality and the likelihood of permanent disability.5 Recombinant tissue plasminogen activator (tPA) has proven to be effective for reducing poststroke disability but must be administered within 4.5 hours of stroke symptom onset.5,6 It is critical that the time from stroke symptom onset to presentation for medical care be as short as possible.

Longer out-of-hospital delays have been observed for certain subgroups of the population. Women and minorities with stroke average longer time to presentation than men and NHWs.7,8 These differences in time to presentation may be explained partially by differences in mode of transport to medical facilities. Patients who use emergency medical services (EMS) arrive at the hospital more rapidly7–9 and are treated earlier and more urgently than patients who arrive by other modes.7,8 Studies have found that older patients,9 patients with more severe strokes,9 and patients who experience their symptoms in the presence of a bystander or family member7,9 are more likely to arrive by EMS. Among MAs, social factors such as language ability may also influence the timeliness of hospital presentation.

This study examined the associations of time to presentation and mode of hospital transport with ethnicity and sex among MA and NHW ischemic stroke patients in a biethnic population-based stroke study.

Materials and Methods
The Brain Attack Surveillance in Corpus Christi (BASIC) project is a population-based stroke surveillance study conducted in Nueces County, Texas. This community of 325 000 is composed of 56% Hispanics, the majority of whom are MA, and 38% NHWs.10 The majority of MAs are second- and third-generation US citizens.11 Corpus Christi hospitals represent the regional medical center for south Texas and allow for complete case capture of initial cerebrovascular events.

Detailed BASIC methodology has been published previously.4,12 Briefly, cases of potential stroke among patients ≥45 years of age were captured by active and passive surveillance of all hospitals.
Cases were ascertained actively by searching admission logs for a set of validated screening diagnostic codes.12,13 Passive surveillance involved using International Classification of Diseases, 9th Revision, code searches for stroke hospital discharges.13 Board-certified neurologists blinded to ethnicity and age used source documentation to validate each stroke case based on published international criteria.14 An initial National Institutes of Health Stroke Scale (NIHSS) was abstracted retrospectively using a previously validated approach.15

**Time to Presentation**

Time to presentation was dichotomized as <3 hours versus ≥3 hours for the purposes of this analysis. It was recorded for each patient using the time of stroke symptom onset and time of hospital arrival documented in the medical record. If a specific onset time was not recorded, the time was estimated by one of 2 methods based on information available in the chart. This standardized approach was published previously16 and planned before data were examined in the current study. If symptom onset specified a part of the day, we proceeded as follows: if described in the chart as “morning,” time of onset was recorded as 9 AM, in the “afternoon” as 3 PM, in the “evening” as 9 PM, and at “night” as midnight. If the patient awoke with symptoms, the last time he or she was known to be awake and normal was recorded; if that time was unknown, 11 PM the previous night was recorded.16 If the chart did not document either an exact time of onset and arrival or a part of the day but contained a reference to a time frame, this time frame was used to estimate the time to presentation category: <3 hours versus ≥3 hours.16 An example would be a patient who noted stroke symptoms while marketing and immediately called 911 and promptly arrived in the emergency department. This patient was considered to be <3 hours. If no reference to time of onset was listed in the medical record, time was recorded as unknown. Mode of transportation to the hospital was abstracted from the medical record and categorized as EMS versus other modes.

**Interview Methodology**

A random sample (75%) of stroke cases was selected for an in-person interview. The structured interview included a detailed questionnaire regarding stroke risk factors, demographics, and language. Orientation questions were asked; patients unable to answer the orientation questions appropriately, or who died, had a proxy interview. We previously showed a very high agreement between patient and proxy responses to select interview questions and no association of interview completion (P=0.9) or use of a proxy with ethnicity (P=0.5).12 Race/ethnicity was self-reported and collected similar to the US 2000 census data.10 Language was measured by self-reported language fluency and dichotomized as “Spanish” or “English”; English speakers included subjects fluent in both languages.

For this study, a sample of patient home addresses and the presenting hospital address were geocoded.17 This information was used to calculate distance from the patient’s home to the hospital (available for 62% of population).

**Statistical Analysis**

χ² Tests were used to determine whether subjects excluded from the analyses because of missing data were different from the study population. Baseline stroke risk factors were compared by ethnicity using χ² tests for categorical variables. Because the continuous variables contained no extreme values, with the exception of the NIHSS, t tests were used to make ethnic comparisons. NIHSS was compared by ethnicity using a rank sum test. Ethnic and sex differences in time to presentation (<3 hours versus ≥3 hours) and mode of arrival (EMS versus all other modes) were assessed through logistic regression. NHWs and men were used as the referents for those described above. Logistic regression models were used to compare EMS arrival by ethnicity among patients arriving within 3 hours of stroke symptom onset.14 The language analysis was limited to MA cases. Baseline stroke risk factors were compared by language using similar methods to those described above.

This project was approved by the institutional review boards at the Nueces County Hospital systems and the University of Michigan.

**Results**

There were 1424 hospitalized ischemic stroke subjects with interview data between January 1, 2000, and December 31, 2006. Because of small numbers, 82 blacks, 8 Asian/Pacific Islanders, 20 Native Americans, and 3 patients of unknown ethnicity were excluded from the analysis. Patients presenting from a nursing home (n=63) were excluded. A small number of patients (n=114) were excluded for other reasons: subjects transferred from out-of-area hospitals were excluded because of lack of adequate medical record documentation; and subjects with an in-hospital stroke and subjects transferred from a physician’s office were excluded because they were under the care of a physician at the time of their stroke. A total of 1134 MA and NHW ischemic stroke cases were eligible for the analysis.

Time to presentation could not be determined using one of the techniques described in the Materials and Methods section in 5% of stroke subjects: 7% NHWs and 4% MAs (P=0.07). There was no association of missing time data with gender (P=0.4). Thirty-four percent of patients were assigned to a time category because of missing data on exact time of onset but with a reference to a time frame. There were no ethnic differences among patients assigned a time category (P=1.0). Thirty-one percent of men and 37% of women were assigned a time category for this study (P=0.02). Thirty subjects were missing mode of arrival (3% of subjects). However, there was no association of missing mode data with ethnicity (P=0.4) or gender (P=0.3). There was no difference in the distance to the hospitals for any of the groups in this study (all P>0.11). Median distance for the population was 4.9 kilometers. Average distance was 7.5 kilometers (SD=7.7). Distance was not associated with time to presentation (P=0.69) or use of EMS (P=0.29).

Table 1 displays demographics and risk factors by ethnicity. Forty-seven percent of the study population were NHW, and 53% were MA. The study population consisted of slightly more women (52%) than men. MAs were younger than NHWs (P<0.001) and less likely to have insurance (P<0.001). Atrial fibrillation was more common among NHWs (P<0.001), and diabetes was more common among MAs (P<0.001). The prevalence of other stroke risk factors did not differ by ethnicity. During the time frame of this study, 1.5% of subjects received recombinant tPA. There
Table 1. Demographic Characteristics by Ethnicity (n=1134), BASIC, January 2000 Through December 2006

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>MAs 53% (n=604)</th>
<th>NHWs 47% (n=530)</th>
<th>Total 52% (n=1134)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45–59</td>
<td>176 29%</td>
<td>67 13%</td>
<td>243 21%</td>
</tr>
<tr>
<td>60–74</td>
<td>224 37%</td>
<td>182 34%</td>
<td>406 36%</td>
</tr>
<tr>
<td>≥75</td>
<td>204 34%</td>
<td>281 53%</td>
<td>485 43%</td>
</tr>
<tr>
<td>Female</td>
<td>316 53%</td>
<td>277 47%</td>
<td>593 52%</td>
</tr>
<tr>
<td>Insurance*</td>
<td>526 88%</td>
<td>501 95%</td>
<td>1027 91%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>395 75%</td>
<td>453 75%</td>
<td>848 75%</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>180 30%</td>
<td>178 34%</td>
<td>358 32%</td>
</tr>
<tr>
<td>Atrial fibrillation*</td>
<td>52 9%</td>
<td>92 16%</td>
<td>144 12%</td>
</tr>
<tr>
<td>Diabetes mellitus*</td>
<td>318 53%</td>
<td>144 27%</td>
<td>462 41%</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>168 28%</td>
<td>123 23%</td>
<td>291 26%</td>
</tr>
<tr>
<td>Stroke or transient ischemic attack</td>
<td>211 35%</td>
<td>165 31%</td>
<td>376 33%</td>
</tr>
<tr>
<td>Current smoking</td>
<td>121 20%</td>
<td>99 19%</td>
<td>220 19%</td>
</tr>
<tr>
<td>Excessive alcohol use</td>
<td>24 4%</td>
<td>17 3%</td>
<td>41 4%</td>
</tr>
</tbody>
</table>

* Differences between groups; P<0.001.

were no differences in recombinant tPA use among any groups in this study (all P>0.11).

Hospital Presentation by Ethnicity

Table 2 presents the proportions of subjects arriving to the hospital within 3 hours of symptom onset and the proportion of subjects arriving by EMS by ethnicity and by ethnicity and gender. Overall, 27% of MAs and 29% of NHWs arrived within 3 hours of symptom onset. In the adjusted model, there was a borderline significant association with MAs more likely than NHWs to arrive within 3 hours (OR, 1.4; 95% CI, 1.0, 1.9). Gender did not modify the relationship between ethnicity and time to presentation (P=0.8). However, in stratified analyses, there was a borderline significant association with MA men more likely to arrive within 3 hours compared with NHW men (OR, 1.5; 95% CI, 1.0, 2.3). A similar association was not observed in women.

Table 2. Logistic Regression Models Assessing Relationship Between Ethnicity and Timing and Mode of Hospital Arrival, Stratified by Ethnicity, BASIC, January 2000 Through December 2006

<table>
<thead>
<tr>
<th>Percentage</th>
<th>MAs</th>
<th>NHWs</th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 Hours*</td>
<td>27</td>
<td>29</td>
<td>1.4</td>
<td>(1.0, 1.9)</td>
<td>0.07</td>
</tr>
<tr>
<td>Women</td>
<td>23</td>
<td>26</td>
<td>1.0</td>
<td>(0.6, 1.6)</td>
<td>0.38</td>
</tr>
<tr>
<td>Men</td>
<td>32</td>
<td>31</td>
<td>1.5</td>
<td>(1.0, 2.3)</td>
<td>0.10</td>
</tr>
<tr>
<td>EMS*</td>
<td>40</td>
<td>56</td>
<td>0.6</td>
<td>(0.4, 0.8)</td>
<td>0.0005</td>
</tr>
<tr>
<td>Women</td>
<td>37</td>
<td>59</td>
<td>0.5</td>
<td>(0.3, 0.8)</td>
<td>0.0044</td>
</tr>
<tr>
<td>Men</td>
<td>43</td>
<td>53</td>
<td>0.7</td>
<td>(0.4, 1.0)</td>
<td>0.066</td>
</tr>
</tbody>
</table>

*Adjusted for age, NIHSS, education, history of stroke, and insurance status.

Forty percent of MAs and 56% of NHWs arrived by EMS. In the adjusted model, ethnicity was associated with mode of arrival, with MAs less likely than NHWs to arrive by EMS (OR, 0.6; 95% CI, 0.4, 0.8). Gender did not significantly modify the relationship between ethnicity and mode of arrival (P=0.1). However, in stratified analyses, MA women were less likely to arrive by EMS compared with NHW women (OR, 0.5; 95% CI, 0.3, 0.8). There was a borderline significant association between ethnicity and mode of arrival among men (OR, 0.7; 95% CI, 0.4, 1.0). Among patients arriving within 3 hours of symptom onset, NHWs were more likely to arrive by EMS than MAs (P=0.001).

Hospital Presentation by Gender

Table 3 presents the proportions of subjects arriving within 3 hours of symptom onset and the proportion of subjects arriving by EMS by gender and by gender and ethnicity. Thirty-one percent of men and 25% of women arrived within 3 hours of stroke symptom onset. Gender was associated with arrival time (OR, 0.7; 95% CI, 0.5, 0.9), with women less likely to arrive within 3 hours compared with men. Ethnicity did not modify this relationship (P=0.8). However, in stratified analyses, gender was borderline significantly associated with arrival at the hospital among MAs (OR, 0.6; 95% CI, 0.4, 1.0), with MA men more likely to arrive within 3 hours compared with MA women. There was no association between gender and time to presentation among NHWs (OR, 0.8; 95% CI, 0.5, 1.2), although the association was in the same direction.

Forty-seven percent of women and 48% of men arrived by EMS (Table 3). In the adjusted model, gender was borderline significantly associated with mode of arrival (OR, 0.8; 95% CI, 0.6, 1.0), with men more likely to arrive by EMS compared with women. Ethnicity did not significantly modify the association between sex and mode of arrival (P=0.1). In stratified analyses, MA women were less likely than MA men to arrive by EMS (OR, 0.7; 95% CI, 0.5, 1.0). Among NHWs, this association was not apparent.

Hospital Presentation by Language Fluency

A total of 529 of the 604 MA stroke subjects had complete language data. Seventy percent were English/bilingual speakers.

The reference group is NHW.
and 30\% Spanish speakers. Among MAs, 27\% of Spanish-speaking and 27\% of English-speaking MAs arrived at the hospital within 3 hours. Language was not associated with arrival within 3 hours ($P=0.4$; OR, 0.8; 95\% CI, 0.5, 1.3) or with arrival by EMS ($P=0.7$; OR, 1.1; 95\% CI, 0.7, 1.7).

Discussion

MAIs with stroke were 40\% less likely to arrive by EMS than NHWs in this study. Although this study suggests that MAs may present earlier to the hospital than NHWs, among those subjects arriving within 3 hours, NHWs were significantly more likely to arrive by EMS than MAs. Arrival by EMS has been shown to be associated with more urgent medical evaluation by physicians, suggesting that less frequent use of EMS among MAs may be a potential target to improve acute stroke therapy in this population despite earlier arrival times for MAs. The difference in EMS use was not attributable to distance from the hospital, although this was distance from home and not necessarily distance from the location of stroke onset. In this population, MAs were less likely to have medical insurance compared with NHWs, but the association between ethnicity and EMS use remained after adjustment for insurance, suggesting that other aspects of access to care may be important. A previous telephone survey in this community demonstrated that MAs were less likely to recognize stroke symptoms than NHWs, which, in turn, may impact their sense of urgency and the need to activate EMS. The telephone survey also found that MAs expressed more distrust in the medical establishment and more concern that money impedes their seeking medical care. These beliefs may result in reluctance to call EMS.

Women were less likely to arrive at the hospital within 3 hours compared with men and, this finding was driven by differences among MAs. Underuse of EMS in MA women compared with MA men may, in part, explain this difference. In addition, a national telephone survey conducted by the American Heart Association found that women, particularly Hispanics and blacks, are not adequately educated about stroke symptoms or current available treatment options for stroke. It is possible that MA women are not recognizing their stroke symptoms and therefore are not motivated to seek help immediately. Other possibilities include the fact that women are more likely to live alone than men, making seeking emergent help more difficult.

We found no association with language and time to presentation or mode of arrival among MAs. The lack of association with language fluency may be explained by the unique features of this community, including equal resource access among MA residents (high prevalence of insurance), availability of Spanish-speaking medical providers, and the fact that MAs in this county are predominantly second- and third-generation American. Therefore, this population reflects what much of the United States will look like by midcentury but does not speak to more immigrant areas.

It is important to note that time to presentation and mode of arrival were less than optimal among both ethnic groups. Approximately two-thirds of MA and NHW subjects presented for medical care $\geq$3 hours after symptom onset. This finding is consistent with a previous study conducted in this community, which found that expanding the treatment window of tPA to 6 hours would not markedly increase the number of treated patients. It is also important to note that tPA treatment rates remain overall very low in this community and others nationally. Efforts to increase appropriate use of acute stroke therapy need to focus on reducing delay to hospital arrival and increasing EMS use.

There are limitations to this study. Similar studies should be conducted in other communities before drawing broad conclusions. Potential information and misclassification bias, missing data, and reliance on self-reported risk factor data are inherent in cross-sectional studies such as this one. However, data for this study have been collected prospectively, reducing the likelihood of some biases common to cross-sectional studies involving retrospective data. A small number of stroke patients did not have any indication of symptom onset timing and were not included. There was no gender difference among cases missing timing data, and NHWs were only slightly more likely to be missing timing data compared with MAs, so it is unlikely these errors introduced systematic bias. Misclassification bias may have been introduced for cases who were missing data on exact time of symptom onset and for whom time to presentation was estimated. It was not possible to distinguish those patients for whom time equivalencies were used because of the manner in which the data were collected. However, the time estimation methods were decided a priori and standardized. The abstractors were rigorously trained, and the methods were used previously. Women were slightly more likely to be assigned a time category compared with men. This may introduce bias; however, this difference was relatively small and likely would not change the findings. Finally, the time to presentation outcome variable was dichotomized at 3 hours at the time of data collection. The decision to dichotomize this outcome was based on the tPA treatment window. It was not possible to explore these data using other time cutoff points, such as patients arriving within 2 hours of symptom onset, timing more conducive to administering tPA.

In summary, ethnic and gender differences in hospital presentation for stroke care were found in this community. Stroke is a medical emergency, and rapid medical treatment is critical to reduce the likelihood of permanent damage to the brain. MAs have a greater incidence of stroke than NHWs, and women have worse outcomes resulting from stroke. Educational campaigns to promote the timely and appropriate arrival for hospital care among stroke patients should be customized and designed to educate as well as motivate behavior changes in response to stroke symptoms, especially in vulnerable populations such as MA women.

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Disclosures

None.

References


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