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

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### Abstract

**Background and Purpose**—Use of emergency medical services (EMS) 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 EMS 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 EMS use were analyzed.

**Results**—There were 1,134 ischemic stroke cases ascertained between January 1, 2000 and December 31, 2006. Mexican Americans were less likely than non-Hispanic whites to arrive by EMS (OR: 0.6, 95% CI 0.4, 0.8). Men were more likely than women to present to the hospital within 3 hours (OR: 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.

### Keywords

Mexican American; stroke; ethnicity; gender

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Stroke is the leading cause of adult disability in the United States (US) 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 post-stroke outcomes (2,3). In the US, sixty two percent of stroke deaths occur in women (1). Mexican Americans (MA) are the largest sub-group of the largest minority population in the US and have an increased risk of stroke compared with non-Hispanic whites (NHW), especially at younger ages (4).

Prompt medical attention for stroke reduces mortality and the likelihood of permanent disability (5). Recombinant tissue plasminogen activator (rtPA) has proven to be effective

for reducing post-stroke 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 partially explained by differences in mode of transport to medical facilities. Patients who use emergency medical services (EMS) arrive at the hospital more rapidly (7–9) 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 by-stander or family member (7,9) 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 bi-ethnic 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 previously published (4,12). Briefly, cases of potential stroke among patients 45 years and older 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 utilizing ICD-9 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 retrospectively abstracted using a previously validated approach (15).

### Time to presentation

Time to presentation was dichotomized as  $<3$  hours versus  $\geq 3$  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 two methods based on information available in the chart. This standardized approach was previously published (8,16) 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 night prior 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  $\geq 3$  hours (16). An example would be a patient who noted stroke symptoms while marketing and immediately called 911 and promptly arrived in the ED. 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 a 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

Chi-square tests were used to determine if subjects excluded from the analyses due to missing data were different from the study population. Baseline stroke risk factors were compared by ethnicity using chi-square 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  $\geq 3$  hours) and mode of arrival (EMS versus all other modes) were assessed through logistic regression. NHWs and men were used as the referents for ethnic and sex comparisons. Separate models were constructed for the two outcomes (time to presentation and mode of arrival), adjusted for age (treated linearly), sex, NIHSS (natural log transformed), education (high school versus no high school), previous history of stroke/TIA (yes/no), and insurance status (any versus no insurance). Effect modification was tested by including an interaction term for sex and ethnicity in the models. Additionally, models were stratified by ethnicity and gender. Finally, a chi-square test was used to compare EMS arrival by ethnicity among patients arriving within 3 hours of stroke symptom onset.

The language analysis was limited to MA cases. Baseline stroke risk factors were compared by language using similar methods to those described above. Logistic regression models were used to assess the association between language and the outcomes. English speaking/bilingual MAs were used as the referent. Covariates included in the model were the same as those listed above. Covariates for all models were pre-selected based on their postulated association with outcome variables. Parameter estimates for the exposures of interest were summarized as odds ratios and 95% confidence intervals were calculated.

This project was approved by the Institutional Review Boards at the Nueces County hospital systems and the University of Michigan.

## RESULTS

There were 1,424 hospitalized ischemic stroke subjects with interview data between January 1, 2000 and December 31, 2006. Due to small numbers, 82 African Americans, 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 due to lack of adequate medical record documentation; and subjects with an inhospital 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 1,134 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 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 due to 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 distances was 7.5 kilometers (standard deviation=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 was NHW, and 53% was 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 rtPA. There were no differences in rtPA 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 (odds ratio (OR) = 1.4, 95% confidence interval (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 to NHW men (OR = 1.5, 95% CI: 1.0, 2.3). A similar association was not observed in women.

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 to 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 to 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 to 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

Five hundred and twenty-nine of the 604 MA stroke subjects had complete language data. Seventy percent were English/bilingual 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

MAs 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 (8) 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 due 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 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 (11). The telephone survey also found MAs expressed more distrust in the medical establishment and more concern that money impedes their seeking medical care (11). These beliefs may result in reluctance to call EMS.

Women were less likely to arrive at the hospital within three hours compared with men and this finding was driven by differences among MAs. Underutilization of EMS in MA women compared with MA men may, in part, explain this difference. Also, a national telephone survey conducted by the American Heart Association found that women, particularly Hispanic and African Americans, are not adequately educated about stroke symptoms or current available treatment options for stroke (18). 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 (19), 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 (11). This population, therefore, reflects what much of the US will look like by mid century, but does not speak to more immigrant areas.

It is important to note, 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 three or more hours after symptom onset. This finding is consistent with a prior study conducted in this community which found that expanding the treatment window of tPA to six hours would not markedly increase the number of treated patients (16). It is also important to note that tPA treatment rates remain overall very low in this community and others nationally (7). Efforts to increase appropriate use of acute stroke therapy need to focus on reducing delay to hospital arrival and increasing EMS use (20).

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 prospectively collected, 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 to 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 in which time equivalencies were employed due to the manner in which the data was collected. However, the time estimation methods were decided *a priori* and standardized. The abstractors were rigorously trained and the method used previously (8). Women were slightly more likely to be assigned a time category compared to 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 cut off 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, 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 due to 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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children to recognize stroke and call 911: the kids identifying and defeating stroke project. *Stroke* 2007;38(11):2972–8. [PubMed: 17885255]



Table 1

Demographic Characteristics by Ethnicity (n=1134), BASIC, January 2000 – December 2006.

Characteristic	Mexican American 53% (n =604)		Non-Hispanic White 47% (n =530)		Total (n =1134)	
	No.	%	No.	%	No.	%
Age*						
45–59	176	29%	67	13%	243	21%
60–74	224	37%	182	34%	406	36%
75+	204	34%	281	53%	485	43%
Female	316	53%	277	47%	593	52%
Insurance*	526	88%	501	95%	1027	91%
Hypertension	395	75%	453	75%	848	75%
Coronary Heart Disease	180	30%	178	34%	358	32%
Atrial Fibrillation*	52	9%	82	16%	134	12%
Diabetes Mellitus*	318	53%	144	27%	462	41%
High Cholesterol	168	28%	123	23%	291	26%
Stroke or TIA	211	35%	165	31%	376	33%
Current Smoking	121	20%	99	19%	220	19%
Excessive Alcohol Use	24	4%	17	3%	41	4%

\* differences between groups,  $P < 0.001$

**Table 2**

Logistic Regression Models Assessing Relationship Between Ethnicity and Timing and Mode of Hospital Arrival, Stratified by Sex. The Reference Group is Non-Hispanic White. BASIC, January 2000 – December 2006.

	%		Odds Ratio	95% Confidence Interval	P-value
	Mexican American	Non-Hispanic White			
<3 Hours*	27	29	1.4	(1.0, 1.9)	0.07
Women	23	26	1.0	(0.6, 1.6)	0.38
Men	32	31	1.5	(1.0, 2.3)	0.10
EMS*	40	56	0.6	(0.4, 0.8)	0.0005
Women	37	59	0.5	(0.3, 0.8)	0.0044
Men	43	53	0.7	(0.4, 1.0)	0.066

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

**Table 3**

Logistic Regression Models Assessing Relationship Between Sex and Timing and Mode of Hospital Arrival, Stratified by Ethnicity. The Reference Group is Men. BASIC, January 2000 – December 2006.

	%		Odds Ratio	95% Confidence Interval	P-value
	Women	Men			
<3 Hours*	25	31	0.7	(0.5, 0.9)	0.0103
Mexican American	23	32	0.6	(0.4, 1.0)	0.0296
Non-Hispanic white	26	31	0.8	(0.5, 1.2)	0.2073
EMS*	47	48	0.8	(0.6, 1.0)	0.1055
Mexican American	37	43	0.7	(0.5, 1.0)	0.0302
Non-Hispanic white	59	53	1.0	(0.7, 1.5)	0.9965

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