Loss of the Mexican American Survival Advantage After Ischemic Stroke

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Background and Purpose—Mexican Americans (MAs) were previously found to have lower mortality after ischemic stroke than non-Hispanic whites. We studied mortality trends in a population-based design.

Methods—Active and passive surveillance were used to find all ischemic stroke cases from January 2000 to December 2011 in Nueces County, TX. Deaths were ascertained from the Texas Department of Health through December 31, 2012. Cumulative 30-day and 1-year mortality adjusted for covariates was estimated using log-binomial models with a linear term for year of stroke onset used to model time trends. Models used data from the entire study period to estimate adjusted mortality among stroke cases in 2000 and 2011 and to calculate projected ethnic differences.

Results—There were 1974 ischemic strokes among non-Hispanic whites and 2439 among MAs. Between 2000 and 2011, model estimated mortality declined among non-Hispanic whites at 30 days (7.6% to 5.6%; \(P=0.24\)) and 1 year (20.8% to 15.5%; \(P=0.02\)). Among MAs, 30-day model estimated mortality remained stagnant at 5.1% to 5.2% \((P=0.92)\), and a slight decline from 17.4% to 15.3% was observed for 1-year mortality \((P=0.26)\). Although ethnic differences in 30-day \((P=0.01)\) and 1-year \((P=0.06)\) mortality were apparent in 2000, they were not so in 2011 (30-day mortality, \(P=0.63\); 1-year mortality, \(P=0.92\)).

Conclusions—Overall, mortality after ischemic stroke has declined in the past decade, although significant declines were only observed for non-Hispanic whites and not MAs at 1 year. The survival advantage previously documented among MAs vanished by 2011. Renewed stroke prevention and treatment efforts for MAs are needed. (Stroke. 2014;45:2588-2591.)

Key Words: Hispanic Americans ▫ mortality ▫ trends

Hispanic Americans are the largest minority population in the United States, and Mexican Americans (MAs) are the largest subgroup comprising 63% of Hispanic Americans.\(^1\) In 2010, 50.5 million Hispanics comprised 16% of the US population, an increase of 35 million since 2000, with MAs making up 75% of the growth.\(^2\) Hispanic Americans are projected to comprise one third of the US population in 2060. In 2010, just 7% of the Hispanic American population was aged ≥65 years; this is expected to rise to 20% by 2050\(^3\) indicating the potential for a large increase in stroke among Hispanic Americans in the coming decades.

The Hispanic Paradox is the observation that despite increased risk factors, comorbidities, and worse access to care, Hispanic Americans have lower case fatality compared with non-Hispanic whites (NHWs) for several diseases including stroke.\(^4\) We previously reported a 42% lower 28-day ischemic stroke case fatality rate and a 21% lower all-cause mortality rate after ischemic stroke in MAs compared with NHWs in a population-based study.\(^4\)

Although many have tried to explain the Hispanic Paradox with everything from genetics to increased social support,\(^5\) we wondered whether the effect was changing over time. Using an urban, nonimmigrant community of MAs and NHWs, we examined population-based trends in mortality after stroke.

Methods
This was a primary prespecified analysis of the Brain Attack Surveillance in Corpus Christi (BASIC) project. The methods were previously published\(^6\) and are summarized here. The University of Michigan and Corpus Christi hospitals’ Institutional Review Boards approved this project.

Setting and Subjects
BASIC takes place in Nueces County, on the Texas Gulf Coast, and 89% of residents reside in the city of Corpus Christi.\(^7\) The population

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is stable, nonimmigrant, and composed of US citizens. There are few undocumented residents making return to Mexico after stroke for long-term care or other reasons unlikely. There are 6 acute care hospitals, all with advanced neuroimaging and neurology consultation. Ethnicity (MA and NHW) is obtained from the medical record. We previously reported 96% agreement between self-report and chart abstracted ethnicity in this community.\(^1\) Over the years, surveillance techniques including out of hospital and coroner inquiries have supplemented the rigorous active and passive surveillance used to capture all acute strokes in the population.\(^6\) Cases are validated by stroke physicians based on source documentation blinded to ethnicity and age.

### Mortality Determination

Deaths from all causes were identified from (1) routine active and passive surveillance of all hospital and Emergency Department deaths and (2) Texas Department of Health death certificate database for the state of Texas. First name, last name, date of birth, and permanent address were cross-referenced with the Texas Department of Health database. At least 3 of the 5 items had to be identical for the BASIC stroke case to be considered a match with the Texas Department of Health death data. Cases were ascertained between January 1, 2000, and December 31, 2011, and mortality data were completed through December 2012, such that there was no censoring for either 30-day or 1-year mortality.

### Statistical Analysis

Descriptive statistics for all patient characteristics were computed overall and by ethnicity, and ethnic comparisons were derived using \(\chi^2\) overall and by ethnicity, and ethnic comparisons were derived using \(\chi^2\) overall and by ethnicity, and ethnic comparisons were derived using \(\chi^2\) overall and by ethnicity, and ethnic comparisons were derived using \(\chi^2\) overall and by ethnicity. Descriptive statistics were also calculated yearly, and we examined trends in risk factors during the study period using linear or log-binomial regression models using time since 2000 as a continuous variable. We examined whether risk factor trends differed by ethnicity by including an interaction term between a binary ethnicity indicator and years since 2000 in these models.

Since 30-day or 1-year mortality was fully observed (no censoring), and mortality was high among some subgroups, log-binomial regression models (versus Cox or logistic regression models) were used to examine trends in cumulative 30-day and 1-year mortality.\(^5\) Log-binomial models have the benefit of directly estimating risk ratios, instead of approximating risk ratios with odds ratios. A linear term of year since 2000 was included in the model to capture the overall trend in mortality, and its interaction with a binary ethnicity indicator was used to test whether the trend differed by ethnicity. Models were estimated adjusting for sex, quartiles of the age distribution (45–60, 61–72, 73–81 and >81), diabetes mellitus, coronary artery disease, high cholesterol, history of stroke/transient ischemic attack, atrial fibrillation, hypertension, smoking status, insurance status, and stroke severity (National Institutes of Health Stroke Scale [NIHSS], categories 0–1, 2–3, 4–7, 8–11, 12–42). Age (quartiles) and NIHSS (5 groups) were treated as categorical variables because they demonstrated nonlinear associations with mortality in crude models. Further, because confounding of the ethnicity by time interaction coefficient is possible (ie, confounding on the effect modification scale), we also empirically selected additional terms to be added into the model out of a list of interaction terms of the above risk factors and time, or the risk factors and ethnicity. Specifically, for the 30-day model, the interaction terms between year since 2000 and atrial fibrillation, NIHSS, age, insurance status were included, as well as the interaction terms of ethnicity and atrial fibrillation, coronary artery disease, hypertension, and smoking status. For the 1-year model, the interactions of year since 2000 and atrial fibrillation and hypertension were included and the interactions between ethnicity and coronary artery disease, hypertension, and smoking status. For interpretation, we estimated adjusted mortality trends by ethnicity for individuals with average age and otherwise average population characteristics. We used the coefficients from models fitted to data from the entire study period to estimate mortality risk in 2000 and 2011 by ethnicity, mortality risk ratios for ethnicity in 2000 or 2011, mortality trends by ethnicity, and ethnic differences in the mortality trends. Therefore, rather than using the individual rates for each year, we used the model that incorporates rates from all years to calculate the estimated rates for each year based on the trend lines.

In the fully adjusted models, the mortality–age association did not deviate significantly from linearity, and a linear term for age was thus used in the sensitivity analysis. We also conducted sensitivity analyses modeling age and NIHSS continuously using splines to examine whether results could be attributed to residual confounding within age or severity categories. Finally, model coefficients for ethnicity, time since 2000, and ethnicity by time since 2000 were used to extrapolate mortality trend lines beyond our study period to enable us to calculate the year when the ethnicity risk ratios estimated for the year 2000 would be reversed.

### Results

There were 4413 ischemic stroke cases, 1974 (44.7%) in NHWs and 2439 (55.2%) in MAs. Of these, there were missing covariate data on 99 (2.2%) and they were excluded from the model calculations. In aggregate, during the study period, MAs were younger and had more diabetes mellitus and hypertension, whereas NHWs had a higher prevalence of atrial fibrillation and smoking and were more likely to be insured (Table 1). The Figure in the online-only Data Supplement provides data on trends in demographics and risk factors among stroke cases during the study period. The trends in risk factors did not differ by ethnicity (Table 1).

Between 2000 and 2011, the model predicted mortality for an average patient declined among NHWs by 30 days (7.6% to 5.6%; \(P=0.24\)) and 1 year (20.8% to 15.5%; \(P=0.02\)). Among MAs, 30-day model predicted mortality remained stagnant at 5.1% to 5.2% (\(P=0.92\)), and a slight decline from 17.4% to 15.3% was observed for 1-year mortality (\(P=0.26\); Table 2). Although ethnic differences in 30-day (\(P=0.014\)) and 1-year (\(P=0.06\)) mortality were apparent in 2000, they were not so in 2011 (30-day mortality, \(P=0.63\); 1-year mortality, \(P=0.92\)). The Figure demonstrates the loss of the MA survival advantage during the study period.

Sensitivity analysis using splines to model age and NIHSS continuously did not change the results, suggesting that residual confounding by age was not responsible for the ethnic differences over time. Using the models to project future trends of ethnic differences in stroke mortality, the 1-year stroke mortality advantage seen for MAs versus NHWs would be reversed by 2023, and the advantage seen for MAs versus NHWs in 30-day case fatality would be reversed by 2028.

### Discussion

The poststroke survival advantage for MAs compared with NHWs diminished during the past decade. This is an important finding considering the rapid growth and aging of the MA
population. A recent American Heart Association/American Stroke Association Scientific Statement attributed the widespread decline in stroke mortality to risk factor control. It also stated that stroke mortality was declining in all race/ethnic groups. Stroke mortality may be declining in MAs because of declines in stroke incidence, but poststroke case fatality

<table>
<thead>
<tr>
<th>Timing of Mortality</th>
<th>Year</th>
<th>MA</th>
<th>NHW</th>
<th>MA vs NHW RR (95% CI)</th>
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<tr>
<td>30 d</td>
<td>2000</td>
<td>5.1%</td>
<td>7.6%</td>
<td>0.67 (0.48 to 0.92)†</td>
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<td>2011</td>
<td>5.2%</td>
<td>5.6%</td>
<td>0.92 (0.65 to 1.29)</td>
</tr>
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<td>% Change</td>
<td>2000–2011</td>
<td>−40.2% to 76.2%</td>
<td>−57.9% to 24.3%</td>
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<td>1 y</td>
<td>2000</td>
<td>17.4%</td>
<td>20.8%</td>
<td>0.84 (0.70 to 1.01)‡</td>
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<td></td>
<td>2011</td>
<td>15.3%</td>
<td>15.5%</td>
<td>0.99 (0.81 to 1.21)</td>
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<tr>
<td>% Change</td>
<td>2000–2011</td>
<td>−13.3%</td>
<td>−27.5%</td>
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<td></td>
<td>−32.5% to 11.4%</td>
<td>−44.1% to −5.9%</td>
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CI indicates confidence interval; MA, Mexican American; NHW, non-Hispanic white; and RR, risk ratio.
*P* for time trend by MA interaction: 30 days, *P*=0.22; 1 year, *P*=0.30.
† *P*=0.014.
‡ *P*=0.06.
and 1-year poststroke mortality are not significantly declining as illustrated by the current work. In addition to higher incidence, \(^6\) MAs have more stroke recurrence\(^{11}\) compared with NHWs. The new data presented in this article coupled with a recent report of worse neurological, functional, and cognitive outcomes in MA stroke survivors compared with NHWs\(^{12}\) suggest that the relative stroke burden in MAs continues to be high. The projections provided by the current work suggest that MA will soon have higher stroke case fatality and 1-year stroke mortality rates compared with NHWs. It seems that the Hispanic Paradox is no longer relevant for MA stroke because the previously identified poststroke survival advantage is no longer apparent.

There are limitations to this work. The overall unadjusted case fatality and 1-year mortality rates are somewhat lower compared with other recently reported Western population-based studies.\(^{13,14}\) Although this may reflect geographical variation or good medical care in this community and better tools to improve stroke outcome, it may also reflect missed mortality assessment despite the rigorous methods used. It could also reflect better ascertainment of cases less likely to die than other studies. Comparing population-based studies with different methods in different communities is always perilous. Furthermore, using sensitivity analysis we examined whether changes in the ethnic-specific age distributions over time explained the results but found no such effect. Our projections for the reversal of the mortality advantage must be taken with extreme caution because they are based on the current trend lines and do not consider the many possible influences on healthcare during the next 2 decades.\(^{15}\) However, these influences would need to have a differential impact on MAs and NHWs to alter these projections.

Because stroke incidence and outcome are worse in MAs compared with NHWs, and 1-year mortality is not significantly declining in MAs but is declining in NHWs, efforts to remedy the increased stroke burden in MAs must involve primary and secondary prevention as well as acute treatment and recovery efforts. Although this appears to be a daunting task, it is important to note that incidence has declined in MAs during the past decade.\(^{6}\) This indicates that positive change is possible.

**Sources of Funding**

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**Disclosures**

None.

**References**


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SUPPLEMENTAL MATERIAL
Supplementary Table I. Mortality and NIHSS by time period, age group and ethnicity.

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Supplementary Figure I. Risk factors among stroke cases by year since 2000 and ethnicity. The trends in risk factors did not differ by ethnicity (p>0.05 for all trend by ethnicity interaction in the risk factor).