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Stroke incidence in older US Hispanics: is foreign birth protective?

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Abstract

Background/Purpose—Although Hispanics are the fastest growing ethnic group in the United States (US), relatively little is known about stroke risk in US Hispanics. We compare stroke incidence and socioeconomic predictors in US- and foreign-born Hispanics to patterns among non-Hispanic whites.

Methods—Health and Retirement Study participants aged 50+ free of stroke in 1998 (mean baseline age 66.3 years) were followed through 2008 for self- or proxy-reported first stroke (n=15,784; 1,388 events). We used discrete-time survival analysis to compare stroke incidence among US-born (including those who immigrated before age 7) and foreign-born Hispanics to incidence in non-Hispanic whites. We also examined childhood and adult socioeconomic characteristics as predictors of stroke among Hispanics, comparing effect estimates to those for non-Hispanic whites.

Results—In age- and sex-adjusted models, US-born Hispanics had higher odds of stroke onset than non-Hispanic whites (OR=1.44, 95% CI: 1.08, 1.90), but these differences were attenuated and non-significant in models that controlled for childhood and adulthood socioeconomic factors (OR=1.07; 95% CI: 0.80, 1.42). In contrast, in models adjusted for all demographic and socioeconomic factors, foreign-born Hispanics had significantly lower stroke risk than non-Hispanic whites (OR=0.58, 95% CI: 0.41, 0.81). The impact of socioeconomic predictors on stroke did not differ between Hispanics and whites.

Conclusions—In this longitudinal national cohort, foreign-born Hispanics had lower incidence of stroke incidence than non-Hispanic whites and US-born Hispanics. Findings suggest that foreign-born Hispanics may have a risk factor profile that protects them from stroke as compared to other Americans.

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Keywords

stroke incidence; cardiovascular disease; social disparities; socioeconomic status; Hispanics; immigrants

Although racial disparities in cardiovascular disease between whites and African-Americans have been well documented, much less is known about inequalities in Hispanic populations.^{1, 2} Hispanics in the US tend to have lower socioeconomic status (SES), an important predictor of higher stroke incidence;^{3, 4} thus we would expect Hispanics to have elevated stroke risk. However, in many domains of health, outcomes among Hispanics are comparable to or better than those of their US non-Hispanic white counterparts, despite lower SES.^{1, 5} The Northern Manhattan Stroke Study (NOMASS) and Brain Attack Surveillance in Corpus Christi (BASIC) studies, two major studies describing stroke in Hispanics, have both reported elevated stroke rates in Hispanic populations in their respective communities.^{6, 7} However, prior evidence suggests that health patterns in US Hispanics may differ by nativity⁸, as both groups may have been exposed to different risk factors over the lifecourse. Whether this apparent Hispanic advantage applies to stroke has not yet been examined.

Most evidence on social patterns of stroke incidence is drawn from a relatively small number of high-quality community-based cohorts,^{9, 10} few of which include substantial Hispanic samples. Neither the NOMASS nor BASIC studies have optimal designs to address research questions related to immigration characteristics or SES and stroke risk. Moreover, these two sites are not representative of the US, potentially compromising generalizability given the tremendous heterogeneity of the US Hispanic population.

In this paper, we use a nationally representative cohort to investigate whether the so-called “Hispanic Paradox” extends to stroke, comparing the incidence of first stroke among non-Hispanic whites to that among US- and foreign-born Hispanics. We also investigated the association between SES and stroke for non-Hispanic whites, foreign-born Hispanics and US-born Hispanics.

Methods

Data are drawn from the nationally representative, longitudinal Health and Retirement Study (HRS), described in detail elsewhere.¹¹ Enrollment year depended on birth cohort with enrollments in 1992, 1993 and 1998. We begin follow-up in 1998, the earliest year when the sample was representative of all birth cohorts through 1947. Biennial interviews (or proxy interviews for decedent participants) were conducted through 2008, by telephone or in person. We included HRS participants born 1900 to 1947 who participated in the 1998 wave and follow them to 2008. Retention rates through 2008 were above 80%. The HRS was approved by the University of Michigan Health Sciences Human Subjects Committee and these analyses were determined exempt by Harvard School of Public Health Office of Human Research Administration.

From the age-eligible sample (n=19,992) including all racial/ethnic groups, we excluded 1,218 individuals who reported diagnosed stroke at baseline; 3,152 individuals who identified as black, African-American or “other” racial group; 51 individuals missing information on key covariates; and 38 individuals who were lost to follow-up before the 2000 interview. The final analytic sample included 15,784 individuals free of stroke, 14,360 non-Hispanic whites (“whites”) and 1,424 Hispanics.

We considered foreign-born Hispanics (n=746) separately from US-born Hispanics (n=678). We categorized 23 immigrants who arrived in the US between the ages of 0 and 6 years as US-born. This age threshold was chosen to be consistent with prior studies indicating similarity in outcomes between the native born and the foreign born with early ages at arrival in the US.^{12, 13} Findings were very similar using the more restrictive definition of US-born (results available from authors).

Information on first stroke came from self- or proxy-report of a doctor's diagnosis ("Has a doctor ever told you that you had a stroke?"). Reports of temporary ischemic attacks were not systematically assessed and were therefore not coded as strokes. No information on stroke subtypes was available. For participants who were unavailable for a direct interview (e.g., due to death or severe impairment, <15% for all 5 waves), interviews were conducted with proxy informants, predominantly spouses.

Socioeconomic measures included self-reported years of completed education (self-reported years of schooling completed, collapsing categories from 0-3 years and top-coded at 17 years), household income, and household wealth in 1998. Income and wealth values were equivalized for household size by dividing by the square-root of the number of household members. Other covariates included baseline age, age-squared, gender, birth in a southern state (yes/no), and parental maximum education (<8/ 8 years, higher value chosen between mother's and father's education).¹⁴

We assessed differences in stroke incidence using discrete-time survival analyses based on pooled logistic regression models. Survival was defined as remaining event-free at each of 5 biennial follow-up interview waves (from 2000 to 2008). Respondents were censored after the first report of an event or death. Analyses were conducted in SAS 9.3 (Cary, NC) PROC GENMOD, using robust standard errors.

Basic models compared hazard rates in US-born Hispanics and foreign-born Hispanics to whites (reference group), adjusted for sex, baseline age, and baseline age-squared. From these models, we calculated the absolute excess number of events (per 100,000 person-years)¹⁵ for 60- and 70-year-old male and female US-born Hispanics and foreign-born Hispanics, compared to their white counterparts. Next, we adjusted also for childhood SES (parental education and Southern birth), and for adult SES (education, household income, and household wealth) in the final models. To examine the contribution of selective survival to ethnic patterns, we repeated the primary analyses stratified by age at baseline (< 65 years). We also examined models with interaction terms for continuous years of age and indicators of US- and foreign-born Hispanic ethnicity, but interaction terms were very close to the null and not statistically significant (results not shown). To assess whether socioeconomic factors predicted stroke similarly for Hispanics and whites, we stratified models by ethnic group (white, US-born Hispanic and foreign-born Hispanic) and examined the association between each of the SES measures (education, household income, and household wealth) and onset of stroke within each ethnic group. We also estimated interaction coefficients in pooled models to test whether the hazard ratios for whites and Hispanics differed significantly on a multiplicative scale. The design effect introduced by the complex sample design was negligible; we therefore present results from models without design effect adjustments. We applied the HRS sampling weights to make the population representative of the 1998 US population aged 50+ years.

Results

From 16,765 age-eligible white or Hispanics respondents, 981 had prevalent stroke at baseline (Table 1). After excluding these individuals, there were 1,388 new onset first

strokes reported through 2008. Both US- and foreign-born Hispanic groups averaged lower own education, parental education, income, and wealth compared to whites. Of the 3 groups, foreign-born Hispanics had the lowest SES.

Adjusted for age and sex, US-born Hispanics had elevated odds of stroke onset (OR=1.44, 95% CI: 1.08, 1.90) compared to whites (Table 2). Foreign-born Hispanics, on the other hand, had lower stroke incidence than whites (OR=0.76, 95% CI: 0.55, 1.05), although estimate were of borderline significance. Adjusting for childhood SES, the OR for US-born Hispanics compared with non-Hispanic whites was attenuated and no longer statistically significant (OR=1.27; 95% CI: 0.96, 1.69). Foreign-born Hispanics had non-significantly lower stroke incidence than whites (OR=0.77, 95% CI: 0.55, 1.07) after adjustment for childhood SES and significantly lower after adjusting for adult SES (OR=0.58, 95% CI=0.41, 0.81).

We stratified models by age at baseline (<65 vs. ≥65) to assess whether there was an age-crossover in the association of ethnicity with stroke onset (Table 3). Most effect estimates were closer to the null in the older age group, but overall patterns persisted. After adjustment for childhood and adult SES, there was no significant difference in stroke rates among US-born Hispanics compared to whites in either <65 (OR=1.15; 95% CI: 0.64, 2.07) or ≥65 (OR=0.98; 95% CI: 0.72, 1.35). In contrast, foreign-born Hispanics in both age groups had significantly lower incidence rates of stroke than whites (<65: OR=0.40, 95% CI: 0.17, 0.96; ≥65: OR=0.62, 95% CI: 0.43, 0.91) in models adjusted for childhood and adult SES.

Age- and sex-adjusted regression results indicated an absolute excess of 233 strokes per 100,000 US-born Hispanic males aged 60, compared to their white counterparts (Table 4). At age 70, the absolute excess among US-born Hispanic males was larger at 515/100,000. Results were similar for US-born Hispanic females, but foreign-born Hispanics had an advantage compared to whites. Absolute values were higher among men and at older ages.

We conducted stratified analyses by ethnicity/nativity to estimate the association between each adult SES risk factor and stroke; we then tested for interactions on a multiplicative scale in pooled models. Respondents' education of high school or more was associated with a statistically significant lower stroke incidence for whites (OR=0.81; 95% CI: 0.70, 0.94) and US-born Hispanics (OR=0.48; 95% CI: 0.23, 0.97); the effect estimate was non-significant with a wide confidence interval among foreign-born Hispanics (OR=0.77; 95% CI: 0.36, 1.69) (Table 5). Higher income was associated with lower stroke incidence for whites, but none of the effect estimates for income in either group of Hispanics was statistically significant. Results were similar for wealth, where higher wealth was associated with lower stroke incidence for whites but not for other groups. Despite non-significant associations within some subgroups, interaction tests indicated no significant difference in the effect estimates for education, income or wealth for whites vs. foreign-born or US-born Hispanics. We also examined patterns pooling US-born and foreign-born Hispanics, but results were qualitatively similar so we do not present them.

Discussion

In this large, nationally representative sample of Americans aged ≥50, we found that foreign-born Hispanics had lower risk of stroke onset compared to whites but US-born Hispanics had higher risk of stroke than whites. Adjusting for two indicators of childhood social conditions substantially attenuated the disadvantage of US-born Hispanics compared with whites. After adjustment for adult socioeconomic differences, the elevated stroke risk among US-born Hispanics was quite small, while the advantage among foreign-born Hispanics widened.

This study has several limitations. Our major limitation is that outcomes in HRS were self- or proxy-reported, without medical verification. Misreporting may be a special concern when studying disadvantaged populations such as foreign-born. We previously established that knowledge of other major medical conditions, specifically hypertension¹⁶ and diabetes (results available from authors), does not differ for US-born compared to foreign-born respondents, but misreporting may be worse for stroke than for these conditions. Extensive prior evidence suggests self-reports of major cardiovascular events correspond well but not perfectly with medical records.¹⁷ Prior analysis of self-reported stroke in HRS has also indicated that results were consistent with other studies using medically verified events.¹⁸ Although HRS respondents may have undiagnosed cerebrovascular disease,¹⁹ neuroimaging studies to detect “silent strokes” are not feasible in this large, national sample. These associations may not hold for any specific subgroup of the extremely heterogeneous US Hispanic population. Further, our Hispanic sample was not large enough to examine specific national origins for foreign-born Hispanics or discern a critical age of arrival in the association with stroke. It is therefore possible that our findings are driven largely by one subgroup (e.g., Mexican Americans) and not generalizable to others. Finally, ethnic differences in stroke incidence are known to be most pronounced in younger ages (<45).²⁰ Because HRS is a study of adults age 50+, important ethnic differences at younger ages may not be observed in HRS.

These results are an important contribution to the limited existing evidence on stroke among US Hispanics. Some geographically localized studies show a two-fold higher incidence of stroke for Hispanics compared to whites,^{6, 7} while other evidence shows that Hispanics have lower rates than whites at age 65.^{20, 21} Our results may diverge from those in the NOMASS or BASIC because of methodological differences, such as distinguishing US- from foreign-born Hispanics and adjusting for childhood or adult SES, or differences in the samples given the diversity of the US Hispanic population. Possible explanations for the divergent findings may require more closely harmonized analyses or evidence from additional data sources.

It is not uncommon to find physical and mental health advantages in foreign-born Hispanics compared to whites,²² consistent with our results. Competing explanations for the relatively good health of foreign-born Hispanics include the “healthy migrant effect”²³ and the “paradox of assimilation.”²⁴ The healthy migrant explanation posits that individuals who are healthy are more likely than others to migrate from their home countries.²⁵ The alternative explanation for this pattern is that Hispanics in the US encounter adverse environmental contexts: segregated, high poverty neighborhoods, low SES and interpersonal discrimination.^{26, 27} In other words, some aspects of life in the US may themselves increase risk of stroke. The hypothesis that adverse US context compromises health in US-born Hispanics and whites compared to foreign-born Hispanics is consistent with our findings that US-born Hispanics have stroke rates similar to or higher than whites. A final explanation for the pattern of reduced stroke among foreign-born Hispanics is the “salmon bias hypothesis,” the possibility of selective return migration by Hispanics at the time of death or major health issue, which may result in lower apparent stroke risk for Hispanics.²⁸ However, this is unlikely to be a large source of bias in these data: loss to follow-up among foreign-born Hispanics was 15%, which is the same as that for whites, US-born Hispanics and the sample overall.

Our results for Hispanic-white differences contrast with results for black-white stroke patterns.²⁹ Blacks show consistent elevations in stroke compared to whites; this disparity cannot be explained by childhood SES but appears largely attenuated with adjustment for adult SES. The association we find between adult SES and stroke has previously been

shown in HRS and several other cohorts, for whites and blacks.^{3, 29} Thus, the associations we find linking low SES with elevated stroke risk seem consistent with prior evidence.

Overall, our findings support the following conclusions: after accounting for childhood and adult SES, US-born Hispanics have stroke risk similar to whites while foreign-born Hispanics have a significantly lower stroke risk; low education predicts elevated stroke risk within all ethnic/nativity groups, even though the most disadvantaged group, foreign-born Hispanics, averaged the lowest stroke risk.^{30, 31} This apparent flattened social gradients among the foreign-born may arise because selection factors operating in successful migration trump the SES influence, or because there are weak SES gradients in the sending populations.³²

Our results paint a complex picture of stroke disparities in America. Patterns for Hispanics do not mirror those among blacks, and appear to differ by nativity such that being foreign-born is advantageous. Explanations for disparities may have roots in both childhood and adult socioeconomic conditions, thus suggesting important and as yet unidentified resources that help reduce stroke risk even in the context of extreme socioeconomic disadvantage. Further, such advantage is lost across generations of life in the US. Explaining these differences may help identify opportunities to reduce stroke incidence in the entire population.

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Table 1
Baseline Characteristics of White and Hispanic Participants in the Health and Retirement Study Incident Stroke Sample (Weighted)

| | Total | | Non-Hispanic White | | US-born Hispanic [‡] | | Foreign-born Hispanic | |
|--|------------------|---------|--------------------|---------|-------------------------------|---------|-----------------------|---------|
| | n | percent | n | percent | n | percent | n | percent |
| n | 16,765 | 100 | 15,259 | 91.02 | 726 | 4.33 | 780 | 4.65 |
| Prevalent stroke at baseline | 981 [*] | 5.83 | 899 | 5.87 | 48 | 6.56 | 34 | 4.35 |
| Sample available for stroke incidence analysis | 15,784 | 94.1 | 14,360 | 94.1 | 678 | 93.4 | 746 | 95.7 |
| Mean years of follow-up | 8.59 | | 8.57 | | 8.61 | | 8.99 | |
| Total person-years of follow-up | 135,553 | | 123,008 | | 5,836 | | 6,707 | |
| Baseline characteristics of the stroke analysis sample: | | | | | | | | |
| Mean age at enrollment (SD) | 66.3 | 10.0 | 66.5 | 10.1 | 64.6 | 9.5 | 64.8 | 9.4 |
| Mean years of education (SD) | 12.2 | 3.2 | 12.6 | 2.8 | 9.4 | 4.0 | 7.5 | 4.3 |
| Southern birth state | 4,442 | 28.1 | 4,132 | 28.8 | 310 | 45.7 | 0 | 0.0 |
| Parental max education > 8 yrs | 11,456 | 72.6 | 11,016 | 76.7 | 234 | 34.5 | 206 | 27.6 |
| Median wealth (IQR, \$1,000) [‡] | 157.0 | 101.4 | 175.0 | 106.0 | 50.4 | 38.5 | 22.1 | 22.1 |
| Median income (IQR, \$1,000) [‡] | 33.6 | 15.6 | 35.8 | 16.2 | 20.1 | 10.3 | 14.0 | 6.8 |
| Male | 6,938 | 43.4 | 6,324 | 44.0 | 303 | 44.7 | 312 | 41.8 |
| Overweight (30-<35 kg/m ²) | 6,182 | 39.2 | 5,591 | 38.9 | 282 | 41.6 | 309 | 41.4 |
| Obese (> 35 kg/m ²) | 3,051 | 19.3 | 2,689 | 18.7 | 180 | 26.6 | 181 | 24.3 |
| Hypertension | 6,826 | 43.3 | 6,184 | 43.1 | 296 | 43.7 | 345 | 46.3 |
| Diabetes | 1,927 | 12.2 | 1,634 | 11.4 | 149 | 22.0 | 143 | 19.2 |

SD indicates standard deviation.

Sample members were all stroke-free at baseline (1998) and results are weighted for the 1998 US community dwelling population of individuals age 50+.

^{*} This excludes blacks and "other" racial groups (total stroke prevalence=1,218).

[‡] Household income and wealth scaled by the square-root of the number of people in the household.

[‡] We define US-born Hispanics to include those who are native US citizens as well as those who migrated to the US at age 6 or younger.

Table 2
Hispanic Ethnicity and Incident Stroke

| Predictors | OR (95% CI) |
|---|-------------------|
| Base Model* | |
| Ethnicity | |
| Non-Hispanic White | 1.00 |
| Hispanic US-Born | 1.44 (1.08, 1.90) |
| Hispanic Foreign-Born | 0.76 (0.55, 1.05) |
| Model Adjusted for Childhood Social Conditions[†] | |
| Childhood SES | |
| Southern Birth | 1.32 (1.16, 1.50) |
| Highest Parental Education [‡] | 0.85 (0.73, 0.97) |
| Ethnicity/Nativity | |
| Non-Hispanic White | 1.00 |
| Hispanic US-Born | 1.27 (0.96, 1.69) |
| Hispanic Foreign-Born | 0.77 (0.55, 1.07) |
| Model Adjusted for Childhood and Adult Social Conditions[§] | |
| Childhood SES | |
| Southern Birth | 1.26 (1.11, 1.43) |
| Highest Parental Education | 0.96 (0.82, 1.11) |
| Adult SES | |
| Education (years) | 0.96 (0.89, 1.02) |
| Income (in quartile groups) | 0.90 (0.83, 0.97) |
| Wealth (in quartile groups) | 0.88 (0.82, 0.94) |
| Ethnicity/Nativity | |
| Non-Hispanic White | 1.00 |
| Hispanic US-Born | 1.07 (0.80, 1.42) |
| Hispanic Foreign-Born | 0.58 (0.41, 0.81) |

* All models adjusted for age, age-squared, and sex.

[†] we take the higher number of years of education between the father and the mother.

[‡] additionally adjusted for southern birth, and parental education

[§] additionally adjusted for southern birth, parental education, income, wealth, and own education.

Table 3
Age-stratified Incident Stroke for White and Hispanics

| Predictors | n | Age- & Sex-Adjusted RR (95% CI) | Multivariable-Adjusted RR (95% CI) |
|------------------------------|-------|---------------------------------|------------------------------------|
| | | Stroke OR (95% CI) | Stroke OR (95% CI) |
| < 65 at baseline | 7,666 | | |
| Non-Hispanic White * | 6,859 | 1.00 | 1.00 |
| US-born Hispanic | 380 | 1.75 (0.98, 3.11) | 1.12 (0.62, 2.02) |
| Foreign-born Hispanic | 427 | 0.72 (0.34, 1.53) | 0.40 (0.17, 0.96) |
| 65 at baseline | 8,118 | | |
| Non-Hispanic White * | 7,501 | 1.00 | 1.00 |
| US-born Hispanic | 298 | 1.31 (0.97, 1.76) | 0.99 (0.73, 1.36) |
| Foreign-born Hispanic | 319 | 0.78 (0.55, 1.10) | 0.62 (0.43, 0.91) |

* adjusted for age, age-squared, sex, southern birth, parental education, income, wealth and own education.

Table 4
Predicted Excess Annual Incident Stroke Rate (per 100,000)

| | US-Born Hispanics* | | Foreign-Born Hispanics* | |
|---------------------|--------------------|---------|-------------------------|---------|
| | Males | Females | Males | Females |
| 60-year olds | 233 | 210 | -128 | -115 |
| 70-year olds | 515 | 465 | -285 | -257 |

* Expressed in the annual number of excess strokes per 100,000 compared to non-Hispanic whites, estimated from predicted values for each group from logistic regression models adjusted for age, age-squared, gender, and nativity.

Table 5
Ethnicity-specific Incident Stroke in the Multivariate Model[†]

| Predictors | Non-Hispanic White | US-Born Hispanic | Foreign-Born Hispanic |
|--|--------------------|-------------------|-----------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| <i>Separately Adjusted for Each SES Factor</i> | | | |
| Own Education | | | |
| 0-12 years | 1.00 | 1.00 | 1.00 |
| 12+ years | 0.81 (0.70, 0.94) | 0.48 (0.23, 0.97) | 0.77 (0.36, 1.69) |
| Income[*] | | | |
| 1 st Quartile | 1.00 | 1.00 | 1.00 |
| 2 nd Quartile | 0.79 (0.68, 0.93) | 0.52 (0.25, 1.11) | 0.44 (0.18, 1.08) |
| 3 rd Quartile | 0.62 (0.52, 0.75) | 1.09 (0.50, 2.37) | 0.92 (0.40, 2.12) |
| 4 th Quartile | 0.52 (0.42, 0.64) | 0.51 (0.14, 1.78) | 0.95 (0.32, 2.78) |
| Wealth[*] | | | |
| 1 st Quartile | 1.00 | 1.00 | 1.00 |
| 2 nd Quartile | 0.76 (0.65, 0.90) | 1.09 (0.51, 2.33) | 0.47 (0.18, 1.20) |
| 3 rd Quartile | 0.67 (0.56, 0.79) | 0.90 (0.42, 1.95) | 0.55 (0.21, 1.39) |
| 4 th Quartile | 0.56 (0.47, 0.67) | 0.69 (0.30, 1.58) | 0.65 (0.26, 1.60) |

OR of 1.00 denotes the reference category.

^{*}The income and wealth quartiles were defined from within each racial/ethnic group separately, i.e., Non-Hispanic Whites, US-born Hispanics, and Foreign-born Hispanics.

[†]All models additionally adjusted for age, age-squared, sex, southern birth and parental education.