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## Original Contribution

# Cohort Differences in Cognitive Impairment and Cognitive Decline Among Mexican-Americans Aged 75 Years or Older

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Research suggests that the prevalence and incidence of cognitive impairment among older adults is decreasing. This analysis used data from 9 waves (1993–2016) of the Hispanic Established Populations for the Epidemiologic Study of the Elderly to assess cognitive status and cognitive decline for 2 cohorts of Mexican-Americans aged ≥75 years in 1993–1994 versus 2004–2005. Logistic regression, joint longitudinal survival models, and illness-death models for interval-censored data were used to examine cohort differences in the odds of prevalent cognitive impairment, trajectories of cognitive decline, and the risk of 10-year incident cognitive impairment, respectively. Results indicated that compared with the 1993–1994 cohort, the 2004–2005 cohort had higher odds for prevalent cognitive impairment (odds ratio = 2.51, 95% confidence interval (CI): 1.92, 3.29), particularly among participants with <4 years of education (odds ratio = 2.99, 95% CI: 2.14, 4.18). Conversely, the 2004–2005 cohort exhibited significantly slower rates of cognitive decline ($\hat{\beta}$ = 0.50, 95% CI: 0.39, 0.62) and had a significantly lower risk of incident cognitive impairment (hazard ratio = 0.75, 95% CI: 0.62, 0.91) compared with the 1993–1994 cohort. This analysis provides mixed results for cohort trends in the cognitive health of older Mexican-Americans. Continued research is needed to identify risk factors that contribute to these population-level trends.

cognitive impairment; incidence; Mexican-Americans; prevalence

Abbreviations: ADRD, Alzheimer disease and related dementias; CI, confidence interval; H-EPESE, Hispanic Established Populations for the Epidemiologic Study of the Elderly; MMSE, Mini-Mental State Examination.

Cognitive impairment and Alzheimer disease and related dementias (ADRD) are major public health concerns. Population aging will cause an increase in the number of older adults living with ADRD (1). However, several studies have observed decreasing trends in ADRD prevalence and incidence (2–12). These findings have been attributed to improved treatment of chronic diseases and higher educational attainment among older adults (13, 14). While not all studies have reported favorable trends in ADRD (15–17), cognitive impairment (18), or cognitive function (19, 20), these results suggest that promoting education, improving management of chronic diseases, and reducing vascular risk factors might be effective strategies for preventing ADRD (10).

Racial and ethnic disparities in cognitive impairment and ADRD are well documented (21–25), although only a few trend studies have focused on minority populations (26–29). Investigators using data from the Health and Retirement Study reported that the prevalence of cognitive impairment from 1993 to 2004 among adults aged ≥70 years decreased 3.9% per year for non-Hispanic white, 5.2% for black, and 4.7% for Hispanic persons (29). Findings from the Washington Heights–Inwood Columbia Aging Project revealed the risk of dementia among adults aged ≥65 years in 1999 compared with 1992 was 40% lower for non-Hispanic white, 48% lower for black, and 36% lower for Hispanic persons (28). Similarly, the age-specific incidence rate for dementia in 2 cohorts of African Americans aged ≥70 years from Indianapolis decreased from 3.6% in 1992 to 1.4% in 2001 (26). Conversely, an increase in the prevalence of cognitive impairment among Mexican-Americans aged ≥75 years has been reported (27).

Hispanic Americans are the largest minority population in the United States (30). Hispanics have longer life expectancy than black and non-Hispanic white Americans (31) despite substantial disadvantages in socioeconomic and health characteristics (32, 33).

This make older Hispanics a high-risk population for cognitive impairment and ADRD. This analysis uses data from the Hispanic Established Populations for the Epidemiologic Study of the Elderly (H-EPESE) to examine differences in the prevalence and incidence of cognitive impairment, and trajectories of cognitive decline between Mexican-Americans aged ≥75 years in 2004–2005 and 1993–1994. We hypothesized that: 1) Older Mexican-Americans in 2004–2005 would have higher odds of being cognitively impaired; 2) the 2004–2005 cohort would exhibit slower cognitive decline; and 3) the risk of incident cognitive impairment would be lower for the 2004–2005 cohort.

## METHODS

### Sample

The H-EPESE is a longitudinal study of Mexican-Americans aged ≥65 years, living in the Southwestern United States (Texas, California, Arizona, Colorado, and New Mexico) (34). The first observation wave was completed in 1993–1994, and 9 observation waves have been completed as of 2016. Details on the sampling procedures have been previously described (35, 36). A multistage area-probability cluster sample was used to select census tracts in counties in which the Mexican-American population comprised at least 6.6% of the county population. Census blocks were then randomly selected to identify Mexican-Americans aged ≥65 years from a minimum of 400 households in each census tract. The baseline observation wave in 1993–1994 had a response rate of 83% and was representative of 500,000 Mexican-Americans aged ≥65 years living in the Southwestern United States (35). A new independent sample of 902 participants aged ≥75 years was enrolled at wave 5 (2004–2005). This new cohort was added so that the H-EPESE reflected the increasing educational attainment and income among older Mexican-Americans (37). New participants were selected using sampling procedures consistent with those used in 1993–1994. Weights were calculated so that the new sample was representative of Mexican-Americans aged ≥75 years living in the Southwestern United States (37).

The selection of the analytical sample for each cohort is presented in Figure 1. Participants who required a proxy to complete the baseline interview or were missing data for 1 or more covariates at the baseline interview were excluded. Participants who required a proxy to complete the baseline interview were excluded because the H-EPESE does not include a proxy measure for cognition, and not all of the covariates included in this analysis are assessed by proxy interview. The analytical sample for analyses on prevalent cognitive impairment and trajectories of cognitive decline included 1,706 participants, 922 from the 1993–1994 cohort and 784 from the 2004–2005 cohort. The analytical sample for incident cognitive impairment included 1,357 participants, 799 from the 1993–1994 cohort and 558 from the 2004–2005 cohort.

Waves 1–5 were used for the 1993–1994 cohort and waves 5–9 were used for the 2004–2005 cohort. The 2004–2005 cohort included only participants who entered into the H-EPESE at wave 5. A total of 882 participants who were <75 years of age at wave 1 were also interviewed at wave 5. We excluded these 882 participants from the 2004–2005 cohort so that the maximum number of times in which participants could be observed was identical for the 1993–1994 cohort and 2004–2005 cohort. The 882 surviving participants were 1.4 years younger than participants included in the 2004–2005 cohort ($P < 0.01$), but there were no statistically significant differences in sex, education, or self-reported health conditions.

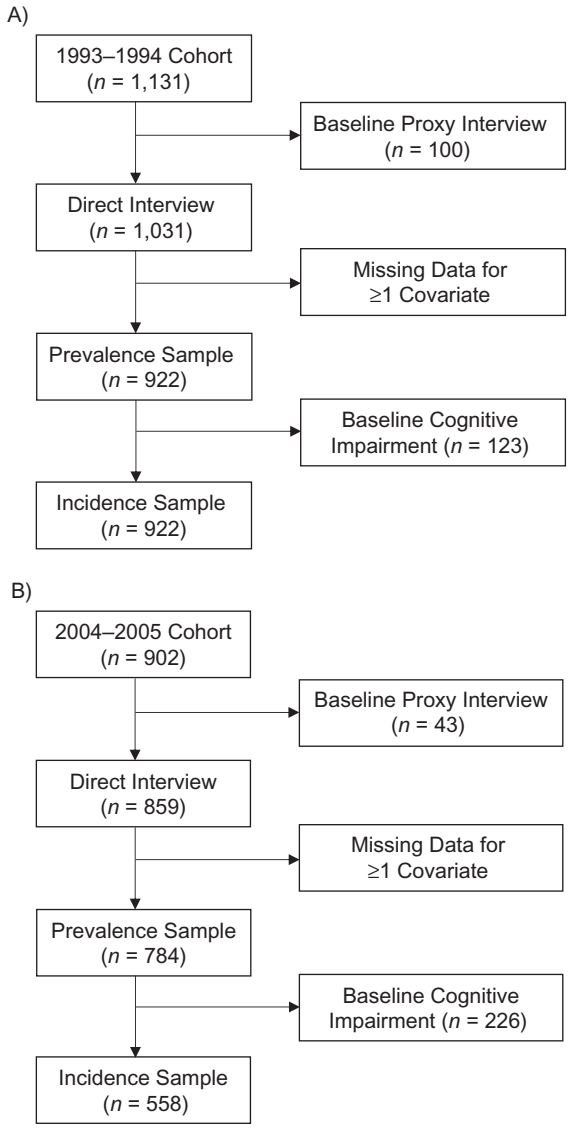


**Figure 1.** Selection of the final analytical sample from the Hispanic Established Populations for the Epidemiologic Study of the Elderly, United States. A) 1993–1994 cohort; B) 2004–2005 cohort.

### Measures

*Outcomes of interest.* Cognitive functioning of participants who did not require a proxy to complete the interview was assessed using the Mini-Mental State Examination (MMSE) (38). Prior research has noted floor and ceiling effects that limit the MMSE in accurately measuring the cognitive functioning of older adults with very high or very low cognition (39, 40). Philipps et al.

(41) have developed a methodology using latent process models (42, 43) to obtain transformed MMSE scores that minimize potential biases from floor/ceiling effects and account for the nonlinear relationship between a respondent's initial MMSE score and the rate of change over time (41). The range of possible scores on the MMSE is 0–30, and the transformed scores are rescaled to a range of 0–100 points (41). The normalized transformation of the raw MMSE scores can be obtained using the R (R Foundation for Statistical Computing, Vienna, Austria) package NormPsy (44). Results for cohort differences in the trajectories of cognitive decline according to the raw and normalized MMSE scores are presented.

Cognitive impairment for participants who did not require a proxy to complete the interview was defined as scoring ≤18 points on the MMSE, to account for the low education and advanced age of the sample population. Incident cases of cognitive impairment were ascertained by identifying the first observation wave in which a participant scored ≤18 points on the MMSE.

For the 1993–1994 cohort, the percentages of participants who required a proxy interview for waves 1–5 were 8.8%, 8.7%, 12.7%, 11.2%, and 14.1%, respectively. For the 2004–2005 cohort, the percentages of proxy interviews for waves 5–9 were 4.8%, 9.8%, 1.9%, 5.8%, and 11.7%, respectively. The H-EPESE survey specifies whether a proxy interview was required because of impaired cognition. Proxy respondents are also asked if the target participant has been diagnosed by a physician with Alzheimer disease.

*Covariates.* Selected covariates included age, sex, education, being born in the United States or Mexico (i.e., nativity), diabetes, heart disease, hypertension, stroke, and depression. All covariates were selected from the respective baseline observation waves. Diabetes, heart disease, hypertension, and stroke were based on self-report. Participants who reported never having been diagnosed with hypertension but who had a systolic blood pressure of ≥140 mm Hg or diastolic blood pressure of ≥90 mm Hg were also classified as having hypertension. Depression was defined as scoring ≥16 points on the Center for Epidemiologic Studies–Depression Scale (45).

## Analysis

Independent sample *t* tests and $\chi^2$ tests were used to assess differences in baseline characteristics between the 1993–1994 cohort and 2004–2005 cohort. Logistic regression models were used to assess the odds of prevalent cognitive impairment among older Mexican-Americans in 2004–2005 compared with 1993–1994. Logistic regression models were also used to estimate the predicted probability of prevalent cognitive impairment in the 1993–1994 cohort and 2004–2005 cohort. The risk difference based on each logistic regression model was calculated by subtracting the predicted probability of cognitive impairment for the 2004–2005 cohort from the predicted probability of cognitive impairment for the 1993–1994 cohort.

The trajectories of cognitive decline were assessed using joint longitudinal survival models (46). This approach was used because rates of cognitive decline increase prior to death (47, 48). A joint longitudinal survival model uses submodels to simultaneously estimate the trajectories of cognitive decline and risk of mortality. The cognitive trajectories were modeled using linear mixed-effects regression (49). This approach produces valid estimates when data is unbalanced because of differences in the number or timing of the observations of the participants (49, 50). Random effects for time (years since baseline) and intercept were included to allow for the trajectory and baseline estimates for cognitive functioning to vary for each participant. A term for the interaction of cohort × time was included to determine whether cognitive trajectories differed between the 1993–1994 cohort and 2004–2005 cohort. The cohort × time term significantly improved the fit of the linear mixed-effects regression models according to the Akaike information criterion. These models also included a dummy variable to indicate the first observation wave (e.g., 0, 1, 1, 1, 1) to account for potential practice effects on the MMSE (51). The survival model was estimated using Cox proportional hazards regression. The joint models were estimated using the R (R Foundation for Statistical Computing) package JM (52).

The risk of incident cognitive impairment was examined using an illness-death model for interval-censored data (53, 54). This approach allows for participants who remained cognitively intact to develop cognitive impairment between their last observation and death. The model estimates 3 transitions: 1) cognitively intact to deceased; 2) cognitively intact to cognitively impaired; and 3) cognitively impaired to deceased. These estimates are based on the age at which a participant is last observed to be cognitively intact, the age at which a participant is first observed to be cognitively impaired, and age at death. The illness-death models were estimated using the R (R Foundation for Statistical Computing) package SmoothHazard (55).

Covariates were added into the analyses using a series of models. Model 1 controlled for age (centered at the sample mean), sex (referent: male), and nativity (referent: foreign-born). A model for the risk of incident cognitive impairment that controlled for baseline MMSE score is also presented. Model 2 added years of education. Years of education was dichotomized as ≥4 and <4 years for regression models that included a term for interaction of education × cohort. Model 3 added diabetes, heart disease, hypertension, stroke, and depression. A fourth model for the trajectories of cognitive decline included terms for interaction between time and each covariate. Subsequent analyses were conducted to test for interactions between cohort and each covariate to determine whether cohort differences in the odds of prevalent cognitive impairment, trajectories of cognitive decline, and risk of incident cognitive impairment varied according to specific sociodemographic and health characteristics. The H-EPESE sampling weights were used to account for the survey design. All analyses were completed using R (R Foundation for Statistical Computing), version 3.1.0 (56).

## RESULTS

The descriptive characteristics of the final sample are presented in Table 1. Participants in the 2004–2005 cohort were older, were more likely to be born in the United States, completed more years of education, and were more likely to have diabetes or hypertension, to be cognitively impaired, and to have lower mean scores on the raw and transformed MMSE.

**Table 1.** Baseline Characteristics of 2 Cohorts, Hispanic Established Populations for the Epidemiologic Study of the Elderly[a], United States, 1993–1994 and 2004–2005

| Characteristic | 1993–1994 Cohort ($n = 922$) | | 2004–2005 Cohort ($n = 784$) | | *P* Value |
|---|---|---|---|---|---|
| | No. of Persons | % | No. of Persons | % | |
| Age, years[b] | 80.5 (0.22) | | 81.2 (0.22) | | 0.02 |
| Female sex | 544 | 58.6 | 461 | 59.7 | 0.61 |
| US born | 455 | 44.8 | 436 | 55.9 | <0.01 |
| Years of education[b] | 4.3 (0.16) | | 5.0 (0.22) | | <0.01 |
| Diabetes | 281 | 22.6 | 277 | 36.2 | <0.01 |
| Heart disease | 124 | 14.5 | 88 | 13.4 | 0.54 |
| Hypertension | 575 | 65.5 | 549 | 72.1 | <0.01 |
| Stroke | 78 | 10.6 | 62 | 7.4 | 0.02 |
| Depression | 228 | 26.2 | 143 | 21.5 | 0.02 |
| Cognitively impaired | 123 | 15.3 | 226 | 27.9 | <0.01 |
| Raw MMSE score[b] | 23.1 (0.35) | | 21.1 (0.26) | | <0.01 |
| Transformed MMSE score[b] | 55.5 (1.12) | | 47.6 (0.93) | | <0.01 |

Abbreviation: MMSE, Mini-Mental State Examination.
[a] Percentages and standard errors were calculated using the sample weights from the Hispanic Established Populations for the Epidemiologic Study of the Elderly.
[b] Values are expressed as mean (standard error).

The 1993–1994 cohort was more likely to have experienced a stroke and depression. Among all US-born participants, the 2004–2005 cohort completed an average of 6.3 years of education compared with 5.1 years for the 1993–1994 cohort ($P < 0.01$). The mean years of education among all foreign-born participants was 3.5 for the 2004–2005 cohort and 3.6 for the 1993–1994 cohort ($P = 0.59$).

### Prevalent cognitive impairment

The 2004–2005 cohort had 2.11 (95% confidence interval (CI): 1.65, 2.71) times higher odds of being cognitively impaired at baseline compared with the 1993–1994 cohort independent of age, sex, and nativity (Table 2). The odds of cognitive impairment increased to 2.37 (95% CI: 1.82, 3.11) after controlling for

**Table 2.** Odds Ratios for Cognitive Impairment Among Mexican-Americans Aged ≥75 Years, Hispanic Established Populations for the Epidemiologic Study of the Elderly[a], United States, 2004–2005 Cohort Compared With 1993–1994 Cohort

| Variable | Model 1 | | | | Model 2 | | | | Model 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | Risk Difference | 95% CI | OR | 95% CI | Risk Difference | 95% CI | OR | 95% CI | Risk Difference | 95% CI |
| 2004–2005 cohort overall | 2.11 | 1.65, 2.71 | 11.95 | 8.12, 15.78 | 2.37 | 1.82, 3.11 | 13.29 | 9.51, 17.07 | 2.51 | 1.92, 3.29 | 13.74 | 10.00, 17.47 |
| Age | 1.10 | 1.07, 1.13 | | | 1.09 | 1.07, 1.12 | | | 1.10 | 1.07, 1.13 | | |
| Female sex | 1.17 | 0.91, 1.51 | | | 1.20 | 0.92, 1.57 | | | 1.11 | 0.85, 1.46 | | |
| US born | 0.83 | 0.65, 1.07 | | | 1.02 | 0.78, 1.34 | | | 0.99 | 0.75, 1.29 | | |
| Education | | | | | 0.87 | 0.84, 0.90 | | | 0.87 | 0.84, 0.91 | | |
| Diabetes | | | | | | | | | 1.28 | 0.96, 1.69 | | |
| Heart disease | | | | | | | | | 0.82 | 0.55, 1.20 | | |
| Hypertension | | | | | | | | | 0.70 | 0.53, 0.93 | | |
| Stroke | | | | | | | | | 2.92 | 1.93, 4.39 | | |
| Depression | | | | | | | | | 1.55 | 1.15, 2.08 | | |

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] Results are from multivariable logistic regression models. Model 1 controlled for age, sex, and nativity. Model 2 controlled for covariates in model 1 plus education. Model 3 controlled for covariates in model 2 plus diabetes, heart disease, hypertension, stroke, and depression.

**Table 3.** Differences in Cognitive Decline for Mexican-Americans Aged ≥75 Years (Raw Scores), Hispanic Established Populations for the Epidemiologic Study of the Elderly[a], United States, 2004–2005 Cohort Compared With 1993–1994 Cohort

| Variable[a] | Raw MMSE Scores[b] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI |
| 2004–2005 cohort overall | −1.53 | −1.94, −1.22 | −1.94 | −2.33, −1.54 | −2.07 | −2.48, −1.67 | −2.03 | −2.41, 1.66 |
| Time | −1.02 | −1.10, −0.94 | −1.00 | −1.10, −0.90 | −0.98 | −1.08, −0.87 | −0.87 | −1.00, 0.75 |
| Cohort × time | 0.53 | 0.43, 0.63 | 0.52 | 0.41, 0.62 | 0.50 | 0.39, 0.62 | 0.58 | 0.48, 0.67 |
| Age | −0.33 | −0.37, −0.29 | −0.29 | −0.33, −0.25 | −0.29 | −0.33, −0.25 | −0.26 | −0.30, −0.22 |
| Female sex | −0.20 | −0.57, 0.17 | −0.17 | −0.53, 0.18 | −0.003 | −0.37, 0.36 | −0.05 | −0.42, 0.32 |
| US born | 0.84 | 0.47, 1.21 | −0.14 | −0.51, 0.22 | −0.14 | −0.51, 0.22 | −0.20 | −0.58, 0.18 |
| Education | | | 0.49 | 0.41, 0.62 | 0.47 | 0.42, 0.52 | 0.47 | 0.42, 0.52 |
| Diabetes | | | | | −0.07 | −0.47, 0.32 | −0.20 | −0.61, 0.22 |
| Heart disease | | | | | 0.51 | −0.06, 1.08 | 0.64 | 0.08, 1.20 |
| Hypertension | | | | | 0.32 | −0.06, 0.69 | 0.32 | −0.07, 0.71 |
| Stroke | | | | | −2.10 | −2.79, −1.41 | −1.92 | −2.62, −1.22 |
| Depression | | | | | −1.74 | −2.19, −1.29 | −1.62 | −2.08, −1.16 |
| Covariate × time | | | | | | | | |
| Age | | | | | | | −0.08 | −0.09, −0.07 |
| Female sex | | | | | | | −0.04 | −0.13, 0.05 |
| US born | | | | | | | 0.04 | −0.06, 0.13 |
| Education | | | | | | | −0.02 | −0.03, −0.01 |
| Diabetes | | | | | | | −0.11 | −0.22, 0.001 |
| Heart disease | | | | | | | −0.06 | −0.21, 0.09 |
| Hypertension | | | | | | | −0.07 | −0.16, 0.03 |
| Stroke | | | | | | | −0.03 | −0.26, 0.19 |
| Depression | | | | | | | −0.19 | −0.31, 0.07 |

Abbreviations: CI, confidence interval; MMSE, Mini-Mental State Examination.

[a] The coefficient for the practice effect term is suppressed from the table.

[b] Results are from joint longitudinal-survival models. Model 1 controlled for age, sex, and nativity. Model 2 controlled for covariates in model 1 plus education. Model 3 controlled for covariates in model 2 plus diabetes, heart disease, hypertension, stroke, and depression. Model 4 controlled for covariates in model 3 plus interaction terms between time and all covariates.

education and to 2.51 (95% CI: 1.92, 3.29) after controlling for health characteristics. The risk differences between the 2004–2005 cohort and 1993–1994 cohort for models 1–3 were 11.95 (95% CI: 8.12, 15.78), 13.29 (95% CI: 9.51, 17.07), and 13.74 (95% CI: 10.00, 17.47), respectively (Table 2).

The results from the interaction analyses revealed that the increased odds of prevalent cognitive impairment for the 2004–2005 cohort varied according to educational attainment ($P$ for interaction = 0.03). The 2004–2005 cohort had 1.85 (95% CI: 1.20, 2.88) times higher odds of cognitive impairment among participants with ≥4 years of education compared with 2.99 (95% CI: 2.14, 4.18) higher odds among participants with low education.

### Trajectories of cognitive decline

The 2004–2005 cohort showed significantly slower rates of cognitive decline compared with the 1993–1994 cohort (Table 3; Figure 2A). The rate of decline for the 2004–2005 cohort was 0.53 points (95% CI: 0.43, 0.63) per year less compared with the 1993–1994 cohort, controlling for age, sex, and nativity. This finding remained consistent after controlling for years of education (model 2), health characteristics (model 3), and interactions between time and the covariates (model 4). None of the 3-way interaction terms for cohort × time × covariates were statistically significant. The results for the normalized MMSE scores were consistent with the primary analysis (Table 4; Figure 2B).

### Incident cognitive impairment

A total of 496 incident cases of cognitive impairment were identified. This included 317 cases in the 1993–1994 cohort and 179 cases in the 2004–2005 cohort. The overall 10-year incidence rate per 100 person-years was 6.32 (95% CI: 5.79, 6.90). The incidence rate was significantly lower for the 2004–2005 cohort (5.24, 95% CI: 4.51, 6.04) compared with the

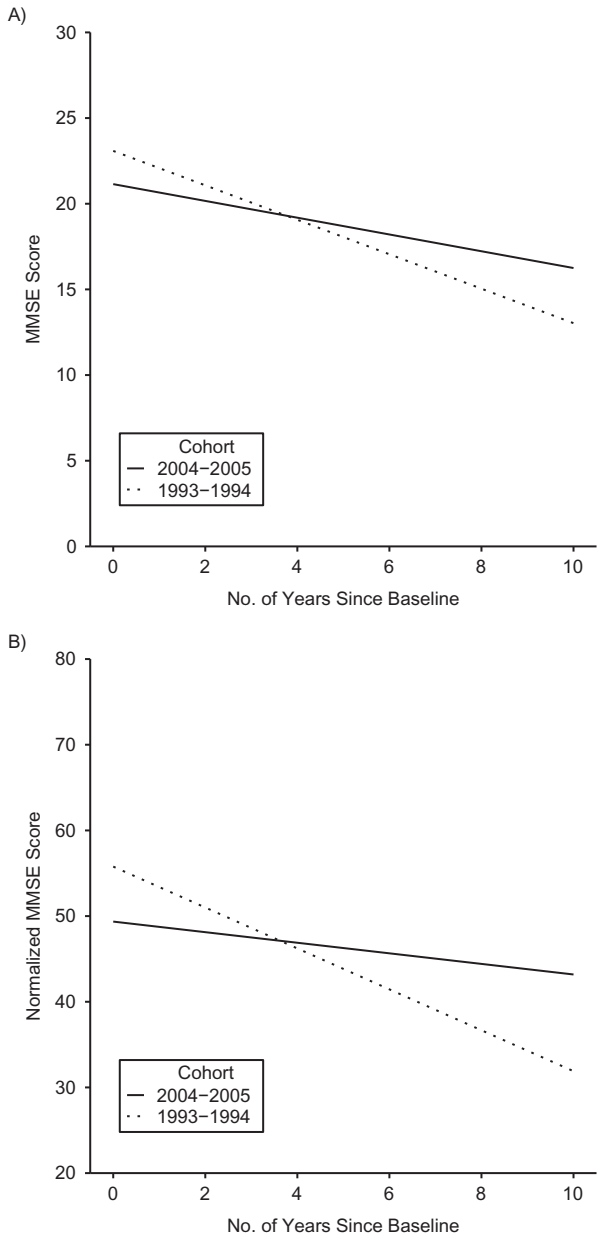


**Figure 2.** Predicted trajectories of raw (A) and normalized (B) Mini-Mental State Examination (MMSE) scores for participants in the 2004–2005 and 1993–1994 cohorts of the Hispanic Established Populations for the Epidemiologic Study of the Elderly, United States. Predicted trajectories are for the reference category: men, age-centered, a dummy variable for practice effects, foreign born, and mean years of education.

1993–1994 cohort (7.18, 95% CI: 6.41, 7.99). The average age for identification of cognitive impairment was 86.6 years for the 2004–2005 cohort and 86.2 years for the 1993–1994 cohort ($P = 0.32$). The average age of death for participants who became cognitively impaired was 89.8 years for the 2004–2005 cohort and 89.6 years for the 1993–1994 cohort ($P = 0.51$).

The 2004–2005 cohort had 0.78 (95% CI: 0.65, 0.94) times the risk of incident cognitive impairment as the 1993–1994 cohort (Table 5). After controlling for baseline MMSE score, the 2004–2005 cohort had 0.75 (95% CI: 0.62, 0.90) times lower risk of incident cognitive impairment compared with the 1993–1994 cohort. The lower risk of incident cognitive impairment for the 2004–2005 cohort was attenuated when controlling for years of education but remained statistically significant (hazard ratio = 0.77, 95% CI: 0.64, 0.93). Controlling for baseline health conditions did not substantially change the risk of incident cognitive impairment in the 2004–2005 cohort (hazard ratio = 0.75, 95% CI: 0.62, 0.91).

## DISCUSSION

The present analysis examined cohort differences in the odds of prevalent cognitive impairment, trajectories of cognitive decline, and risk of incident cognitive impairment among older Mexican-Americans. We observed that Mexican-Americans aged ≥75 years in 2004–2005 had approximately 2.5 times higher odds of being cognitively impaired compared with Mexican-Americans aged ≥75 years in 1993–1994. The higher odds of prevalent cognitive impairment for the 2004–2005 cohort were greatest among participants who completed <4 years of education. Conversely, the 2004–2005 cohort exhibited significantly slower rates of cognitive decline and had a significantly lower risk of incident cognitive impairment over a 10-year period.

The prevalence of a disease is based on disease incidence and duration. A potential explanation for the higher prevalence but lower incidence of cognitive impairment in the 2004–2005 cohort is that this cohort might be living longer with cognitive impairment. However, the illness-death model indicated that the risk of transitioning from cognitively impaired to deceased was not significantly different between the 2 cohorts. Prior studies have not investigated cohort differences in survival following the onset of cognitive impairment in the H-EPESE. In our sample, the average time between age of first being observed to be cognitively impaired and death was 3.20 years for the 2004–2005 cohort and 3.38 years for the 1993–1994 cohort. A recent analysis of data from the Framingham Heart Study revealed that survival after a diagnosis of dementia had decreased from an average of 6 years in 1977–1984 to 3 years in 2004–2008 (57). A compression of morbidity for cognitive impairment has also be observed in the Health and Retirement Study (58).

The decreasing trends for ADRD prevalence and incidence among recent cohorts of older adults have been attributed to increased educational attainment (13). We observed that the 2004–2005 cohort had significantly higher odds of prevalent cognitive impairment compared with the 1993–1994 cohort despite the 2004–2005 cohort's having completed nearly 1 year of education more on average. The decreased risk of incident cognitive impairment remained statistically significant after controlling for education. A possible explanation for this finding is that increases in education have not coincided with improvements in educational quality. Past research indicates that reading ability and other measures that approximate educational quality are stronger predictors of cognitive functioning than educational attainment, especially for minority older adults (59, 60). Educational quality is also important to consider given that a

**Table 4.** Differences in Cognitive Decline Among Mexican-Americans Aged ≥75 Years (Normalized Scores), Hispanic Established Populations for the Epidemiologic Study of the Elderly[a], United States, 2004–2005 Cohort Compared With 1993–1994 Cohort

| Variable[a] | Normalized MMSE Scores[b] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI | $\hat{\beta}$ | 95% CI |
| 2004–2005 cohort overall | −4.79 | −6.59, −2.98 | −6.42 | −8.09, −4.74 | −6.43 | −8.12, −4.75 | −6.83 | −8.56, −5.10 |
| Time | −2.39 | −2.69, 2.09 | −2.34 | −2.64, −2.05 | −2.35 | −2.64, 2.05 | −2.21 | −2.67, −1.74 |
| Cohort × time | 1.73 | 1.34, 2.11 | 1.77 | 1.39, 2.15 | 1.79 | 1.41, 2.17 | 1.92 | 1.56, 2.27 |
| Age | −1.35 | −1.52, −1.18 | −1.07 | −1.22, −0.91 | −1.10 | −1.25, −0.95 | −0.95 | −1.13, −0.76 |
| Female | −0.53 | −2.04, 0.99 | −0.46 | −1.84, 0.92 | 0.12 | −1.27, 1.52 | 0.23 | −1.50, 1.96 |
| US born | 3.38 | 1.88, 4.88 | −1.16 | −2.57, 0.25 | −1.24 | −2.64, 0.16 | −1.32 | −3.07, 0.42 |
| Education | | | 2.27 | 2.09, 2.45 | 2.21 | 2.03, 2.39 | 2.27 | 2.05, 2.50 |
| Diabetes | | | | | −1.78 | −3.32, −0.23 | −1.34 | −3.24, 0.56 |
| Heart disease | | | | | 1.99 | −0.15, 4.13 | 2.47 | −0.12, 5.07 |
| Hypertension | | | | | 0.01 | −1.42, 1.45 | 0.37 | −1.43, 2.17 |
| Stroke | | | | | −3.58 | −6.17, 1.01 | −4.66 | −7.79, −1.52 |
| Depression | | | | | −5.12 | −6.84, 3.41 | −4.96 | −7.05, −2.87 |
| Covariate × time | | | | | | | | |
| Age | | | | | | | −0.15 | −0.20, −0.11 |
| Female | | | | | | | 0.03 | −0.32, 0, 38 |
| US born | | | | | | | 0.20 | −0.16, 0.55 |
| Education | | | | | | | −0.09 | −0.13, 0.05 |
| Diabetes | | | | | | | −0.29 | −0.69, 0.11 |
| Heart disease | | | | | | | −0.29 | −0.83, 0.26 |
| Hypertension | | | | | | | −0.09 | −0.45, 0.27 |
| Stroke | | | | | | | 0.16 | −0.53, 0.86 |
| Depression | | | | | | | −0.18 | −0.62, 0.26 |

Abbreviations: CI, confidence interval; MMSE, Mini-Mental State Examination.

[a] The coefficient for the practice effect term is suppressed from the table.

[b] Results are from joint longitudinal-survival models. Model 1 controlled for age, sex, and nativity. Model 2 controlled for covariates in model 1 plus education. Model 3 controlled for covariates in model 2 plus diabetes, heart disease, hypertension, stroke, and depression. Model 4 controlled for covariates in model 3 plus interaction terms between time and all covariates.

significantly higher percentage of participants in the 2004–2005 cohort were born in the United States compared with the 1993–1994 cohort. The United States and Mexico have substantially different educational systems, which could influence an individual's risk of cognitive impairment through disparities in educational quality.

We observed that US-born participants had significantly higher risk of incident cognitive impairment compared with foreign-born participants. However, a term for interaction between cohort and nativity was not statistically significant. Prior research indicates that nativity differences in cognitive functioning are influenced by sex and, for foreign-born Mexican-Americans, the age at which an individual migrated to the United States. Foreign-born Mexican-American men who migrated to the United States as middle-aged adults show slower rates of cognitive decline (61) and have a lower risk of cognitive impairment (62) compared with US-born Mexican-American men. However, foreign-born Hispanics regardless of sex have been observed to live longer with cognitive impairment than US-born Hispanics (31, 63).

The 2004–2005 cohort also had significantly higher prevalence of diabetes and hypertension. Diabetes and midlife hypertension are important risk factors for ADRD (64). However, controlling for health conditions explained very little of the decreased risk of incident cognitive impairment in the 2004–2005 cohort. Prior studies have reported that health characteristics explained only a small amount of the decrease in ADRD incidence (2, 9), although reducing the prevalence of chronic health conditions and increased engagement in positive health behaviors might have a substantial impact on the prevalence of ADRD (64).

This analysis has important limitations. First, the MMSE is the only measure of cognitive functioning in the H-EPESE. The MMSE was originally designed to be used in clinical settings as a screening tool for ADRD and severe cognitive impairment (39). The MMSE has limited accuracy for detecting ADRD in community settings (65), especially among older adults with low educational attainment (65) or whose first language is not English (66). Consequently, some H-EPESE participants might have been incorrectly classified as cognitively impaired or cognitively

**Table 5.** Hazard Ratios for 10-Year Incident Cognitive Impairment Among Mexican-Americans Aged ≥75 Years, Hispanic Established Populations for the Epidemiologic Study of the Elderly[a], United States, 2004–2005 Cohort Compared With 1993–1994 Cohort

| Variable | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| | HR | 95% CI | HR | 95% CI | HR | 95% CI | HR | 95% CI |
| 2004–2005 cohort overall | 0.78 | 0.65, 0.94 | 0.75 | 0.62, 0.90 | 0.77 | 0.64, 0.93 | 0.75 | 0.62, 0.91 |
| Female sex | 0.98 | 0.82, 1.18 | 1.02 | 0.85, 1.22 | 1.01 | 0.84, 1.22 | 0.99 | 0.82, 1.19 |
| US born | 1.14 | 0.95, 1.37 | 1.22 | 1.01, 1.47 | 1.26 | 1.04, 1.51 | 1.25 | 1.04, 1.51 |
| Baseline MMSE | | | 0.92 | 0.90, 0.95 | 0.93 | 0.90, 0.96 | 0.93 | 0.90, 0.96 |
| Education | | | | | 0.98 | 0.95, 1.01 | 0.97 | 0.95, 1.00 |
| Diabetes | | | | | | | 1.20 | 0.98, 1.46 |
| Heart disease | | | | | | | 1.24 | 0.94, 1.63 |
| Hypertension | | | | | | | 1.26 | 1.03, 1.53 |
| Stroke | | | | | | | 1.37 | 0.99, 1.92 |
| Depression | | | | | | | 1.09 | 0.88, 1.37 |

Abbreviations: CI, confidence interval; HR, hazard ratio; MMSE, Mini-Mental State Examination.

[a] Results are from illness-death models for interval-censored data. Model 1 controlled for sex and nativity. Model 2 controlled for covariates in model 1 plus baseline MMSE score. Model 3 controlled for covariates in model 2 plus education. Model 4 controlled for covariates in Model 4 plus diabetes, heart disease, hypertension, stroke, and depression.

intact. We also did not consider functional limitations, which must be present to warrant a clinical diagnosis ADRD (67), in our definition of cognitive impairment. Comparing trends reported in different studies is complicated by the fact that diagnostic criteria for ADRD vary across studies, and this can dramatically decrease or increase estimates (68, 69). Our estimates for the prevalence and incidence of cognitive impairment would have been lower had participants been required to be functionally impaired as well.

A second limitation is that the MMSE has poor psychometric properties for detecting changes in cognitive functioning (39, 70). We analyzed trajectories of cognitive decline using the raw MMSE scores and using a normalized transformation of the MMSE to account for floor/ceiling effects. While these analyses produced consistent results, our findings need to be replicated using data for older Mexican-Americans that include a comprehensive cognitive evaluation. The findings for the trajectories of cognitive decline might have also been influenced by the lower percentage of proxy interviews in the 2004–2005 cohort compared with the 1993–1994 cohort. An additional limitation is that the H-EPESE does not include information for potentially important risk factors such as level of physical activity or midlife health conditions. We also did not control for other measures of socioeconomic status, such as income. However, it is unlikely that controlling for income would have substantially changed our results given that approximately 75% of participants in both cohorts reported having a yearly household income of less than $15,000. Finally, it is important to consider the representativeness of the sample populations with respect to the general population of Mexican-Americans aged ≥75 years living in the Southwestern United States. The H-EPESE sampling procedures were designed so that participants in both cohorts were representative of older Mexican-Americans living in the Southwestern United States during the 1990s and 2000s. The 2004–2005 cohort had higher educational attainment than the 1993–1994 cohort, and educational attainment has continued to increase among older Hispanics since 2005 (33). The prevalence of chronic health conditions associated with greater risk of cognitive impairment has also increased among Hispanics (71). Population-level changes of risk factors for cognitive impairment make it important to continue monitoring trends in ADRD and cognitive impairment prevalence and incidence among older Mexican-Americans.

To summarize, this analysis detected significant cohort differences in the odds of prevalent cognitive impairment, risk of incident cognitive impairment, and rates of cognitive decline among Mexican-Americans aged ≥75 years. Future research is needed to identify potentially modifiable environmental, social, neighborhood, health, and lifestyle characteristics that contribute to cohort differences in cognitive impairment and cognitive decline among older Mexican-Americans.

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