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Age of Migration Differentials in Life Expectancy With Cognitive Impairment: 20-Year Findings From the Hispanic-EPESE

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Abstract

Background and Objectives

To examine differences in life expectancy with cognitive impairment among older Mexican adults according to nativity (U.S.-born/foreign-born) and among immigrants, age of migration to the United States.

Research Design and Methods

This study employs 20 years of data from the Hispanic Established Populations for the Epidemiologic Study of the Elderly to estimate the proportion of life spent cognitively healthy and cognitively impaired prior to death among older Mexican adults residing in the

southwestern United States. We combine age-specific mortality rates with age-specific prevalence of cognitive impairment, defined as a Mini-Mental Status Exam score of less than 21 points to calculate Sullivan-based life table models with and without cognitive impairment in later life.

Results

Foreign-born Mexican immigrants have longer total life expectancy and comparable cognitive healthy life expectancy regardless of gender compared to U.S.-born Mexican-Americans. However, the foreign-born spend a greater number of years after age 65 with cognitive impairment relative to their U.S.-born counterparts. Furthermore, we document an advantage in life expectancy with cognitive impairment and proportion of years after age 65 cognitively healthy among mid-life immigrant men and women relative to early- and late-life migrants.

Discussion and Implications

The relationship between nativity, age of migration, and life expectancy with cognitive impairment means that the foreign-born are in more need of support and time-intensive care in late life. This issue merits special attention to develop appropriate and targeted screening efforts that reduce cognitive decline for diverse subgroups of older Mexican-origin adults as they age.

Keywords: Cognition, Mexican-origin population, Nativity

The U.S. Latino population is rapidly aging as a result of immigration, high fertility rates, and increased life expectancy. However, greater life expectancy is accompanied by high rates of disease and disability (Cantu et al., 2013; Garcia, Angel, Angel, Chiu, & Melvin, 2015). In particular, the number of Latino elders with Alzheimer's disease and related dementias (ADRD) is projected to increase from fewer than 200,000 to approximately 1.3 million by 2050 (Alzheimer's Association, 2010). Despite the growth of the U.S. Latino population, the cognitive functioning of this population remains understudied. Describing the prevalence and heterogeneity of ADRD in the Latino population is an integral step toward developing effective policies and practices that can potentially reduce the burden of ADRD on older Latinos, their family caregivers, and the U.S. health care system.

Latinos 65 and older are the fastest-growing segment of the U.S. older adult population and are projected to increase to over 15.4 million by 2050 (U.S. Census Bureau, 2014). Given that over 50% of older Latinos in the United States are foreign-born (Stepler & Brown, 2016), many researchers have sought to understand differences in health by nativity status. Previous research finds that foreign-born Latinos exhibit favorable health profiles compared to their U.S.-born counterparts (Garcia & Reyes, 2017a). This has been observed for health-promoting behaviors (Antecol & Bedard, 2006; Riosmena, Kuhn, & Jochem, 2017), biological risk profiles (Crimmins, Kim, Alley, Karlamangla, & Seeman, 2007), disability (Markides & Gerst, 2011),

and mortality (Markides & Eschbach, 2005). The favorable health profiles of foreign-born Latinos are largely attributed to positive migration selection, meaning healthy rather than unhealthy individuals are more likely to migrate to the United States (Bostean, 2013; Riosmena, Wong, & Palloni, 2013). However, the health advantages of foreign-born Latinos may diminish over time and greater acculturation has been associated with a higher prevalence of diabetes, hypertension, and poor health behaviors (Antecol & Bedard, 2006; Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005).

Although the immigrant advantage is well-established for some health indicators, somewhat conflicting results have been reported for cognitive function and cognitive decline by nativity status among U.S. Latinos. For instance, using data from the Hispanic Established Populations for the Epidemiologic Study of the Elderly, Nguyen and colleagues (2002) found no differences in the rate of cognitive decline between foreign-born and U.S.-born Mexican-Americans. In a more recent analysis, Sheffield & Peek (2009) documented significant baseline differences in cognitive scores between U.S.-born and foreign-born Mexican-Americans, but no nativity differentials in cognitive decline. Conversely, González and colleagues (2009) found a positive association between higher cognitive functioning and duration in the United States among Mexican immigrants.

Much of the evidence on cognitive health examines Mexican immigrants as a whole. However, Mexican immigrants are not a monolithic group and their health in later life may vary considerably depending on gender, timing of migration, social and cultural environment, health behaviors, and socioeconomic status (Markides & Gerst, 2011). Motivations for migration differ by age and gender (Angel et al., 1999). Recent evidence suggests the relationship between nativity and cognition among Mexican elders varies by age of migration (Hill, Angel, Balistreri, & Herrera, 2012; Hill, Angel, & Balistreri, 2012). For example, Hill, Angel, & Balistreri (2012) demonstrated that early-life (0–19 years) and late-life (50 and older) immigrants did not vary in cognitive status relative to their U.S.-born co-ethnics. However, there was favorable cognitive functioning among Mexican immigrants who migrated in mid-life (age 20–49 years) compared to their U.S.-born counterparts. The authors suggest that cognitive advantages among mid-life immigrants reflect the unique cognitive demands of acculturation and adaptation to new social, cultural, and economic processes. In addition, Hill and colleagues (2012) documented that mid-life male immigrants were able to maintain an advantage in cognitive functioning for a longer period of time relative to female mid-life immigrants; a pattern they attribute to a healthy immigrant effect. These studies urge researchers to consider heterogeneity in cognitive health by both gender and age of migration.

Age of migration is an important factor to consider when studying cognition because: (1) the type of migration (i.e., labor vs. family); (2) degree of health selectivity; (3) exposure to a new social and cultural environment; and (4) hazardous environmental conditions in the country of origin are likely related to the age in which a person migrates (Garcia & Reyes, 2017b; Gubernskaya, Bean, & Van Hook, 2013). For example, positive health selection is thought to be weakest for child migrants because children are frequently accompanying a parent or other adult family member and the child's migration is more likely to reflect the parents' characteristics (Angel et al., 1999). However, individuals who migrate in early-life have more educational and occupational opportunities to accumulate financial resources that may be beneficial to cognitive

health in later life. Similarly, health selection is thought to also be weak for individuals who migrate in late life since the decision to migrate is often based on the desire to rejoin adult children already living in the United States (Treas & Mazumbar, 2002). Older migrants may be especially vulnerable to stresses associated with migration including lack of familiarity with U.S. culture, exposure to stress, social isolation, and limited health care resources which may influence cognitive functioning in old age (Treas & Mazumbar, 2002). Conversely, positive health selection is posited to be strongest for young-adults seeking employment opportunities in potentially demanding environments. These individuals are self-selected on the basis of good health, since they are healthy enough to migrate and work when they arrive to the United States (Angel, Angel, Díaz Venegas, & Bonazzo, 2010).

The process of migration selection, coupled with strong traditional gender roles in Mexico, suggests that immigrant health advantages may be stronger for men than women. Immigrant men are likely to migrate for employment opportunities, whereas immigrant women may migrate to follow their husbands or for family reunification purposes (Angel et al., 2010; Treas, 2015). These different selection mechanisms may result in strong health selection for men compared to women. Stronger immigrant advantages for men than women have been reported among older Mexican-Americans in terms of activities of daily living and instrumental activities of daily living disability (Garcia & Reyes, 2017a), physical functioning (Angel et al., 2014), and cognitive decline (Hill et al., 2012).

Conceptual Framework

The present study uses a life-course perspective. The life course describes the temporal sequence of events and transitions that occur within interconnected domains (e.g., health, family, education) with advancing age. The life course also provides a useful framework for examining how early-life events, experiences, circumstances, and the timing in which they occur, may influence health in old age (Dannefer, 2003). We posit that the cognitive health of older Mexican-Americans is shaped by the circumstances surrounding where they were born and, for immigrants, the age at which they migrated to the United States. Lower education, limited financial resources, and greater exposure to stress associated with migration and acculturation may lead to an increased risk of cognitive impairment among immigrant subgroups.

Existing research on the relationship between nativity, age of migration, and cognition has focused on rates of cognitive decline and less has examined if nativity and age of migration are related to the proportion of the lifespan spent living with cognitive impairment. Using a life-course perspective, we seek to estimate the proportion of life spent with cognitive impairment for U.S.-born and foreign-born Mexican-American elderly. Following previous research, we hypothesize: (1) foreign-born Mexican-Americans will spend a greater number of years after age 65 with cognitive impairment than U.S.-born Mexican-Americans, and these differences by nativity will vary by gender and age of migration due to heterogeneous migration processes; (2) foreign-born women will spend a greater number of years after age 65 with cognitive impairment compared to foreign-born men due to their longer life expectancies; and (3) mid-life migrants will spend more years without cognitive impairment compared to early-life and late-life migrants due to positive health selectivity.

Data

This research employs data from the Hispanic Established Population for the Epidemiological Study of the Elderly (H-EPESE). The H-EPESE is a representative sample of community-dwelling Hispanic elderly aged 65 years and older living in the southwestern United States. (Markides, Rudkin, Angel, & Espino, 1997). These data provide detailed information for a sample of 3,050 individuals first interviewed in 1993–94. Due to attrition in the original cohort, a new cohort of 902 individuals aged 75 and older was added in 2004. We use aggregated individual level data from 1993 to 2013 to obtain prevalence estimates across survey years with a mortality linkage through the National Death Index up to December 31, 2015. Thus, participants classified as cognitively impaired (see Measures) at baseline were retained in the analytic sample. Respondents ranged in age from 65 to 107 years. Respondents who required a proxy (n = 325) did not receive the cognitive assessment and were excluded from the analysis. The final analytic sample includes 3,627 unique individuals and 35,658 person-years of data.

Measures

Cognitive functioning was assessed using the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). Scores range from 0 to 30, with higher scores indicating better cognitive function. We dichotomized the MMSE score as less than 21 for cognitive impairment and greater than or equal to 21 for normal cognition. This cut point has been used previously in the H-EPESE (Raji, Al Snih, Ray, Patel, & Markides, 2004; Samper-Ternent, Al Snih, Raji, Markides, & Ottenbacher, 2008) and accurately screens for older adults with dementia in populations with low educational attainment (Uhlmann & Larson, 1991). Respondents could complete the MMSE in English or Spanish. Prior research indicates that there are measurement differences for specific items on the English and Spanish language versions of the MMSE (Jones, 2006), but that overall scores for the English and Spanish language versions are comparable (Morales, Flowers, Gutierrez, Kleinman, & Teresi, 2006).

Sociodemographic Characteristics

Following previous research (Angel et al., 1999; Hill et al., 2012), we create four nativity groups. Nativity was assessed by asking the respondents if they were born in the United States. To capture age of migration, we created three groups; those who arrived in early-life (0–19 years); mid-life (20–49 years); and late-life (50 years and older). Age of migration was determined by asking participants how old they were when they came to the United States to stay.

To assess how cognitive impairment patterns vary by age, five age categories are included that allow for reasonable cell sizes and encompass different stages of late life: 65–69, 70–74, 75–79, 80–84, and 85 years and older. Education is measured by the years of schooling completed.

Methods

In the descriptive analysis, comparisons across cognitive status were made using chi-square and z-tests for independent proportions to assess nativity and age of migration differentials by gender

and age. Prevalence is estimated for cognitive impairment by dividing the total number of cases by the total population and multiplying this proportion by 100.

We integrate age-specific mortality rates with age-specific prevalence of cognitive impairment to calculate Sullivan-based life table models of life expectancy with and without cognitive impairment (Sullivan, 1971). This prevalence-based method divides total life expectancy (at age 65) into different health states based on the age-specific prevalence of cognitively healthy and cognitively impaired states.

The prevalence is estimated with multinomial logistic regression models and mortality rates with Gompertz hazard models and sampling weights from the H-EPESE. Cognitive life expectancies calculated by this method are the number of remaining years (at age 65) a population can expect to live in each state (Jagger et al., 2006). A bootstrapping technique is used to obtain standard errors. Based on 300 life tables for a given group, confidence intervals were obtained for the life expectancy. Statistical significance tests were performed according to the confidence intervals. All results are reported by nativity (i.e., U.S.-born vs. *all* foreign-born) and by age of migration (U.S.-born vs. three foreign-born subgroups) to assess whether any immigrant advantage emerges by age of migration.

Results

Table 1 reports descriptive characteristics stratified by gender for nativity, age, and education. The total sample in this study is 44% foreign-born and 56% U.S.-born. Approximately 58% of respondents are women compared to 42% men. On average, foreign-born men and women are older and report significantly lower levels of education than their U.S.-born counterparts.

Table 1. Sociodemographic Characteristics Among Mexican-Americans Age 65 and Older by Gender, Nativity, and Age of Migration

	Females				**Males**			
		Foreign-Born				**Foreign-Born**		
Age of Migration	**U.S.-Born**	**0–19**	**20–49**	**50+**	**U.S.-Born**	**0–19**	**20–49**	**50+**
N (%)	4,624 (55.8)	788 (10.0)	1,762 (22.3)	732 (9.3)	2,863 (55.8)	512 (10.0)	1,321 (25.8)	431 (8.4)
Education (*SD*)	6.0 (4.1)	4.7 (3.5)	4.4 (3.5)	3.0 (3.2)	6.5 (4.5)	4.3 (3.7)	3.8 (3.4)	2.2 (2.6)
Mean age (*SD*)	78.2 (7.1)	81.3 (7.9)	77.9 (7.2)	79.5 (7.3)	77.4 (6.8)	80.0 (7.6)	78.1 (7.1)	79.4 (7.6)

Note: H-EPESE Waves 1–8, 1993–2013. Unweighted N's' weighted percentages and means.

Cognitive Impairment

Table 2 presents the prevalence of cognitive impairment in 5-year age categories by nativity and age of migration. Among women (panel A), foreign-born immigrants exhibit a significantly higher prevalence of cognitive impairment across all age categories. However, when stratified by age of migration, a general pattern emerges where late-life immigrants have the highest

prevalence of cognitive impairment, followed by early-life and mid-life immigrant women. For men (panel B), a slightly different pattern emerges: Foreign-born men exhibit significantly higher rates for cognitive impairment only at ages 70–79 compared to U.S.-born men. The overall higher rates of cognitive impairment appear to converge at age 85 and above; at which point U.S.-born men exhibit marginally higher cognitive impairment rates. Similar to women, high rates of cognitive impairment among foreign-born men are largely driven by late-life immigrants. Mid-life immigrant men do not statistically differ from their U.S.-born counterparts in the prevalence of cognitive impairment in 65–84 age groups. However, mid-life immigrant men exhibit significantly lower rates of cognitive impairment (36.8% vs. 55.7 %, respectively) compared to U.S.-born men at age 85 and older driving the overall immigrant crossover (see Figure 1).

Table 2. Prevalence of Cognitive Impairment Among Mexican-Americans Age 65 and Older

			Age of migration subgroups		
	US-Born	**All FB**	**0–19**	**20–49**	**50+**
Age Group:	**%**	**%**	**%**	**%**	**%**
Panel A: females					
65–69	8.1	13.4***	14.6*	11.5*	18.4***
70–74	16.6	20.0**	16.7	15.1	38.1***
75–79	21.9	32.3***	27.0	30.3***	40.8***
80–84	28.9	39.5***	37.9	33.5	53.3***
85+	49.6	55.1***	53.7*	50.0	66.1***
Panel B: males					
65–69	9.0	18.8	18.6	13.0	35.1*
70–74	15.8	29.0**	27.8	25.0	42.0**
75–79	25.4	32.2*	28.5	31.5	37.8**
80–84	30.7	38.3	44.9	31.6	51.0**
85+	55.7	47.2	49.5	36.8*	69.0**

Note: FB = Foreign-born refers to all age of migration subgroups. Proportions are weighted. The reference category is U.S.-born respondents. Source: H-EPESE Waves 1–8, 1993–2013.

*Significant at the 0.05 level. **Significant at the 0.01 level. ***Significance at the 0.001 level.

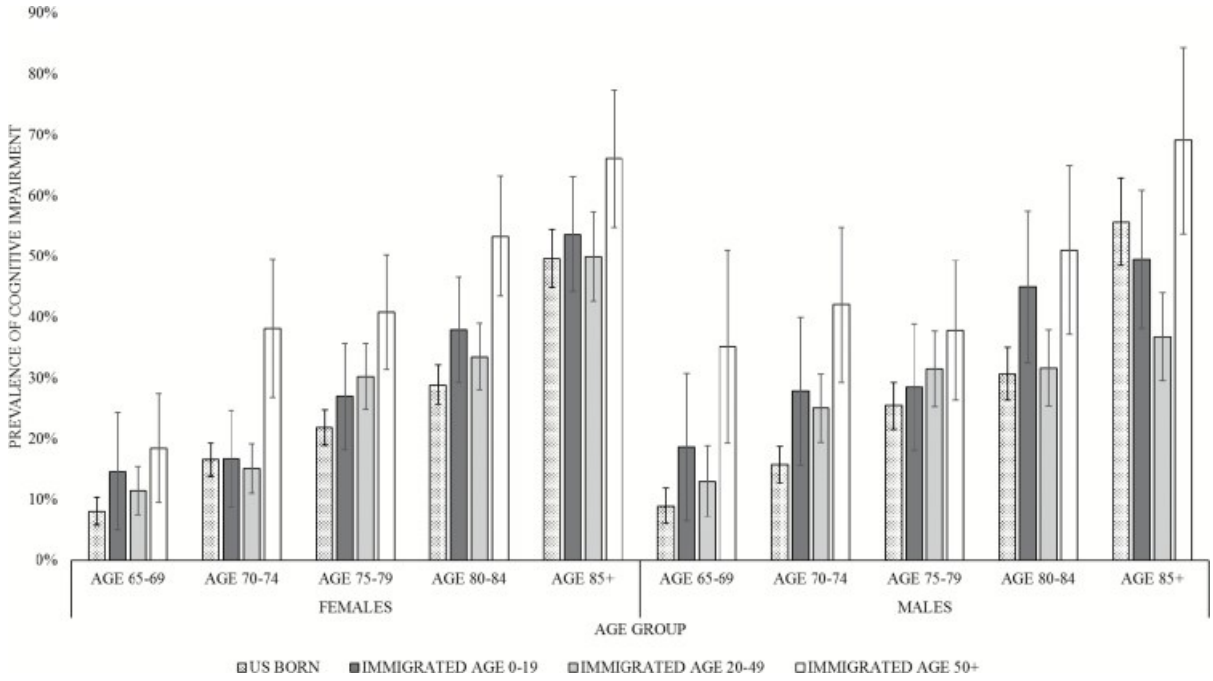

Figure 1. Prevalence of cognitive impairments by gender, nativity, and age group among older Mexican-Americans.

Table 3 presents estimates of total life expectancy for men and women at age 65 as well as the expected number of years lived with and without cognitive impairment. The analysis involves the estimate of the proportion of life spent with cognitive impairment relative to the total number of years lived after age 65 (see Figure 2).

Table 3. Life Expectancy With Cognitive Impairment at Age 65 by Nativity, Age of Migration, and Gender

	Cognitive Impairment				
	Age of Migration Subgroups				
	US-Born	(All) FB	0–19	20–49	50+
Females	**Years (*SE*)**	**Years (*SE*)**	**Years (*SE*)**	**Years (*SE*)**	**Years (*SE*)**
TLE	17.8 (0.34)	19.3 (0.38)**	20.8 (0.81)***	18.9 (0.49)	19.5 (0.83)**
LE without cognitive impairment	13.5 (0.27)	13.1 (0.31)	14.7 (0.68)	13.7 (0.47)	10.7 (0.67)***
LE with cognitive impairment	4.2 (0.17)	6.2 (0.26)***	6.1 (0.65)**	5.2 (0.31)*	8.7 (0.71)***
% Cognitively healthy	0.76 (0.01)	0.68 (0.01)***	0.70 (0.03)*	0.73 (0.01)*	0.55 (0.03)***
Males					
TLE	15.4 (0.31)	16.6 (0.49)*	16.0 (1.09)	17.1 (0.61)*	16.1 (0.89)
LE without cognitive impairment	11.9 (0.28)	11.3 (0.40)	11.1 (0.88)	12.3 (0.58)	9.0 (0.74)***
LE with cognitive impairment	3.5 (0.17)	5.4 (0.30)***	4.9 (0.60)*	4.8 (0.37)***	7.1 (0.67)***
% Cognitively healthy	0.77 (0.01)	0.68 (0.01)***	0.69 (0.03)*	0.72 (0.02)	0.56 (0.03)***

Note: H-EPESE Wave 1–8, 1993–2013. The reference category is U.S.-born respondents. FB = foreign-born refers to all age of migration subgroups; LE = life expectancy; TLE = total life expectancy; SE = standard error.

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

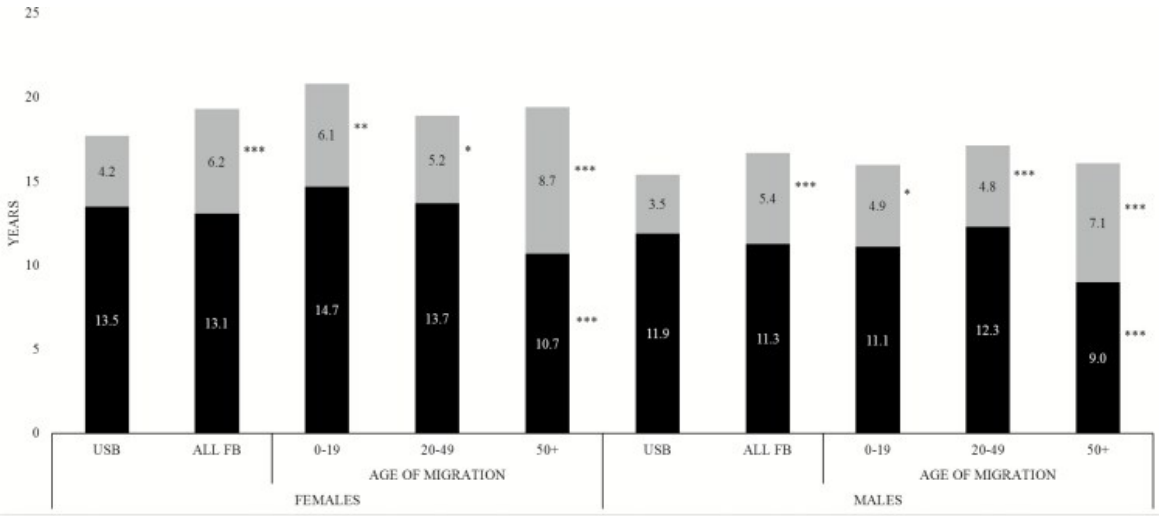

Figure 2. Life expectancy with cognitive impairment at age 65 by nativity, age of migration, and gender. USB = U.S.-born respondents; FB = foreign-born.

Among women, total life expectancy at age 65 is significantly higher (19.3 years) for the foreign-born than for the U.S.-born (17.8 years). Foreign-born women can expect to spend about the same number of years without cognitive impairment (13.1 years vs. 13.5 years), but more years with cognitive impairment (6.2 years vs. 4.2 years) than U.S.-born women.

Although life expectancy without cognitive impairment for foreign-born women is somewhat similar to that of U.S.-born women, their years of life expectancy with cognitive impairment are

not. There are statistically significant differences in the ratio of number of years lived with cognitive impairment to the total number of years lived. Foreign-born women are expected to spend 68% of their remaining years after age 65 without cognitive impairment compared to 76% for U.S.-born. Thus, cognitive impairment is much more a feature of the lives of foreign-born women past age 65 than for U.S.-born women. When assessed by age of migration, there are stark differences with late-life immigrant women being significantly disadvantaged in years after age 65 spent with cognitive impairment (8.7 years vs. 4.2 years), without cognitive impairment (10.7 years vs. 13.5 years), and the ratio of late-life spent cognitively healthy (55% vs. 76%, respectively) relative to U.S.-born women. Early-life and mid-life immigrant women are also disadvantaged in life expectancy with cognitive impairment and proportion of life after 65 spent cognitively healthy compared to U.S.-born women. However, mid-life immigrant women are the least disadvantaged among foreign-born subgroups.

A slightly different pattern emerges for men. Results indicate that at age 65, foreign-born men can expect to live an additional 16.6 years compared to 15.4 years for U.S.-born men. Foreign-born men also spend significantly more time with cognitive impairment than U.S.-born men (5.4 years vs. 3.5 years, respectively). Conversely, no differences emerge in the number of years spent without cognitive impairment. Moreover, the data indicate the ratio of the number of years lived cognitively healthy to the total number of years lived is lower for foreign-born men than U.S.-born men (68% vs. 77%, respectively). Although foreign-born men clearly show an immigrant advantage in total life expectancy at age 65, the additional years of life largely reflect additional years spent with cognitive impairment. These results represent not only the greater prevalence of cognitive impairment among the foreign-born, but also their lower rates of mortality. However, important differences are evident by age of migration. Similar to women, late-life immigrant men are the most disadvantaged in years after age 65 spent with cognitive impairment (7.1 years vs. 3.5 years), without cognitive impairment (9.0 years vs. 11.9 years), and the ratio of late-life spent cognitively healthy (56% vs. 77%) compared to U.S.-born men. Early-life immigrant men are disadvantaged only in life expectancy with cognitive impairment (4.9 years) and ratio of years after age 65 spent cognitively healthy (69%). Conversely, mid-life immigrant men are driving the immigrant advantage in total life expectancy and are not statistically different in the ratio of years after 65 spent without cognitive impairment. In sum, both foreign-born men and women live longer than their U.S.-born counterparts, but they do so living with cognitive impairment with important variations by age of migration.

Discussion

The rapid growth in the elderly Mexican-American population presents policy makers and health care professionals with an urgent need for research focused on the health of older Latinos. Despite the growing numbers of Mexican-Americans in the United States, we understand little about how nativity and, for immigrants, age of migration effect cognitive health outcomes among older Mexican-Americans.

We find support for our first hypothesis that foreign-born Mexican-Americans, regardless of gender, spend a greater number of years after age 65 with cognitive impairment compared to U.S.-born Mexican-Americans. This finding is in contrast to previous research suggesting favorable health profiles among immigrants (Riosmena et al., 2013). Our findings may reflect the

longer life expectancies among the foreign-born, which would result in a decreased health advantage with age (Markides & Rote, 2015). Lower levels of education for foreign-born Latinos may also contribute to the high levels of cognitive impairment and greater number of years lived with cognitive impairment.

Providing care for older adults with cognitive impairment is costly and time-consuming for families. Our findings raise serious concerns about the lack of culturally and linguistically competent formal cognitive impairment care options for older Mexican-Americans. Latinos, especially of Mexican-origin, are highly reliant on family members for support in late life (Rote & Moon, 2016). Recent evidence from the H-EPESE caregiver supplement shows that cognitive impairment, especially when accompanied by neuropsychiatric disturbances, is a strong predictor of Mexican-American caregiver psychological distress (Rote, Angel, & Markides, 2015). Providing care for older Mexican-Americans with impaired cognition can be further complicated by the substantial physical functioning and disability life expectancies observed for older Latinos (Cantu et al., 2013; Garcia et al., 2015). This is particularly true of late-life immigrant women who have been shown to spend over two thirds and nearly 78% of their remaining years after age 65 with a functional limitation and an instrumental activities of daily living disability (Garcia et al., 2017; Garcia & Chiu, 2016). Evidence also shows that Mexican-American caregivers to foreign-born elders have smaller networks of support, less resources, and less help with care tasks (Angel, Angel, & Hill, 2014). With more years spent with cognitive and physical impairments, and smaller networks of support, providing care may be more costly for families of Latinos born outside of the United States. In addition, older Latinos born outside of the United States may face more linguistic and cultural barriers when engaging with the formal care sector. Intervention strategies and efforts should focus on the unique challenges and needs of older foreign-born Latinos and their family caregivers.

Second, we find support for our second hypothesis that foreign-born Mexican-American women are especially disadvantaged compared to men in life expectancy with cognitive impairment. These findings support the notion that foreign-born men are more health selected for migration than women (Garcia & Reyes, 2017a; Garcia & Reyes, 2017b). Moreover, cognitive deterioration appears to be slower for foreign-born than U.S.-born men to the extent that foreign-born men had a higher prevalence of cognitive impairment from ages 70 to 79, but this disadvantage disappeared in the oldest age groups (85+). A similar crossover effect has been observed for physical functioning and depressive symptoms among subjects of the H-EPESE (Garcia & Reyes, 2017a; Rote, Chen, & Markides, 2015). This crossover effect in the rates of cognitive impairment for Mexican-American men may also be due to selective mortality among the foreign-born such that the observed risk for cognitive impairment begins to decline after a certain age. This is supported by evidence that the incidence rate of dementia slows in the oldest old (90+), which has been reported by several studies (Gao, Hendrie, Hall, & Hui, 1998; Hall et al., 2005), but not all (Corrada, Brookmeyer, Paganini-Hill, Berlau, & Kawas, 2010). Additionally, the decrease in incidence rates for dementia among the oldest old have been reported to be greater for men than women (Hall et al., 2005; Ruitenberg, Ott, van Swieten, Hofman, & Breteler, 2001).

An alternative explanation is that U.S.-born Mexican-Americans may have a later onset of cognitive impairment than foreign-born Mexican-Americans, possibly due to higher educational

attainment and better access to preventive health care. Greater educational attainment is associated with decreased risk for dementia (Stern et al., 1994), but older adults with high education have also been observed to experience more rapid cognitive decline (Gross et al., 2015). Thus, the observed crossover in cognitive impairment prevalence at advanced ages may be due to the incidence of cognitive impairment among U.S.-born "catching up" to the incidence of foreign-born in later ages as a result of education differences and other factors that may delay the onset of cognitive impairment.

Finally, we find support for our third hypothesis indicating positive health selectivity among mid-life immigrants in life expectancy with cognitive impairment compared to early- and late-life immigrants regardless of gender. The results presented above document an advantage in life expectancy with cognitive impairment and proportion of years after age 65 cognitively healthy among mid-life immigrant men and women relative to other foreign-born subgroups. This is further evidence that foreign-born Mexican immigrants are not a homogeneous group. Their health in later life varies considerably depending on demographic and socioeconomic characteristics associated with age of migration. Thus, the inclusion of age of migration is particularly important in examining how the Mexican migration experience to the United States influences cognitive aging.

The prevalence of cognitive impairment increased with age and was greater for the combined foreign-born compared to U.S.-born respondents. The highest prevalence of cognitive impairment was for respondents aged 85 years and older, in which 55.7% of U.S.-born men and 55.1% foreign-born women were classified as cognitively impaired. The prevalence of cognitive impairment for Hispanics aged 85 years and older in the Health and Retirement Study (Langa, Kabeto, & Weir, 2010) and the Washington Heights-Inwood Columbia Aging Project (Gurland et al., 1999) are 44.8% and 62.9%, respectively, which is consistent with our findings. However, approximately 70% of foreign-born men and 66% of women aged 85 years and older who migrated to the United States more than age 50 were classified as cognitively impaired. This highlights the importance of accounting for nativity *and* age of migration when examining cognitive impairment at the population level.

A limitation of this analysis is that cognitive impairment was defined using a threshold approach in which respondents scoring below 21 points on the MMSE were classified as impaired. Using a threshold approach may misclassify respondents as cognitively impaired or not impaired because it does not account for changes in cognition with age. Consequently, respondents who perform poorly on the MMSE across several observations may not actually be cognitively impaired. The potential for misclassification may have contributed to the very high prevalence of cognitive impairment among respondent aged 85 years and older who migrated to the United States after 50 years of age. A sensitivity analysis was conducted using a cutoff of 18 points to define cognitive impairment, but the interpretation of these results for life expectancy with cognitive impairment did not change from the original analysis. Assessments such as the Wide Range Achievement Test (WRAT; Wilkinson, 1993) that measure cognitive domains that show minimal change with age or progression of dementia can be used to account for premorbid cognitive function. Adjusting for WRAT performance has been shown to be more accurate than using education-based norms for identifying mild cognitive impairment (Ahl et al., 2013). The H-EPESE does not include a measure of premorbid cognitive function and our findings need to be

replicated before conclusions on the prevalence of cognitive impairment among very old Mexican-Americans can be made.

The aim of our research was to describe the patterns of life expectancy with cognitive impairment by gender, nativity, and age of migration. The specification of our models has important implications for public health and public policy in that we estimate the burden that cognitive impairments in the Mexican-American population will place on families and health care systems. However, future research should examine how differences in educational attainment across gender, nativity, and age of migration groups influence both cognitive impairment *and* the life expectancy of the Mexican-American population.

Our findings that foreign-born Mexican-Americans spend a greater number of years living with cognitive impairment compared to U.S.-born Mexican-Americans has important implications given the rapid growth of the Mexican-American population. The robust relationship between nativity, age of migration, and life expectancy with cognitive impairment provides evidence that the foreign-born may place particularly serious burdens on their families and the society at large. The potential magnitude of the problem is dramatized by the fact that more than 50% of older Mexican-Americans in the H-EPESE rely primarily on Medicaid for their health care needs and rely on family members for cognitive impairment support and care (Rote, Angel, & Markides, 2015). Interventions that are culturally and linguistically competent and include caregiver support and education on providing effective care for a person with cognitive impairment are needed for this growing segment of the aging population. Continued research is also necessary to identify health, behavioral, and cultural factors that may reduce cognitive impairment risk among older Mexican-Americans.

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Conflict of Interest

The authors declare no conflict of interest.

References

- Ahl R. E. Beiser A. Seshadri S. Auerbach S. Wolf P. A., & Au R (2013). Defining MCI in the Framingham Heart Study Offspring: education versus WRAT-based norms. Alzheimer Disease and Associated Disorders, 27, 330–336. doi:10.1097/WAD.0b013e31827bde32 [PMC free article] [PubMed] [Google Scholar]
- Alzheimer's Association.(2010). 2010 Alzheimer's disease facts and figures. Alzheimer's and Dementia, 6, 158–194. [PubMed] [Google Scholar]
- Angel R. J. Angel J. L. Díaz Venegas C., & Bonazzo C (2010). Shorter stay, longer life: age at migration and mortality among the older Mexican-origin population. Journal of

Aging and Health, 22, 914–931. doi:10.1177/0898264310376540 [PMC free article] [PubMed] [Google Scholar]
- Angel R. J. Angel J. L., & Hill T. D (2014). Longer lives, sicker lives? Increased longevity and extended disability among Mexican-origin elders. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 70, 639–649. doi:10.1093/geronb/gbu158 [PMC free article] [PubMed] [Google Scholar]
- Angel R. J. Angel J. L. Lee G.-Y., & Markides K. S (1999). Age at migration and family dependency among older Mexican immigrants: recent evidence from the Mexican American EPESE. The Gerontologist, 39, 59–65. doi:10.1093/geront/39.1.59 [PubMed] [Google Scholar]
- Antecol H., & Bedard K (2006). Unhealthy assimilation: why do immigrants converge to American health status levels?Demography, 43, 337–360. doi:10.1353/dem.2006.0011 [PubMed] [Google Scholar]
- Bostean G. (2013). Does selective migration explain the Hispanic paradox? A comparative analysis of Mexicans in the U.S. and Mexico. Journal of Immigrant and Minority Health, 15, 624–635. doi:10.1007/s10903-012-9646-y [PMC free article] [PubMed] [Google Scholar]
- Cantu P. Hayward M. Hummer R., & Chiu C.-T (2013). New estimates of racial/ethnic differences in Life expectancy with chronic morbidity and functional loss: evidence from the National Health Interview Survey. Journal of Cross-Cultural Gerontology, 28, 283–297. doi:10.1007/s10823-013-9206-5 [PMC free article] [PubMed] [Google Scholar]
- Corrada M. M. Brookmeyer R. Paganini-Hill A. Berlau D., & Kawas C. H (2010). Dementia incidence continues to increase with age in the oldest old: the 90+ study. Annals of Neurology, 67, 114–121. doi:10.1002/ana.21915 [PMC free article] [PubMed] [Google Scholar]
- Crimmins E. M. Kim J. K. Alley D. E. Karlamangla A., & Seeman T (2007). Hispanic paradox in biological risk profiles. American Journal of Public Health, 97, 1305–1310. doi:10.2105/AJPH.2006.091892 [PMC free article] [PubMed] [Google Scholar]
- Dannefer D. (2003). Cumulative advantage/disadvantage and the life course: cross-fertilizing age and social science theory. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 58, S327–S337. doi:10.1093/geronb/58.6.S327 [PubMed] [Google Scholar]
- Folstein M. F. Folstein S. E., & McHugh P. R (1975). “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research, 12, 189–198. [PubMed] [Google Scholar]
- Gao S. Hendrie H. C. Hall K. S., & Hui S (1998). The relationships between age, sex, and the incidence of dementia and Alzheimer disease: a meta-analysis. Archives of General Psychiatry, 55, 809–815. [PubMed] [Google Scholar]
- Gross A. L., Mungas D. M., Crane P. K., Gibbons L. E., MacKay-Brandt A., Manly J. J., Jones R. N. (2015). Effects of education and race on cognitive decline: an integrative study of generalizability versus study-specific results. Psychology and Aging, 30, 863–880. doi:10.1037/pag0000032 [PMC free article] [PubMed] [Google Scholar]
- Garcia M. A. Angel J. L. Angel R. J. Chiu C. T., & Melvin J (2015). Acculturation, gender, and active life expectancy in the Mexican-origin population. Journal of Aging and Health, 27, 1247–1265. doi:10.1177/0898264315577880 [PMC free article] [PubMed] [Google Scholar]

- Garcia M. A., & Chiu C.-T (2016). Age at migration and disability-free life expectancy among the elder Mexican-origin population. Demographic Research, 35, 1523–1536. doi:10.4054/DemRes.2016.35.51 [PMC free article] [PubMed] [Google Scholar]
- Garcia M. A., & Reyes A. M (2017a). Physical functioning and disability trajectories by age of migration among Mexican elders in the United States. The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, gbw167. doi:10.1093/geronb/gbw167 [PMC free article] [PubMed] [Google Scholar]
- Garcia M. A., & Reyes A. M (2017b). Prevalence and trends in morbidity and disability among older Mexican Americans in the Southwestern United States, 1993–2013. Research on Aging, doi:0164027517697800 [PMC free article] [PubMed] [Google Scholar]
- Garcia M. A. Valderrama-Hinds L. M. Chiu C.-T. Mutambudzi M. S. Chen N.-W., & Raji M (2017). Age of migration life expectancy with functional limitations and morbidity in Mexican Americans. Journal of the American Geriatrics Society. doi:10.1111/jgs.14875 [PMC free article] [PubMed] [Google Scholar]
- González H. M. Ceballos M. Tarraf W. West B. T. Bowen M. E., & Vega W. A (2009). The health of older Mexican Americans in the long run. American Journal of Public Health, 99, 1879–1885. doi:10.2105/AJPH.2008.133744 [PMC free article] [PubMed] [Google Scholar]
- Gubernskaya Z. Bean F. D., & Van Hook J (2013). (Un)Healthy immigrant citizens: naturalization and activity limitations in older age. Journal of Health and Social Behavior, 54, 427–443. doi:10.1177/0022146513504760 [PMC free article] [PubMed] [Google Scholar]
- Gurland B. J. Wilder D. E. Lantigua R. Stern Y. Chen J. Killeffer E. H., & Mayeux R (1999). Rates of dementia in three ethnoracial groups. International Journal of Geriatric Psychiatry, 14, 481–493. [PubMed] [Google Scholar]
- Hall C. B. Verghese J. Sliwinski M. Chen Z. Katz M. Derby C., & Lipton R. B (2005). Dementia incidence may increase more slowly after age 90: results from the Bronx Aging Study. Neurology, 65, 882–886. doi:10.1212/01.wnl.0000176053.98907.3f [PubMed] [Google Scholar]
- Hill T. D. Angel J. L., & Balistreri K. S (2012). Does the “healthy immigrant effect” extend to cognitive aging? Aging, health, and longevity in the Mexican-origin population (pp. 19–33). New York: Springer. [Google Scholar]
- Hill T. D. Angel J. L. Balistreri K. S., & Herrera A. P (2012). Immigrant status and cognitive functioning in late-life: an examination of gender variations in the healthy immigrant effect. Social Science and Medicine (1982), 75, 2076–2084. doi:10.1016/j.socscimed.2012.04.005 [PMC free article] [PubMed] [Google Scholar]
- Jagger C. Cox B., & Le Roy S (2006). EHEMU (2006) Health expectancy calculation by the sullivan method. European Health Expectancy Monitoring Unit (EHEMU) Technical Report, Montpellier. [Google Scholar]
- Jones R. N. (2006). Identification of measurement differences between English and Spanish language versions of the Mini-Mental State Examination. Detecting differential item functioning using MIMIC modeling. Medical Care, 44(11 Suppl 3), S124–S133. doi:10.1097/01.mlr.0000245250.50114.0f [PubMed] [Google Scholar]

- Langa K. M. Kabeto M., & Weir D (2010). Report on race and cognitive impairment using HRS in, 2010 Alzheimer's disease facts and figures 2010. Alzheimer's Disease Facts and Figures. [Google Scholar]
- Lara M. Gamboa C. Kahramanian M. I. Morales L. S., & Bautista D. E (2005). Acculturation and Latino health in the United States: a review of the literature and its sociopolitical context. Annual Review of Public Health, 26, 367–397. doi:10.1146/annurev.publhealth.26.021304.144615 [PMC free article] [PubMed] [Google Scholar]
- Markides K., & Gerst K (2011). Immigration, aging, and health in the United States. In Settersten R. A., Angel J. L. (Eds.), Handbook of Sociology of Aging (pp. 103–116). New York: Springer. [Google Scholar]
- Markides K. S., & Eschbach K (2005). Aging, migration, and mortality: current status of research on the Hispanic paradox. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 60, 68–75. doi:10.1093/geronb/60.Special_Issue_2.S68 [PubMed] [Google Scholar]
- Markides K. S., & Rote S (2015). Immigrant health paradox emerging trends in the social and behavioral sciences: an interdisciplinary, searchable, and linkable resource. New York: John Wiley & Sons, Inc; Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/9781118900772.etrds0174/full [Google Scholar]
- Markides K. S. Rudkin L. Angel R. J., & Espino D. V (1997). Health status of Hispanic elderly. In National Research Council (US) Committee on Population; Martin LG, Soldo BJ, editors. Racial and ethnic differences in the health of older Americans, Washington, DC: National Academies Press (US), 285–300. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK109838/
- Morales L. S. Flowers C. Gutierrez P. Kleinman M., & Teresi J. A (2006). Item and scale differential functioning of the Mini-Mental State Exam assessed using the Differential Item and Test Functioning (DFIT) Framework. Medical Care, 44(11 Suppl 3), S143–S151. doi:10.1097/01.mlr.0000245141.70946.29 [PMC free article] [PubMed] [Google Scholar]
- Nguyen H. T. Black S. A. Ray L. A. Espino D. V., & Markides K. S (2002). Predictors of decline in MMSE scores among older Mexican Americans. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 57, M181–M185. [PubMed] [Google Scholar]
- Raji M. A. Al Snih S. Ray L. A. Patel K. V., & Markides K. S (2004). Cognitive status and incident disability in older Mexican Americans: findings from the Hispanic established population for the epidemiological study of the elderly. Ethnicity and Disease, 14, 26–31. [PubMed] [Google Scholar]
- Riosmena F. Kuhn R., & Jochem W. C (2017). Explaining the immigrant health advantage: self-selection and protection in health-related factors among five major National-Origin Immigrant Groups in the United States. Demography, 54, 175–200. doi:10.1007/s13524-016-0542-2 [PMC free article] [PubMed] [Google Scholar]
- Riosmena F. Wong R., & Palloni A (2013). Migration selection, protection, and acculturation in health: a binational perspective on older adults. Demography, 50, 1039–1064. doi:10.1007/s13524-012-0178-9 [PMC free article] [PubMed] [Google Scholar]

- Rote S. Chen N. W., & Markides K (2015). Trajectories of depressive symptoms in elderly Mexican Americans. Journal of the American Geriatrics Society, 63, 1324–1330. doi:10.1111/jgs.13480 [PMC free article] [PubMed] [Google Scholar]
- Rote S. Angel J. L., & Markides K (2015). Health of elderly Mexican American adults and family caregiver distress. Research on Aging, 37, 306–331. doi:10.1177/0164027514531028 [PMC free article] [PubMed] [Google Scholar]
- Rote S. M., & Moon H (2016). Racial/ethnic differences in caregiving frequency: does immigrant status matter?The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, gbw106. doi:10.1093/geronb/gbw106 [PubMed] [Google Scholar]
- Ruitenberg A. Ott A. van Swieten J. C. Hofman A., & Breteler M. M (2001). Incidence of dementia: does gender make a difference?Neurobiology of Aging, 22, 575–580. [PubMed] [Google Scholar]
- Samper-Ternent R. Al Snih S. Raji M. A. Markides K. S., & Ottenbacher K. J (2008). Relationship between frailty and cognitive decline in older Mexican Americans. Journal of the American Geriatrics Society, 56, 1845–1852. doi:10.1111/j.1532-5415.2008.01947.x [PMC free article] [PubMed] [Google Scholar]
- Sheffield K. M., & Peek M. K (2009). Neighborhood context and cognitive decline in older Mexican Americans: results from the Hispanic Established Populations for Epidemiologic Studies of the Elderly. American Journal of Epidemiology, 169, 1092–1101. doi:10.1093/aje/kwp005 [PMC free article] [PubMed] [Google Scholar]
- Stepler A., & Brown A (2016). Statistical portrait of Hispanics in the United States in 2013 (Vol. 4, pp. 19). Washington, DC: Pew Research Center; Retrieved October 6, 2016, from http:// www. pewhispanic.org [Google Scholar]
- Stern Y. Gurland B. Tatemichi T. K. Tang M. X. Wilder D., & Mayeux R (1994). Influence of education and occupation on the incidence of Alzheimer's disease. JAMA, 271, 1004–1010. [PubMed] [Google Scholar]
- Sullivan D. F. (1971). A single index of mortality and morbidity. HSMHA Health Reports, 86, 347–354. [PMC free article] [PubMed] [Google Scholar]
- Treas J. (2015). Incorporating immigrants: integrating theoretical frameworks of adaptation. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 70, 269–278. doi:10.1093/geronb/gbu067 [PubMed] [Google Scholar]
- Treas J., & Mazumbar S (2002). Older people in America's immigrant families: Dilemmas of dependence, integration, and isolation. Journal of Aging Studies, 16, 243–258. doi:/10.1016/S0890-4065(02)00048-8 [Google Scholar]
- Uhlmann R. F., & Larson E. B (1991). Effect of education on the mini-mental state examination as a screening test for dementia. Journal of the American Geriatrics Society, 39, 876–880. [PubMed] [Google Scholar]
- U.S. Census Bureau (2014). An Aging nation: The older Population in the United States. Washington, DC: U.S. Census Bureau. [Google Scholar]
- Wilkinson G. S. (1993). Wide Range Achievement Test 3- Administration manual. Wilmington, DE: Jastak Associates, Inc. [Google Scholar]
