The relationship between living arrangements and nativity status on cognitive health of older Mexican American adults using the H-EPESE dataset

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Abstract –

Objectives: Examine nativity differences in the relationship between living arrangement and cognitive impairment among Mexican Americans aged ≥75 years with normal or high cognitive function at baseline over a 9-year period.

Design: Longitudinal cohort study.

Setting: Data from the Hispanic Established Population for the Epidemiological Study of the Elderly (2004/2005–2016).

Participants: A total of 1,026 participants aged ≥75 years. Participants were categorized into three living arrangement groups: living alone (n=274), living with one other person (n=469), and living with two or more people (n=283). These groups were further stratified by nativity.

Measurements: Living arrangement was the predictor variable and the outcome variable was performance on Mini Mental State Examination (MMSE). Covariates included age, sex, nativity, years of education, marital status, language of interview, multimorbidity, pain on weightbearing, falls, depressive symptoms, and scores on short physical performance battery (SPPB) and hand grip strength.

Results: US-born participants living with one other person or with two or more people had significantly higher odds of cognitive impairment (OR=1.68, 95% CI=1.02-2.76, p=0.0415 and OR=1.66, 95% CI=1.02-2.68, p=0.0395, respectively) compared to those living alone over time after controlling for all covariates. In contrast, no significant association between living arrangement and cognitive impairment was observed among foreign-born participants.

Conclusions: US-born older Mexican Americans living with one or more people have higher odds of cognitive impairment over time compared to foreign-born older Mexican Americans. These findings emphasize the importance of targeted interventions that consider household composition and cultural heritage in addressing cognitive health among older adults.

(Word count: 249)

1   INTRODUCTION

The Hispanic community, with Mexican Americans constituting over 60%, is among the fastest-growing cohorts of older adults in the United States.[1] Projections indicate a substantial increase in the proportion of Hispanic seniors, accompanied by a stark contrast in the aging trends of non-Hispanic whites. Despite the strides made in healthcare accessibility and quality in the United States, disparities in morbidity and mortality rates persist, revealing a complex interplay of factors that influence health across different racial and ethnic groups.[2–6] The Mexican American population carries significant public health implications, particularly in light of research pointing to a higher prevalence of cognitive impairment and dementia among older Hispanics compared to their non-Hispanic white counterparts. For example, older Latinos are at 1.5 times greater risk for Alzheimer's disease and other forms of dementia in late life than non-Latino whites, displaying symptoms of cognitive impairment 7 years earlier.[7] These differences observed in cognitive impairment and dementia rates are believed to stem from genetic, behavioral, and socioeconomic influences, with the majority of research underscoring the significance of socioeconomic conditions.[8]

This study draws from a life course perspective to identify the role of midlife factors, specifically marital status, nativity status, and living arrangements, to late-life cognitive impairment. The life course can refer to the complex interrelationship between events and transitions across important life domains (eg., education, family, migration, health) that occur as a person ages. As an analytical approach, life course theory is well suited to explore the impact of life experiences and events on health statuses.[9]

Living arrangement is a critical component for the psychological well-being of older adults.[10] Older adults with cognitive decline are more likely to engage in limited activities of daily living and require increased levels of care from their families and society.[11] The current evidence on the associations between living arrangement and cognitive function remains mixed. A substantial body of literature suggests that living with household members is more beneficial for mental health and cognitive function than living alone.[12–14] Conversely, other studies have found that older adults living in multigenerational-homes or with other household members had a higher risk of cognitive impairment compared to those living with their spouses.[15]

Interestingly, one study by Evans et al. suggests that people living alone in later life were not at greater risk of cognitive impairment because they were not prevented from interacting with others in their community and were likely to engage in regular social activity.[16]

Furthermore, studies have documented differences in health status by nativity across different racial and ethnic groups, generally revealing that foreign-born individuals tend to have better health compared to their US-born counterparts, including healthier behaviors such as reduced rates of smoking, lower mortality from cardiovascular disease, and lower late-life mortality.[17] The importance of the health of foreign-born older-adult populations will continue to increase as the U.S. population of foreign-born adults age 65 years and older is expected to rise from 13.9% in 2018 to an estimated 23.3% by 2060.[18] Interestingly, studies examining cognitive function among older adults also demonstrate nativity differences. A recent analysis on the H-EPESE dataset found that foreign-born individuals in the top 3rd and 4th handgrip strength quartiles had lower odds of cognitive impairment than US-born individuals in the upper two handgrip strength quartiles.[19] Data from the Health and Retirement Study shows that both U.S. and foreign-born Latina females maintained higher cognitive function in comparison to White females over the same time period.[20] Another study using the same dataset found that foreign-born Hispanic males and females experienced a significantly lower decline in cognitive functioning in comparison to Whites after controlling for socioeconomic and health-related factors.[21]

While many studies have found associations between living arrangement and cognitive impairment, and nativity status and cognitive impairment, few studies have examined the effect of nativity status on the relationship between living arrangement and cognitive impairment in the Mexican American older adult population, which is a population at increased risk of cognitive impairment and dementia. Therefore, the objective of this study was to examine nativity differences in the relationship between living arrangement and cognitive impairment among Mexican American older adults over 12 years of follow-up among those with moderate to high cognitive function at baseline. We hypothesize that an increased number of

household members will be associated with cognitive impairment, and that this association will vary by nativity status.

2   MATERIALS AND METHODS

2.1   Sample

The data used in this study was drawn from the Hispanic Established Population for the Epidemiologic Study of the Elderly (HEPESE), a longitudinal cohort study of non-institutionalized Mexican American older adults who resided in Arizona, California, Colorado, New Mexico, and Texas. The initial HEPESE cohort study included 3050 Mexican Americans aged 65 years and older interviewed in 1993/94. In 2004/05, an additional cohort of 902 participants aged 75 years and older were added to those who survived from the original cohort (N=1167) aged 75 years and older (N = 2069). Interviews in English or Spanish were conducted every 2 or 3 years by trained interviewers to gather information on participant socio-demographics, health conditions, and psychosocial characteristics. Information on the survey contents and datasets is available at the National Archive of Computerized Data on Aging.[22] The present analysis used data from Waves 5-9. Fig. 1 shows the process of cohort selection. As we were interested in examining the relationship of living arrangement and nativity on changes in cognitive function in those with normal or high cognitive function at baseline, we excluded those who scored less than 21 in the Mini Mental State Examination (MMSE) at baseline (n=441). Of the 2069 participants interviewed at Wave 5, we also excluded 602 with missing information on any of the variables included in the analyses. Compared to those included, excluded participants were significantly more likely at baseline to be older, widowed, foreign-born; to have a lower level of education; report more falls; report more depressive symptoms; to have multimorbidity, and to score lower on the Short Physical Performance Battery (SPPB) and handgrip strength. Oral informed consent was obtained from all participants at each wave of interview, and the study protocol was approved by the University of Texas Medical Branch Institutional Review Board (IRB#16-0014).

2.2   Measures

2.2.1   Predictor Variable

Living arrangement was assessed by asking participants: "How many people live in this household?" and reported as the number of individuals living in the household, and participants were categorized as living alone, living with one other person, and living with 2 or more people.

2.2.2   Outcome Variable

Cognitive function was assessed with MMSE, a 30-item examination concentrating on the cognitive aspects of mental functions.[23] The examination was administered by interviewers who were trained through workshops and videotaped instructions. The Spanish version of the MMSE meets standardized criteria for translated tests, which includes formal translation, back-translation, and committee consensus approval of the finalized content.[24] MMSE scores were used as a continuous variable, ranging from 0 to 30, with higher scores indicating better cognitive performance. We defined cognitive impairment as an MMSE score <21, which has been previously found to be appropriate for samples of older adults with low education and has been previously used with the HEPESE.[25,26]

2.2.3   Covariates

Selected covariates for analysis included age, sex, nativity (US-born vs. foreign-born), years of education, marital status (married vs unmarried), language of interview (English vs. Spanish), multimorbidity (2 or more of the following: hypertension, arthritis, diabetes, heart failure, heart attack, stroke, cancer, hip fracture, anemia, kidney disease, COPD, thyroid disease), pain on weightbearing, number of falls in the prior year (1 or more), depressive symptoms (measured with Center for Epidemiological Studies Depression Scale), and scores on short physical performance battery (SPPB) and hand grip strength.

2.3   Statistical Analysis

Descriptive statistics are presented as mean ± standard deviation for normally distributed continuous variables. The distribution of normality was tested using the Shapiro-Wilk test. The frequency distributions

of categorical variables are presented as numbers and percentages. We used Chi Square and ANOVA tests to compare the baseline characteristics of the sample by living arrangement and nativity status. Generalized estimating equation (GEE) models using the GENMOD procedure in SAS were used to estimate the odds ratio (OR) and 95% confidence interval (CI) of cognitive impairment (MMSE <21) over 9 years as a function of living arrangement by nativity status. The GEE model minimizes selection bias from missing data because it allows for the use of all available data from all follow-up interviews by accounting for differences in the follow-up duration.[27,28] The models used a logit-linked binomial distribution and autoregressive order correlation structure to account for repeated measures of participants.[29] The Akaike information criterion and Bayesian information criterion values were used to select the covariance matrix for analysis. All variables were used as time varying with the potential to change from interview to interview except for age, sex, and education. Participants who refused to participate, died, or were lost to follow-up were included until their last interview date over the 9 years of follow-up. Statistical analyses were performed using the SAS System for Windows version 9.4 (SAS Institute, Inc. Cary, NC).

3 RESULTS

3.1 Characteristics of study participants

A total of 1,026 participants were included in the final analysis. The average age of overall sample was 80.8 years, standard deviation (SD) ± 4.2 years; 62.1% were female, 48% were married, 10% were separated or divorced, and 42% were widowed; the mean years of education was 6.4 ± 3.9 years. About 69% had multimorbidity, 11% reported high depressive symptoms (CES-D ≥ 16), 53% reported experiencing pain, 29% experienced one or more falls in the last 12 months. The mean scores were 25.4 ± 3.1 for MMSE, 6.6 ± 3.5 for SPPB, and 28.6 ± 7.6 kg (males) and 17.7 ± 5.0 kg (female) for handgrip strength.

Among US-born participants, 26.7% lived alone, 42.7% lived with one other person, and 25.7% lived with two or more people. Compared to those living alone, those living with two or more people were significantly more likely to be younger (mean age 81 years ± 4.9 years vs. 82.2 years ± 5.6 years), be male (46.2% vs. 26.9% female), be married (58.8% vs. 2.9%), have a lower level of education (mean 3.1 ± 2.8 years vs. 5.3 ± 3.5 years), have more multimorbidity (73.1% vs. 60.6%), and report fewer depressive symptoms (11.8% vs. 22.1%). Compared to those living alone, those living with one other person were significantly more likely to be younger (mean age 80.4 years ± 3.6 years vs. 82.2 years ± 5.6 years), be male (45.8% vs. 26.9% female), be married (70.5% vs. 2.9%), have a similar level of education (mean 5.2 ± 3.5 years vs. 5.3 ± 3.5 years), interview in English, and report fewer depressive symptoms (10.8% vs. 22.1%).

Among foreign-born participants, 26.7% lived alone, 47.6% lived with two people, and 25.7% lived with three or more people. Compared to those living alone, those living with two or more people were significantly more likely to be younger (mean age 80.7 years ± 4.2 years vs. 81.2 years ± 4.2 years), be male (43.9% vs. 25.9% female), be married (54.3% vs. 1.2%), and report fewer depressive symptoms (10.4% vs. 13.5%). Compared to those living alone, those living with one other person were significantly more likely to be younger (mean age 80.2 years ± 3.5 years vs. 81.2 years ± 4.2 years), be male (37.6% vs. 25.9% female), be married (67.0% vs. 1.2%), and report fewer depressive symptoms (5.6% vs. 13.5%).

3.2   Generalized Estimation Equation Model Results

Table 2 presents the results of the Generalized Estimation Equation (GEE) models for cognitive impairment as a function of living arrangement by nativity among Mexican American older adults with moderate to high cognitive function (MMSE > 21) at baseline.

US-born participants living with one person or with two or more people had greater odds (OR=1.68, 95% CI=1.02-2.76, p=0.0415 and OR=1.66, 95% CI=1.02-2.68, p=0.0395, respectively) of cognitive impairment compared to those living alone over time after controlling for all covariates. Other factors associated with increased risk cognitive decline were time of follow-up (years), being unmarried, and high depressive symptoms (CES-D $\geq$ 16). Factors associated with lower risk of cognitive impairment were female sex, higher levels of education, and higher scores on the SPPB test.

Among foreign-born participants, no significant association was found between living with one person or living with two or more people compared to living alone (OR=0.98, 95% CI=0.56-1.73, p=0.9517, OR=1.50, 95% CI=0.84-2.68, p=0.1673, respectively), with cognitive decline over time compared to living alone after controlling for all covariates. Factors associated with cognitive decline were time of follow-up (years), older age, and high depressive symptoms. Female sex, higher levels of education, and higher scores on the SPPB and handgrip strength were associated with lower odds of cognitive impairment over time.

Figure 1a shows the rates of cognitive impairment (MMSE $\leq$ 21) among US-born participants by living arrangement (living alone, living with one other person, or living with two or more people) over the study period. Among US-born participants, the percent of cognitive impairment increased over time among all living arrangement groups.

Figure 1b shows the rates of cognitive impairment (MMSE $\leq$ 21) among foreign-born participants by living arrangement (living alone, living with one other person, or living with two or more people) over the study period. Among foreign-born participants, those living alone and those living with 2 or more people showed

the highest percent of cognitive impairment until 2012/2013. In 2016, those living with one other person had the highest percent of cognitive impairment amongst the three living arrangement groups.

4   DISCUSSION

This longitudinal study examined the association between living arrangements and cognitive decline among Mexican American older adults by nativity (US-born vs. foreign-born). The findings revealed that among US-born participants, those living with one other person or those living with two or more people had 62.7% and 62.4% greater odds of developing cognitive impairment over time, respectively, compared to those living alone, after adjusting for all covariates. No significant association was observed between living arrangements and developing cognitive impairment over time among foreign-born participants after controlling for all covariates.

Several mechanisms may underlie our findings. Contrary to previous studies that suggest living alone is associated with higher rates of cognitive impairment[30–32], our results indicate that US-born older adults living alone experienced the smallest decline in cognitive function. One possible explanation is that living alone does not necessarily equate to social isolation, which is strongly associated with cognitive decline.[33,34] Indeed, living alone can coexist with robust social networks and active community engagement, mitigating the risks associated with social isolation.[35]

Another plausible explanation for this study's finding is 'selection bias.' Older adults who are cognitively intact and maintain healthier lifestyles may be more capable of living independently, leading their families to support their choice to live alone. Conversely, those with declining cognitive function or greater frailty may be more likely to co-reside with others, necessitating increased social support due to the complexity of their care needs.[36,37] This relationship is further complicated by research showing that native-born older adults are more likely to live alone than their immigrant counterparts, suggesting that US-born older adults may inherently have a higher likelihood of living alone from the outset, which could contribute to the observed differences in cognitive decline in such living arrangements.[38,39]

The non-significant difference in rates of cognitive impairment among foreign-born older adult participants living with one or more people may be partially explained by differences in communal living practices and the dynamics of acculturation. Foreign-born Mexican Americans tend to have larger households, a higher percentage of extended family households, and are more likely to live with children or other relatives than US-born Mexicans.[40] The extended family support and multigenerational living arrangements may provide emotional and practical support that can enhance overall well-being and potentially buffers against cognitive decline.[41] The impact of household size on cognitive health may be moderated by these cultural factors and the specific dynamics within the household, rather than being a universal risk factor.[42,43] Cultural factors and level of acculturation may also play a role. US-born Mexican Americans might have different family dynamics and social networks compared to their foreign-born counterparts. The assimilation into mainstream U.S. culture may alter traditional family structures and support systems, potentially affecting cognitive health.[44,45] The stress associated with acculturation experienced by foreign-born Mexican-American adults may also play a role in the rate of cognitive decline, further modulating the relationship between nativity and cognitive decline.[46]

Our findings differ from several studies conducted in other racial and ethnic groups, where living with others is often associated with better cognitive outcomes. For instance, one study found that among European older adults, those living with family members experienced a slower rate of cognitive decline compared to those living alone.[13] Similarly, another study in Singapore reported that older adults residing with family had better cognitive abilities than those living alone.[15] Additionally, a study in the United Kingdom observed that living alone was not associated with greater cognitive decline, emphasizing that social engagement outside of the household can mitigate risks associated with solitary living.[16] Interestingly, a study conducted Chinese older adults found that those experiencing family conflict while co-residing had a higher risk of cognitive impairment.[47] The results from these studies combined with our own highlight the role that cultural and environmental context have in mediating the relationship between living arrangement and cognitive impairment.

This study has some limitations. First, the assessment of cognitive impairment using the MMSE has some limitations in assessing cognitive function. Second, the exclusion of participants with missing key variables may underestimate our findings. Third, the HEPESE is not fully representative of the broader older Hispanic/Latino population in the US, which constrains the generalizability of these findings. Cultural and ethnic variations in perceptions of aging, cognitive impairment, disability, and dementia may further limit applicability to other populations. Despite these limitations, the study has several strengths, including the use of longitudinal data with nine years of follow-up from a large, representative Mexican American cohort, with a focus on the very old group of 75 years and older, which is one of the fastest growing group of older adults in the United States.[48]

In conclusion, this study demonstrates significant differences in cognitive decline among Mexican American older adults based on living arrangement and nativity, underscoring the unique challenges faced by these groups. US-born older adults residing with others exhibited a higher risk of cognitive impairment over time, while foreign-born older adults in households with one or more people exhibited less risk of cognitive impairment over time. These findings highlight the need for targeted interventions that consider household composition and cultural heritage when addressing cognitive health in older adults.

Further investigation into the role of family and community members in caregiving, particularly in foreign-born populations, may provide valuable insights into protective factors associated with multigenerational living arrangements. Understanding these factors could contribute to the development of culturally appropriate public health strategies tailored to the specific needs of Mexican American older adults. Addressing both individual risk factors and broader social and cultural contexts is essential for designing effective interventions to support aging populations experiencing cognitive decline.

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Table legend

Table 1. Baseline descriptive characteristics of the sample by living arrangement and nativity among Mexican American older adults with moderate to high cognitive function at baseline (N=1026).

Table 2: Generalized Estimation Equation models for cognitive impairment as a function of living arrangement by nativity among Mexican American older adults with moderate to high cognitive function at baseline (N=1026).

Figure legend

Figure 1. Rates of cognitive impairment (MMSE ≤ 21) among US-born participants by living arrangement over study period

Figure 2. Rates of cognitive impairment (MMSE ≤ 21) among Foreign-born participants by living arrangement over study period

Table 1. Baseline descriptive characteristics of the sample by living arrangement and nativity among Mexican American older adults with moderate to high cognitive function at baseline (N=1026).

	US-Born				Foreign-Born			
	Living alone	2 people	≥ 3 people	p-value	Living alone	2 people	≥ 3 people	p-value
Total	104 (26.7)	166 (42.7)	119 (30.6)		170 (26.7)	303 (47.6)	164 (25.7)	
Age, mean ± SD	82.2 ± 5.6	80.4 ± 3.6	81 ± 4.9	0.0086	81.2 ± 4.2	80.2 ± 3.5	80.7 ± 4.2	0.0189
Female	76 (73.1)	90 (54.2)	64 (53.8)	0.0033	126 (74.1)	189 (62.4)	92 (56.1)	0.0021
Marital status				<0.0001				<0.0001
Married	3 (2.9)	117 (70.5)	70 (58.8)		2 (1.2)	203 (67.0)	89 (54.3)	
Separated /divorced	19 (18.3)	5 (3.0)	7 (5.9)		38 (22.3)	26 (8.6)	8 (4.9)	
Widow	82 (78.9)	44 (26.5)	42 (35.3)		130 (76.5)	74 (24.4)	67 (40.8)	
Education (years), mean ± SD	5.3 ± 3.5	5.2 ± 3.5	3.1 ± 2.8	0.0059	7.2 ± 3.8	7.4 ± 4.0	7.0 ± 4.0	0.5982
Spanish Interview	99 (95.2)	157 (94.6)	113 (95.0)	<0.0001	110 (64.7)	208 (68.7)	111 (67.7)	0.6769
Multimorbidity	63 (60.6)	123 (74.1)	87 (73.1)	0.0431	119 (70.0)	201 (66.3)	117 (71.3)	0.4849
Pain	56 (53.9)	94 (56.6)	68 (57.1)	0.8671	100 (58.8)	144 (47.5)	86 (52.4)	0.0607
Falls (≥ 1)	37 (35.6)	45 (27.1)	42 (35.3)	0.2194	54 (31.8)	80 (26.4)	43 (26.2)	0.4004

High depressive symptoms (CES-D ≥ 16)	23 (22.1)	18 (10.8)	14 (11.8)	0.0237	23 (13.5)	17 (5.6)	17 (10.4)	0.0115
MMSE	24.8 ± 2.9	25.4 ± 3.2	24.7 ± 2.8	0.0946	25.6 ± 3.2	25.8 ± 3.1	25.3 ± 3.1	0.1894
SPPB	6.8 ± 3.3	6.6 ± 3.4	6.1 ± 3.8	0.2882	6.9 ± 3.3	6.6 ± 3.3	6.5 ± 3.8	0.5254
Handgrip strength, mean ± SD								
Male	28.6 ± 7.8	28.7 ± 7.7	28.4 ± 7.3	0.9365	28.6 ± 7.8	28.7 ± 7.7	28.4 ± 7.3	0.9365
Female	18.1 ± 4.8	17.9 ± 4.9	16.9 ± 5.4	0.0522	18.1 ± 4.8	17.9 ± 4.9	16.9 ± 5.4	0.0522

Abbreviations: CES-D= Center for Epidemiologic Studies Depression Scales; MMSE=Mini Mental State Examination; SPPB=Short Physical Performance Battery.
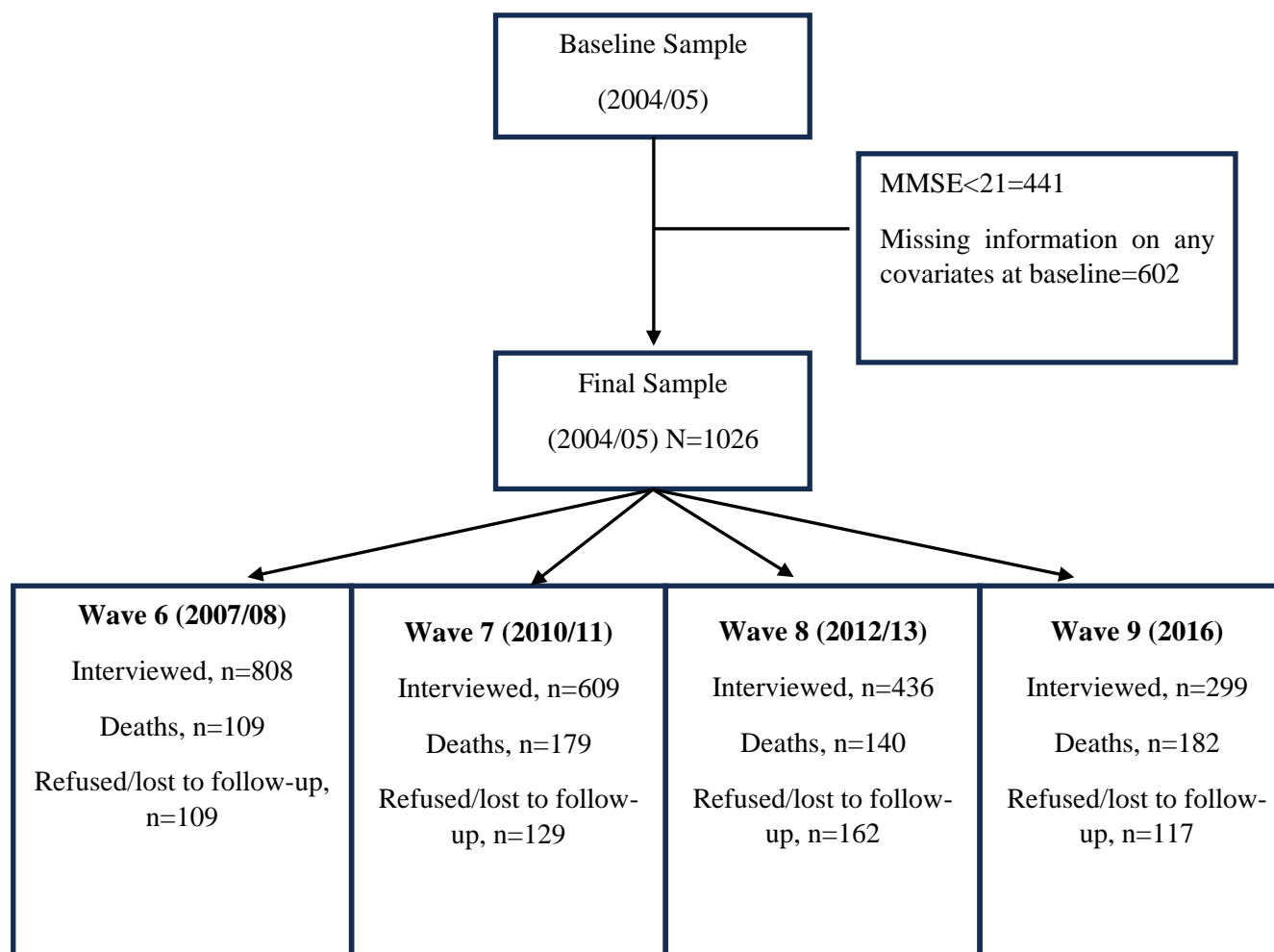
Table 2. Generalized Estimation Equation models for cognitive impairment as a function of living arrangement by nativity among Mexican American older adults with moderate to high cognitive function at baseline (N=1026).

Variables	US-Born OR 95% CI	p-value	Foreign-Born OR 95% CI	p-value
Time (years)	1.13 (1.06-1.21)	0.0003	1.10 (1.02-1.18)	0.0152
Living arrangement				
Alone	Reference	Reference	Reference	Reference
2	1.68 (1.02-2.76)	0.0415	0.98 (0.56-1.73)	0.9517
≥ 3	1.66 (1.02 -2.68)	0.0395	1.50 (0.84-2.68)	0.1673
Age	1.05 (1.00 - 1.10)	0.0595	1.05 (1.00-1.11)	0.0721
Female	0.38 (0.21 – 0.67)	0.0008	0.46 (0.26-0.81)	0.0072
Marital status				
Married	Reference	Reference	Reference	Reference
Separated	2.33 (1.19-4.58)	0.0138	0.81 (0.31-2.13)	0.6726
Widow	1.31 (0.81-2.12)	0.2752	1.17 (0.70-1.98)	0.5442
Education (years)	0.89 (0.85-0.94)	<0.0001	0.90 (0.83-0.98)	0.0171
Spanish Interview	0.77 (0.52-1.12)	0.1736	0.42 (0.16-1.09)	0.0743
Multimorbidity	0.76 (0.50-1.15)	0.1923	1.04 (0.63-1.71)	0.8902

Pain	0.82 (0.59-1.15)	0.2472	0.79 (0.54-1.16)	0.2217
Falls (≥ 1)	0.94 (0.67-1.32)	0.7131	0.78 (0.53-1.16)	0.2241
High depressive symptoms (CES-D ≥ 16)	2.09 (1.38-3.16)	0.0005	2.05 (1.34-3.12)	0.0009
SPPB	0.88 (0.84-0.92)	<0.0001	0.88 (0.83-0.93)	<0.0001
Handgrip strength	0.97 (0.94-1.00)	0.0854	0.94 (0.91-0.97)	0.0008

Abbreviations: CES-D=Center for Epidemiologic Studies Depression Scales; SPPB=Short Physical Performance Battery.

Supplemental Figure 1. Flow chart of participant selection.


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                          ┌─────────────────────┐
                          │   Baseline Sample   │
                          │                     │
                          │     (2004/05)       │
                          └──────────┬──────────┘
                                     │         ┌──────────────────────────────┐
                                     ├─────────│ MMSE<21=441                  │
                                     │         │                              │
                                     │         │ Missing information on any   │
                                     │         │ covariates at baseline=602   │
                                     ▼         └──────────────────────────────┘
                          ┌─────────────────────┐
                          │    Final Sample     │
                          │                     │
                          │ (2004/05) N=1026    │
                          └──────────┬──────────┘
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Wave 6 (2007/08)	Wave 7 (2010/11)	Wave 8 (2012/13)	Wave 9 (2016)
Interviewed, n=808	Interviewed, n=609	Interviewed, n=436	Interviewed, n=299
Deaths, n=109	Deaths, n=179	Deaths, n=140	Deaths, n=182
Refused/lost to follow-up, n=109	Refused/lost to follow-up, n=129	Refused/lost to follow-up, n=162	Refused/lost to follow-up, n=117

Abbreviations: MMSE = Mini Mental State Examination

Figure 1a. Rates of cognitive impairment (MMSE ≤ 21) among US-born participants by living arrangement over study period
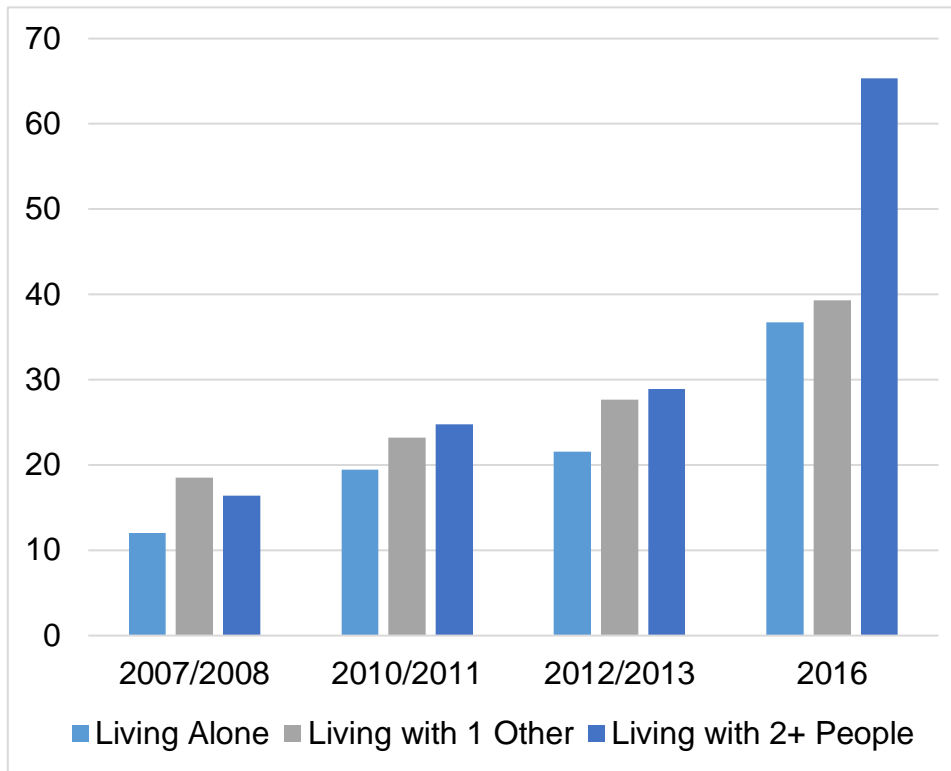
Figure 1b. Rates of cognitive impairment (MMSE ≤ 21) among Foreign-born participants by living arrangement over study period