

RESEARCH ARTICLE

# Health and social correlates of dementia in oldest-old Mexican-origin populations

Silvia Mejia-Arango<sup>1</sup> | Emma Aguila<sup>2</sup> | Mariana López-Ortega<sup>3</sup> |  
Luis Miguel Gutiérrez-Robledo<sup>3</sup> | William A. Vega<sup>4</sup> | Flavia C. Drumond Andrade<sup>5</sup> |  
Sunshine M. Rote<sup>6</sup> | Stephanie M. Grasso<sup>7</sup> | Kyriakos S. Markides<sup>8</sup> |  
Jacqueline L. Angel<sup>9</sup>

<sup>1</sup> Department of Population Studies, El Colegio de la Frontera Norte, Tijuana, Baja California, México

<sup>2</sup> Health Policy and Management Department, Sol Price School of Public Policy, University of Southern California, Los Angeles, California, USA

<sup>3</sup> National Institute of Geriatrics, National Institutes of Health, Ciudad de México, México

<sup>4</sup> Office of Research and Educational Development, Florida International University, Miami, Florida, USA

<sup>5</sup> School of Social Work, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA

<sup>6</sup> Kent School of Social Work, University of Louisville, Louisville, Kentucky, USA

<sup>7</sup> Speech, Language and Hearing Sciences, The University of Texas at Austin, Austin, Texas, USA

<sup>8</sup> Department of Preventive Medicine and Community Health, University of Texas Medical Branch, Galveston, Texas, USA

<sup>9</sup> LBJ School of Public Affairs and Department of Sociology, The University of Texas at Austin, Austin, Texas, USA

## Correspondence

Jacqueline L. Angel, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 2315 Red River St, Austin, TX 78712.  
E-mail: [jangel@austin.utexas.edu](mailto:jangel@austin.utexas.edu)

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## Abstract

**Introduction:** Substantial gaps in research remain across oldest-old ethnic populations while the burden of dementia increases exponentially with age among Mexican and Mexican American older adults.

**Methods:** Prevalence and correlates of dementia among individuals  $\geq 82$  years of age were examined using two population-based cohort studies: The Mexican Health and Aging Study (MHAS,  $n = 1078$ , 2012) and the Hispanic Established Populations for the Epidemiologic Study of the Elderly (HEPESE,  $n = 735$ , 2012–2013). The analytic MHAS and HEPESE samples had an average age of 86.4 and 88.0 years, 1.2 and 1.8 women to men, and 2.7 and 5.1 average years of education, respectively.

**Results:** We identified 316 (29.2%) and 267 (36.3%) cases of likely dementia in the MHAS and HEPESE cohorts, respectively. For Mexicans but not Mexican Americans, age-adjusted prevalence rates of likely dementia were higher in women than men. For both populations prevalence rates increased with age and decreased with education for Mexican Americans but not for Mexicans. In both populations, odds of likely dementia increased with age. Health insurance for the low-income was significantly associated with higher odds of likely dementia for Mexican American men and women and Mexican women but not men. Living in extended households increased the odds of likely dementia in women, but not in men for both studies. Multiple cardiovascular conditions increased the odds of likely dementia for Mexicans but not for Mexican Americans.

**Discussion:** Our study provides evidence of the high burden of dementia among oldest-old Mexicans and Mexican Americans and its association with health and social vulnerabilities.

## KEYWORDS

dementia, health and social vulnerabilities, Mexicans, Mexican Americans, population-based studies

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## 1 | BACKGROUND

The number of oldest-old, that is, persons at least 85 years of age, in Mexico and the United States, is projected to roughly triple by 2050.<sup>1</sup> The increase of the oldest-old will lead to a rise in the number of individuals with dementia on both sides of the United States–Mexico border. Mexican-origin people in both nations are expected to experience disproportionate increases in Alzheimer's disease and related disorders (ADRD) given low socioeconomic status and rapid expansion of the aging segment in the coming decades.<sup>2</sup> In Mexico, global prevalence of dementia has been higher among women and persons at least 80 years of age.<sup>3,4</sup> The National Plans to Address Alzheimer's Disease launched in Mexico<sup>5</sup> in 2014 and the United States<sup>6</sup> in 2012 seek to address challenges associated with a sharp increase in dementia syndrome cases, including research about preventing, delaying, or managing ADRD. There are substantial gaps in research across ethnic and racial populations, and particularly among the oldest-old.<sup>7</sup>

Social determinants of health are associated with cognitive status across the life course and with dementia.<sup>8</sup> In the United States and Mexico health inequalities are highly prevalent in both societies. Social determinants affecting those of Mexican origin include low literacy,<sup>3,9</sup> reduced access to health services,<sup>10</sup> rurality<sup>11</sup>; migration selection factors;<sup>12</sup> indoor and outdoor contamination;<sup>13</sup> socioeconomic disadvantages;<sup>14</sup> and depression,<sup>15</sup> which can adversely affect cognitive functioning and represent a global research challenge for research and intervention development.<sup>16</sup>

Even though previous studies have analyzed predictors of cognitive impairment among Mexicans and Mexican Americans, they have not focused on the oldest-old. One study by Downer et al. for Mexican Americans 75 or older found that age, functional impairment, and depressive symptoms were associated with severe cognitive decline; and educational attainment with maintenance of high cognition or slight cognitive decline.<sup>17</sup>

Accordingly, this is the first study that seeks to identify health and social correlates of likely dementia among Mexican and Mexican Americans older adults aged 82 and over, using cross-sectional data from the Mexican Health and Aging Study (MHAS) and Hispanic Established Populations for the Epidemiologic Study of the Elderly (HEPESE) collected between 2012 and 2013. Comparative research about ethnically similar aging populations in different societies at the same point in time has value for understanding how social and cultural factors are related to cognitive aging in binational contexts. Such work can yield insights on specific factors relevant for informal and formal institutions that provide support for dementia care. Implications of our study will lay the foundation for cross-national longitudinal studies on cognitive changes of the oldest-old.

## 2 | METHODS

### 2.1 | Study population

The study population included participants from two longitudinal population-based cohort studies of Mexicans (MHAS) [Dataset]<sup>18</sup> and

### HIGHLIGHTS

- Dementia affects more than one third of the oldest-old Mexican-origin population.
- Mexican females are 2.3 times more likely to have dementia than men.
- Mexicans with dementia have higher cumulative burden of cardiovascular diseases.
- Mexican-origin populations with dementia have limited health coverage and living arrangements.
- Mini-Mental State Examination age and education reference norms for the oldest-old Mexican Americans were developed.

Mexican Americans (HEPESE) [Dataset].<sup>19</sup> MHAS is a nationally representative panel study of Mexican residents aged  $\geq 50$  years<sup>20</sup> with four follow-up waves (2003, 2012, 2015, 2018) of the baseline conducted in 2001. We analyzed data from MHAS third wave collected between October and December of 2012 and selected individuals aged  $\geq 82$  to match age strata of HEPESE participants during a similar time period. The sample comprised 1078 individuals; 72% were interviewed directly, and 28% by proxy. We used imputed data on cognitive performance for 67 individuals with missing values using a multivariate, regression-based procedure applied by the MHAS team following the same methodology as the Health and Retirement Study.<sup>21</sup> The total analytic sample had an average age of 86.4 (standard deviation [SD], 4.5) years, 56% were women (1.2 women to men) and had 2.7 (SD, 3.5) average years of education.

The HEPESE has collected eight follow-up waves from the baseline in 1993/1994 to 2015/2016 of older Mexican Americans residing in the southwestern United States.<sup>19</sup> We analyze data from HEPESE wave eight collected between December 2012 and September 2013 that comprised 744 individuals 82 or older. We did not analyze HEPESE data from 2015/2016 wave due to the smaller sample size ( $N = 480$ ). Our analysis of 735 individuals excludes nine individuals with incomplete cognitive data; 90% were interviewed directly and 10% by proxy. Individuals had an average age of 88 (SD, 3.7) years, 64.9% were women (1.8 women to men) and had 5.1 (SD, 4.1) average years of education.

### 2.2 | Cognitive status

For direct respondents, the MHAS assesses cognitive function through a modified version<sup>22</sup> of the Cross-Cultural Cognitive Examination (CCCE),<sup>23</sup> which measures performance in eight cognitive domains—verbal learning, delayed memory, attention, constructional praxis, visual memory, verbal fluency, orientation, and processing speed—and has reference norms by age and education. For respondents interviewed by proxy, the MHAS uses a brief version of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE).<sup>24</sup> Cognitive status was classified either as cognitively normal or likely

## RESEARCH IN CONTEXT

1. **Systematic Review:** We searched PubMed, Web of Science, and Google Scholar through March 26, 2020 for keywords: ("dementia" OR "cognitive impairment" OR "cognitive decline") AND ("Mexican-origin" OR "Mexican American" OR "Mexican") AND ("oldest old" OR "age 80 and older") AND ("Mexico and U.S." OR "Mexico and United States"). We searched for English and Spanish articles and reviews but did not apply any other language restrictions. We found no studies that analyze cognitive impairment of the oldest-old in Mexico. For older persons of Mexican origin in the United States, we found one study regarding cognitive decline and impairment using the Hispanic Established Populations for Epidemiologic Studies of the Elderly (HEPESE). That study used four waves of the HEPESE from 2004/2005 to 2012/2013 and found, among persons 75 or older, age, limitations in activities of daily living, and depressive symptoms were associated with severe cognitive decline. Living alone and not being married were associated with slight cognitive decline while higher educational attainment was associated with maintenance of high cognition or slower decline.
2. **Interpretation:** Our study analyzed social correlates of likely dementia for the oldest-old Mexican-origin population in Mexico and the United States. We found a common pattern in predictors of likely dementia across the two countries. Odds of likely dementia in both populations were increased by age, living in an extended household, and holding *Seguro Popular* (Mexican universal health service for the uninsured) or Medicaid. Among those in Mexico but not in the United States, being female and having comorbid cardiovascular conditions were associated with likely dementia. Data revealed wide gaps in access to health care. While many of the oldest-old with dementia currently rely on extended families for support, they will be increasingly unable to do so as extended families become smaller. These results have implications for understanding the contribution of social vulnerabilities in likely dementia as they relate to informal care. In addition, results highlight differences in access to health-care coverage and their potential impact on quality of dementia care in both countries.
3. **Future Directions:** Alzheimer's disease and related dementias (ADRD) present a global crisis for the aging particularly and society generally. Given that there is little research on the oldest-old, a fast-growing group with high rates of ADRD, future research should focus on detailed characterization of those at highest risk. Much information will be gleaned from longitudinal cohort studies including the measurement of sensitivity and specificity of functional criteria. These findings will inform future research focused on the design of programs and treatment plans for the oldest-old adults.

dementia using a checklist assessing cognitive function. Considering the lack of a clinical diagnosis in these large field studies, we will refer to *likely dementia* instead of dementia throughout the study. Directly interviewed respondents were classified as having likely dementia if in at least two cognitive domains scores were  $\geq 1.5$  SDs below norms and who had difficulty performing at least one instrumental activity of daily living (IADL). IADLs included the ability to prepare a meal, go shopping, manage money, or take medications. As cognitively normal, the performance was no more than one SD below norms in all cognitive domains or  $\geq 1.5$  SDs below in only one domain, and no IADL limitations were present. For responses collected via proxy interview, we classified individuals as having likely dementia if IQCODE scores were  $\geq 3.4$  and  $< 3.4$  for cognitively normal, as recommended for community samples.<sup>25</sup>

The HEPESE uses the Mini-Mental State Examination (MMSE) to assess cognitive status.<sup>26</sup> Given the lack of education-specific normative data for oldest-old individuals, we developed reference norms for three education levels: 0, 1 to 6, and  $\geq 7$  years of education (see Tables S1 and S2 and Figure S1 in supporting information). Individuals directly interviewed were classified as having likely dementia if MMSE total score was  $\geq 1.0$  SDs below norms, and they had difficulty performing at least one IADL (we use the same IADLs as in MHAS). We classified all other MMSE respondents as cognitively normal. Proxy-interviewed individuals were classified as likely dementia if the informant reported them as mentally incapacitated, defined as being unable

to think properly in carrying out basic activities of daily life, including giving informed consent.

## 2.3 | Covariates

We included the following covariates based on previous findings for adults aged 60 and older from Mexican origin populations that have addressed the impact of social inequalities in health and cognitive aging.<sup>12,15,16,27-32</sup> Sociodemographic characteristics were sex, age, and education or number of years of formal schooling and categorized as no schooling (0 year), 1 to 6 years, or  $\geq 7$  years. Living arrangements were classified as living alone, with spouse only, or with extended family members. For Mexicans, health insurance was categorized as *Seguro Popular*<sup>33</sup> (universal health services for the uninsured) or employer-based insurance. For Mexican Americans, health insurance is coded as a dichotomous variable where (1) = having any Medicaid coverage (government-provided service for the impoverished) and (0) = Medicare only or any other forms of insurance coverage. Cardiovascular conditions (CVC) for both studies were measured through self-reported previous diagnoses of hypertension, diabetes, stroke, or heart attack and categorized as 0, 1, or  $\geq 2$  of these conditions. We analyzed depressive symptoms as follows. The MHAS includes a modified version of the Center for Epidemiological Studies-Depression (CES-D) with nine items (yes/no). We classified respondents with a

**TABLE 1** Descriptive characteristics of Mexicans and Mexican Americans at age 82 years and older by sex and diagnostic group (MHAS 2012 and HEPESE 2012/2013)

	Mexicans MHAS						Mexican Americans HEPESE					
	Likely dementia			Normal			Likely dementia			Normal		
	Men	Women		Men	Women		Men	Women		Men	Women	
	n = 97	n = 219		n = 377	n = 385		n = 86	n = 176		n = 171	n = 291	
	% or Mean (SD)	P-value	% or Mean (SD)	P-value		% or Mean (SD)	P-value	% or Mean (SD)	P-value	% or Mean (SD)	P-value	
<i>Sociodemographics</i>												
Age, years	88.3 (4.9)	87.4 (4.9)	0.12	86.1 (4.5)	85.6 (4.5)	0.16	89.2 (3.8)	88.9 (3.8)	0.66	87.2 (3.5)	87.6 (3.5)	0.26
82 to 89 years	66.0	73.1	0.22	82.2	84.2	0.48	54.7	61.4	0.31	81.3	79.0	0.56
90 and more years	34.0	26.9	0.22	17.2	15.3	0.47	45.3	38.6	0.31	18.7	21.0	0.56
Education, years	3.2 (4.3)	2.4 (4.3)	0.07	2.9 (3.8)	2.6 (3.8)	0.26	4.2 (3.9)	4.5 (3.9)	0.64	5.3 (4.1)	5.7 (4.1)	0.28
No schooling	40.2	46.1	0.33	36.1	43.1	0.05	18.6	20.5	0.72	14.0	13.4	0.85
1 to 6 years	44.3	44.3	0.99	54.4	47.0	0.04	60.5	55.1	0.41	55.6	51.2	0.37
7 or more	15.5	9.6	0.16	9.5	9.9	0.88	20.9	24.4	0.52	30.4	35.4	0.27
<i>Living arrangements</i>												
Lives alone	22.7	26.0	0.52	23.3	34.3	0.00	24.4	23.9	0.92	19.3	36.1	0.00
Lives with spouse only	17.5	4.1	0.00	20.2	8.8	0.00	31.4	5.1	0.00	35.1	12.7	0.00
Extended household	59.8	69.9	0.09	56.5	56.9	0.91	44.2	71.0	0.00	45.6	51.2	0.25
<i>Health insurance</i>												
Employer-based	54.6	52.5	0.73	61.3	59.7	0.67	NA	NA	NA	NA	NA	NA
Seguro Popular	42.3	46.6	0.48	34.7	37.4	0.45	NA	NA	NA	NA	NA	NA
Any Medicaid	NA	NA	NA	NA	NA	NA	52.3	63.1	0.10	30.4	39.9	0.04
Medicare	NA	NA	NA	NA	NA	NA	33.7	27.3	0.29	57.3	48.5	0.07
<i>Cardiovascular conditions (CVC)</i>												
Diabetes	10.3	20.1	0.02	13.0	15.3	0.36	24.4	35.2	0.07	34.5	34.0	0.92
Hypertension	40.2	49.3	0.13	38.2	54.0	0.00	70.6	73.3	0.66	72.0	79.9	0.06
Heart	9.3	5.0	0.20	5.3	3.1	0.13	11.6	6.9	0.23	13.1	6.9	0.04
Stroke	12.4	7.8	0.23	4.0	3.6	0.81	20.9	15.8	0.33	7.6	6.2	0.56
CVC none	50.5	43.4	0.24	54.1	42.3	0.00	20.9	18.8	0.68	22.8	16.2	0.09
CVC one	29.9	35.2	0.36	34.2	41.6	0.04	41.9	40.3	0.82	38.6	48.8	0.03
CVC two+	19.6	21.5	0.70	11.7	16.1	0.08	37.2	40.9	0.57	38.6	35.1	0.45
Depressive symptoms	56.1	65.7	0.30	27.4	45.9	0.00	36.1	53.7	0.02	11.3	23.6	0.00

Note: P-value from t-test for continuous variables and Chi-square for categorical variables.

Abbreviations: CVC, cardiovascular conditions; HEPESE, Hispanic Established Populations for the Epidemiologic Study of the Elderly; MHAS, Mexican Health and Aging Study; NA, not available; SD, standard deviation.

score  $\geq 5$  as having high depressive symptoms based on a clinical validation study.<sup>34</sup> For HEPESE, the CES-D scale has 20 items. Its index ranges from 0 to 60; we classified those with a score  $\geq 16$  as having high depressive symptoms.<sup>35,36</sup>

## 2.4 | Statistical analysis

To examine differences in covariates between diagnostic groups we use t-test for continuous variables and Chi-square for categorical

variables. Table 1 provides descriptive characteristics of Mexicans and Mexican Americans stratified by sex and diagnostic groups. Crude and age-adjusted prevalence rates for both populations stratified by sex, age groups, and education are presented in Table 2 for Mexicans and Table 3 for Mexican Americans. We standardized to the 2012 Hispanic population in the United States to obtain age-adjusted prevalence rates. For multivariable analysis, we estimated separate logistic regression models for Mexican and Mexican American men and women, with cognitive status as the dependent variable. For predictors, we used

**TABLE 2** Prevalence of likely dementia in Mexicans at age 82 years or older in 2012 from MHAS

	Mexicans					
	Crude prevalence			Age-adjusted prevalence		
	Overall	Men	Women	Overall	Men	Women
	N = 1078	n = 474	n = 604	N = 1078	n = 474	n = 604
Total	29.3 [26.6, 32.0]	20.5 [16.8, 24.1]	36.3 [32.4, 40.1]	29.2 [26.5, 31.9]	20.2 [16.7, 23.8]	36.2 [32.4, 40.0]
<b>Age</b>						
82–89	26.1 [23.2, 29.1]	17.1 [13.3, 20.9]	33.1 [28.9, 37.3]	26.0 [23.1, 28.9]	17.0 [13.2, 20.8]	33.7 [24.3, 43.1]
90+	42.6 [35.9, 49.2]	33.7 [24.1, 43.2]	50.0 [40.8, 59.2]	42.6 [36.0, 49.2]	32.9 [28.7, 37.1]	50.0 [40.9, 59.1]
<b>Education</b>						
No schooling	31.7 [27.3, 36.0]	22.3 [16.1, 28.5]	37.8 [32.0, 43.7]	31.2 [26.9, 35.4]	21.6 [15.5, 27.6]	37.5 [31.8, 43.3]
1 to 6	26.6 [22.8, 30.4]	17.3 [12.6, 22.1]	34.9 [29.3, 40.5]	26.8 [23.0, 30.5]	17.6 [12.9, 22.2]	35.0 [29.4, 40.6]
7+	32.7 [23.8, 41.6]	29.4 [16.5, 42.4]	35.6 [23.0, 48.2]	32.8 [24.0, 41.5]	29.4 [16.8, 41.9]	35.7 [23.4, 48.0]

Note: Percentages and 95% confidence intervals [in brackets] provided. Age-adjusted by standardization to the 2012 Hispanic population in the United States.

Abbreviations: MHAS, Mexican Health and Aging Study.

**TABLE 3** Prevalence of likely dementia in Mexican Americans at age 82 years or older in 2012/2013 from HEPSE

	Mexican Americans					
	Crude prevalence			Age-adjusted prevalence		
	Overall	Men	Women	Overall	Men	Women
	N = 724	n = 257	n = 467	N = 724	n = 257	n = 467
Total	36.2 [32.7, 39.7]	33.5 [27.7, 39.3]	37.7 [33.3, 42.1]	34.2 [30.8, 37.6]	30.9 [25.4, 36.4]	36.0 [31.7, 40.3]
<b>Age</b>						
82–89	29.6 [25.7, 33.5]	25.3 [19.0, 31.6]	32.0 [27.0, 36.9]	29.4 [25.5, 33.3]	25.1 [18.9, 31.4]	31.8 [26.8, 36.7]
90+	53.5 [46.5, 60.5]	54.9 [43.1, 66.8]	52.7 [44.0, 61.4]	54.1 [47.3, 61.0]	54.9 [43.3, 66.6]	53.7 [45.2, 62.2]
<b>Education</b>						
No schooling	45.2 [36.0, 54.5]	40.0 [24.1, 55.9]	48.0 [36.4, 59.6]	38.9 [29.7, 48.2]	34.1 [19.4, 48.9]	41.7 [29.8, 53.5]
1 to 6	37.9 [33.1, 42.7]	35.4 [27.6, 43.2]	39.4 [33.3, 45.6]	36.1 [31.4, 40.8]	32.4 [25.1, 39.8]	38.3 [32.3, 44.4]
7+	28.2 [22.2, 34.3]	25.7 [15.2, 36.2]	29.5 [22.0, 36.9]	28.1 [22.3, 34.0]	25.2 [15.0, 35.3]	29.5 [22.3, 36.6]

Note: Percentages and 95% confidence intervals [in brackets] provided. Age-adjusted by standardization to the 2012 Hispanic population in the United States.

Abbreviations: HEPSE, Hispanic Established Populations for the Epidemiologic Study of the Elderly.

age, years of education, living arrangement, type of health insurance, and multi cardiovascular conditions. Our HEPSE model includes 724 respondents, dropping 11 for whom living arrangements were missing. We used Stata SE 14 for our analyses and reported coefficients as odds ratios (OR).

The HEPSE and MHAS protocols and instruments were approved by the Institutional Review Board of the University of Texas Medical Branch, and in Mexico, by the National Institute of Statistics (INEGI) and the National Institute of Public Health (INSP).

### 3 | RESULTS

Figure 1 shows the prevalence of likely dementia increases after age 82 for both Mexicans and Mexican Americans. These rates show similar trends with approximately 20% at age 82 and close to 60% at age 98 and over.

In Table 1, we observe Mexican and Mexican-American men and women with likely dementia were on average 2 years older than those in the normal diagnostic group. Men and women at least 90 years of age comprise one third of those with likely dementia among Mexicans and 40% among Mexican Americans. A larger ratio of women to men among Mexicans (2.3) than for Mexican Americans (2.0) had likely dementia. On average, Mexican women had fewer years of education than Mexican-American women; however, less marked differences were observed among men. Both groups, though, are below secondary school completion. Compared to those cognitively normal, Mexican men and women with likely dementia had significantly higher percentages of individuals with no schooling. In contrast, Mexican-American men and women with likely dementia compared to those cognitively normal had higher percentages of individuals with no schooling and 1 to 6 years of education attainment.

In both samples for men and women with likely dementia, the largest group lived in extended households. Most Mexican men and women had employer-based health insurance. Most Mexican-American men and women with likely dementia had any Medicaid and those cognitively normal had Medicare health insurance. A higher proportion of men and women with likely dementia had access to public insurance generally for more impoverished persons, ie, *Seguro Popular* or Medicaid.

In addition, diabetes and hypertension were the most prevalent chronic medical conditions for men and women in both samples, but only stroke was statistically significant as a cofactor with likely dementia. Finally, the proportion of men and women with likely dementia who had depressive symptoms was significantly higher in both samples.

Table 2 for Mexicans and Table 3 for Mexican Americans provides crude and age-adjusted prevalence rates of likely dementia for men and women, stratified by age and education. For Mexicans aged 82 years and over, the overall age-adjusted prevalence of likely dementia was 29.2%. Still, prevalence rates increased 1.6 times between ages 82 to 89 years and 90 years and over. Prevalence rates were higher in women (36.2%) than men (20.2%), and sex differences were marked in both age groups. Prevalence rates among women with no schooling (37.5%)

were 1.7 times higher than in men (21.6%) and nearly twice as higher (35% vs 17.6%) than those with 1 to 6 years of education. We did not find large differences by sex for the highest education level (7+). For Mexican Americans aged 82 years and higher, we find an overall age-adjusted prevalence of 34.2%. Rates increased 1.8 times between ages 82 to 89 years and 90 years and over. Prevalence rates were lower among those with more years of education. Women presented higher rates of likely dementia (36.0%) than men (30.9%), but differences were marked only in the younger age-group.

Table 4 presents the results of the fully adjusted regression models. Among both Mexican and Mexican American men and women, age increased the odds of likely dementia. Living in an extended household increased the odds of likely dementia only for women. For Mexican women, *Seguro Popular* and for Mexican-American men and women, Medicaid participation had higher odds of likely dementia. Among Mexican men and women but not Mexican Americans, having multiple cardiovascular conditions increased the odds of likely dementia. Among both populations, more years of education did not, after controlling for other variables, change the odds of likely dementia. However, education levels were low overall.

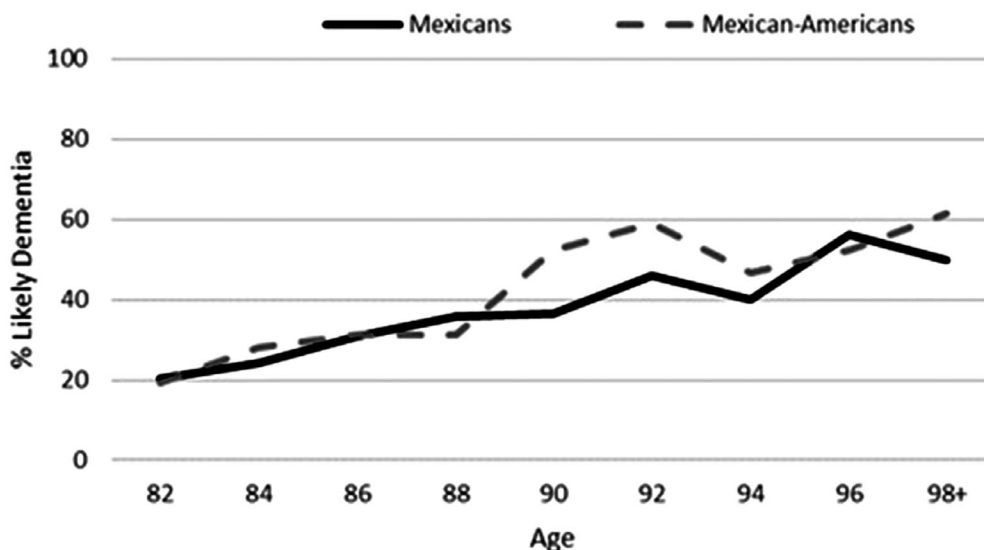
In regression models using depressive symptoms as a covariate (described in the Table S3 in supporting information), we found no substantive change to the covariates in Table 4. We found that the odds of likely dementia were two times greater for older Mexican women with depressive symptoms and 3.7 times greater for Mexican American women. We did not include depressive symptoms in our regression results in Table 4 because this scale was not included in proxy questionnaires.

### 4 | DISCUSSION

This is the first study to analyze the social correlates of likely dementia in two representative samples of Mexicans and Mexican Americans age 82 years and older using comparable data on sociodemographic characteristics, living arrangements, health insurance, and cardiovascular conditions. We found that approximately one third of Mexicans (29.2%) and Mexican Americans (34.2%) met the criteria for likely dementia. It was our intention to examine the association of critical cofactors with likely dementia in two samples linked by ethnicity, cultural heritage, and a common border, but not to provide clinically valid dementia prevalence rates across countries. Although the comparison of prevalence rates between countries was not the core focus of the study, our prevalence of likely dementia corresponds with previous findings of population-based studies in Mexican<sup>3,4</sup> and Mexican Americans,<sup>37</sup> which considered 80 $\geq$  years age strata. Our results indicated that rates of likely dementia continue to increase with age, tripling from 82 to 98 years and over. In both populations, odds of likely dementia increased 1.1 for every additional year of age.

We found higher levels of likely dementia among older Mexican women than older men, matching similar results for Mexican older adults aged 60 years and over.<sup>3,4</sup> Previous research suggests hormonal exposure and increased survival with cognitive impairment as





**FIGURE 1** Prevalence of likely dementia for Mexicans and Mexican Americans age 82 and over. Solid line depicts Mexicans and dashed line depicts Mexican Americans

**TABLE 4** Logistic regression for likely dementia in men and women at age 82 years and older from MHAS (2012) and HEPES (2012/2013)

	Mexicans MHAS						Mexican Americans HEPES					
	Men			Women			Men			Women		
	OR	P-value	95% CI	OR	P-value	95% CI	OR	P-value	95% CI	OR	P-value	95% CI
Age	1.104	0.000	[1.05, 1.16]	1.103	0.000	[1.05, 1.16]	1.142	0.001	[1.06, 1.23]	1.086	0.005	[1.03, 1.15]
Years of education	1.043	0.188	[0.98, 1.11]	0.993	0.824	[0.94, 1.05]	0.978	0.564	[0.91, 1.06]	0.961	0.153	[0.91, 1.01]
Lives alone	1.261	0.538	[0.60, 2.64]	1.746	0.209	[0.73, 4.16]	1.251	0.573	[0.57, 2.72]	1.510	0.334	[0.65, 3.49]
Extended household	1.384	0.324	[0.73, 2.64]	2.991	0.010	[1.30, 6.86]	0.933	0.832	[0.49, 1.78]	3.077	0.005	[1.40, 6.77]
<i>Seguro Popular</i>	1.520	0.112	[0.91, 2.55]	1.458	0.048	[1.00, 2.12]	NA	NA	NA	NA	NA	NA
Any Medicaid	NA	NA	NA	NA	NA	NA	2.179	0.012	[1.19, 4.00]	2.377	0.000	[1.54, 3.68]
CVC (2 +)	2.241	0.008	[1.24, 4.05]	1.740	0.013	[1.12, 2.70]	1.188	0.557	[0.67, 2.11]	1.391	0.116	[0.92, 2.10]
Constant	0.000	0.000	[0.00, 0.00]	0.000	0.000	[0.00, 0.00]	0.000	0.000	[0.00, 0.00]	0.000	0.000	[0.00, 0.02]
Observations	474			604			257			467		

Note: Reference categories are employer-based health insurance for MHAS, Medicare health insurance for HEPES and Lives with spouse only for both MHAS and HEPES.

Abbreviations: CI, confidence interval; CVC, cardiovascular conditions; HEPES, Hispanic Established Populations for the Epidemiologic Study of the Elderly; MHAS, Mexican Health and Aging Study; NA, not available; OR, odds ratio; SD, standard deviation.

possible explanations for the greater prevalence of dementia among women.<sup>38</sup> However, sex gaps in education and labor force participation point to extreme disadvantages among older generations of Mexican women.<sup>39</sup> Similarly, we found (analysis not presented) that, among women 90 years or older with no schooling, nearly half (46.6%) had likely dementia.

In contrast to the Mexican sample, rates of likely dementia in our Mexican American sample were not significantly greater for women than for men. This is consistent with lower sex gaps in education and labor participation among Mexican Americans than among Mexicans. Higher levels of education and a less-traditional gender division of labor among Mexican Americans may account for these findings.<sup>40</sup>

In our regression analyses, we did not find an association between education and prevalence of likely dementia. This finding contrasts with previous studies that show that women 85 and older and both men and women in younger groups with higher levels of education have a lower prevalence of dementia.<sup>38,41,42</sup> Only a small share of our samples had 7 or more years of education—on average 10% among Mexicans and 30% for Mexican Americans. Both samples had low average educational levels—3 years for Mexicans and 5 years for Mexican Americans. As such, future research should investigate the relation between education and dementia prevalence in these populations in order to better understand how life experiences influence the development of dementia.

Odds of likely dementia increased among older Mexican men and women with multiple cardiovascular conditions. These findings are consistent with earlier research suggesting the cumulative burden of vascular diseases increases risks for cognitive impairment among the oldest-old.<sup>43</sup> Although Mexican Americans show higher rates of cardiovascular conditions than Mexicans, odds of likely dementia were not significantly increased by the occurrence of two or more cardiovascular conditions. Higher diagnostic screening and control of these conditions in middle and late-life in the United States may account for these results.<sup>44</sup>

Diabetes mellitus type 2 (DM2) has been associated with an increased risk of dementia in Hispanic populations.<sup>45</sup> Despite the high prevalence of diabetes in both samples, particularly among Mexican American men and women, rates of diabetes were not significantly higher among those with likely dementia. This result could be explained by the older age of the participants, and probably by a milder form of diabetes that allowed survival.

Our results also showed higher odds of likely dementia among older Mexican and Mexican-American women with high depressive symptoms. Previous research has found depression to be associated with an increased risk of cognitive decline in older adults with women showing higher rates of depressive symptoms than men.<sup>17</sup> However, the cross-sectional nature of our study and measuring depressive symptoms during the last 2 weeks before the survey only allows us to confirm an association with likely dementia. We cannot ascertain that depressive symptoms precede or follow the diagnosis of likely dementia and avoid the circularity implicit in our results.

The association between likely dementia and living in extended households for women is in line with findings reporting that care for older Mexicans and Mexican Americans has relied on strong, altruistic family structures, and family social capital.<sup>46</sup> Living in extended households for older adults is even higher for those with lower socioeconomic status.<sup>29,47</sup> In addition, previous studies have shown that illness or disability of an older adult may result in changes in living arrangements where two or three generations live together to provide additional support and care.<sup>48</sup> Furthermore, we found no association for men that may be explained by a higher proportion of older men than women living with their spouse only. For Mexicans with likely dementia, 63.4% of men lived with their spouse only in contrast to 34.6% of women. For Mexican Americans with likely dementia, 75% of men lived with their spouse only compared to 25% of women (results not shown).

It is worth noting that the availability of unpaid family caregivers has rapidly decreased as a result of demographic, social, and economic changes. Specifically, migration of young Mexicans to other countries, and women, who have traditionally performed unpaid caregiving activities, have increased their labor force participation.<sup>30</sup> Therefore, family care networks may not be able to provide different services needed to address functional disability and cognitive decline.<sup>31,49</sup>

We also found that older women with likely dementia in Mexico rely on *Seguro Popular*, while Mexican-American men and women in the United States rely on Medicaid. *Seguro Popular* mainly covers uninsured individuals in the large informal sector of the Mexican labor force, including self-employed or salaried workers in small firms that

did not contribute to social security. Women are more likely than men to work in the informal sector.<sup>50</sup> In Mexico, health and long-term care protection for older persons that could substitute for unpaid family caregivers are almost nonexistent.<sup>51</sup> Medicaid provides health-care services and long-term care to lower income older adults, and Medicare provides vital acute but limited long-term care services. Mexican Americans' low socioeconomic status, greater risk of chronic disease and functional limitations, and longer life expectancy represent a greater burden on Medicaid for providing dementia care—and for Mexican Americans unable to afford supplemental care programs—higher risks of bankruptcy or having to get by without needed care.<sup>32</sup> Given that *Seguro Popular* was based on a basic package of services that did not include ADRD, the new insurance that replaced *Seguro Popular* in 2020 (INSABI), could extend services to older adults with dementia, currently underserved.

Altogether, our findings demonstrate that older Mexicans and Mexican Americans with likely dementia share several characteristics while differing in others. For both, aging leads to a greater likelihood of dementia. Both populations have a large proportion of persons with likely dementia living in extended households, and both have relatively limited health insurance. However, there is a larger socioeconomic gap between Mexican men and women than among Mexican Americans. Among Mexicans but not Mexican Americans, there are sex differences in likely dementia as well as an association between dementia and multiple cardiovascular conditions.

There are several limitations to our work. Our data sources and methods were not designed to generate a clinical diagnosis of dementia. As in other population-based studies, we analyzed data derived from cognitive instruments designed for screening purposes and used proxy measures that are not interchangeable with direct instruments, but permit comparable broad categories<sup>52</sup> such as overall likely dementia. This constraint limited our ability to provide a uniform evidence-based standard for case identification of dementia. Another limitation of our study is the inclusion of self-reported measures of cardiovascular diseases that can be influenced by a lack of medical diagnosis, resulting in under-reporting of conditions. We use cross-sectional data to examine the health and social correlates of likely dementia in Mexico, and among Mexican Americans. Future investigations using longitudinal data will allow sensitivity and specificity analysis of cognitive and functional criteria for diagnostic classification, clarify the role of covariates as risk factors for likely dementia, and account for the competing risk of death<sup>53</sup> limited by the cross-sectional nature of the present study.

Nevertheless, our study has several strengths. This is the first study to analyze the social and health correlates of likely dementia in two representative samples of oldest-old Mexicans and Mexican Americans in 2012/2013. Another strength of our study is the incorporation of normative values to classify cognitive performance based on population characteristics. We created age and education reference norms for the MMSE in Mexican Americans and used normative values already estimated for the cognitive instrument in MHAS.<sup>22</sup> Diagnostic classification based on a single cut-point would have yielded larger prevalence rates of dementia and misclassification of older adults.



This study contributes to the limited yet growing research on prevalence rates of dementia and disease cofactors in older ages within an international comparative context. Our results show that key social and personal determinants associated with dementia—sex, household structure, health insurance, depressive symptoms, and cardiovascular conditions—vary by specific social and cultural contexts that have been recognized in the World Health Organization, Alzheimer's Disease International Global Action Plan and in the 10/66 Research Group plan for closing the gap in dementia care.<sup>54</sup>

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

## REFERENCES

- Bank TheWorld. Population Estimates and Projections. Last updated 09/19/2019. Retrieved 3/20/2020 from <https://databank.worldbank.org/source/population-estimates-and-projections#>. 2019.
- Matthews KA, Xu W, Gaglioti AH, et al. Racial and ethnic estimates of Alzheimer's disease and related dementias in the United States (2015-2060) in adults aged  $\geq 65$  years. *Alzheimers Dement*. 2019;15:17-24.
- Mejia-Arango S, Gutierrez LM. Prevalence and incidence rates of dementia and cognitive impairment no dementia in the Mexican population: data from the Mexican Health and Aging Study. *J Aging Health*. 2011;23:1050-1074.
- Llibre JJ, Ferri CP, Acosta D, et al. Prevalence of dementia in Latin America, India, and China: a population-based cross-sectional survey. *Lancet North Am Ed*. 2008;372:464-474.
- Gutierrez-Robledo LM, Arrieta-Cruz I. [Dementia in Mexico: the need for a National Alzheimer's Plan]. *Gac Med Mex*. 2015;151:667-673.
- Epstein-Lubow G, Khachaturian AS, Ryan LM, Baumgart M. The National Alzheimer's Project Act and the National Plan to Address Alzheimer's Disease: an update and future directions. *Am J Geriatr Psychiatry*. 2013;21:S36-S37.
- Gardner RC, Valcour V, Yaffe K. Dementia in the oldest old: a multi-factorial and growing public health issue. *Alzheimers Res Ther*. 2013;5:27.
- Livingston G, Huntley J, Sommerlad A, et al. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet North Am Ed*. 2020;396:413-446.
- Garcia MA, Saenz J, Downer B, Wong R. The role of education in the association between race/ethnicity/nativity, cognitive impairment, and dementia among older adults in the United States. *Demogr Res*. 2018;38:155.
- Gutiérrez JP, Garcia-Saiso S, Dolci GF, Ávila MH. Effective access to health care in Mexico. *BMC Health Serv Res*. 2014;14:186.
- Saenz JL, Downer B, Garcia MA, Wong R. Cognition and context: rural-urban differences in cognitive aging among older Mexican adults. *J Aging Health*. 2018;30:965-986.
- Garcia MA, Ortiz K, Arévalo SP, et al. Age of migration and cognitive function among older Latinos in the United States. *J Alzheimers Dis*. 2020:1-19.
- Saenz JL, Wong R, Ailshire JA. Indoor air pollution and cognitive function among older Mexican adults. *J Epidemiol Community Health*. 2018;72:21-26.
- Torres JM, Rizzo S, Wong R. Lifetime socioeconomic status and late-life health trajectories: longitudinal results from the Mexican Health and Aging Study. *J Gerontol B Psychol Sci Soc Sci*. 2018;73:349-360.
- Saenz JL, Garcia MA, Downer B. Late life depressive symptoms and cognitive function among older Mexican adults: the past and the present. *Aging Ment Health*. 2020;24:413-422.
- Downer B, Raji MA, Markides KS. Relationship between metabolic and vascular conditions and cognitive decline among older Mexican Americans. *Int J Geriatr Psychiatry*. 2016;31:213-221.
- Downer B, Chen NW, Raji M, Markides KS. A longitudinal study of cognitive trajectories in Mexican Americans age 75 and older. *Int J Geriatr Psychiatry*. 2017;32:1122-1130.
- Wong R, Palloni A. The Mexican Health and Aging Study. [www.MHASweb.org](http://www.MHASweb.org) 2012.
- Markides KS, Rudkin L, Angel RJ, Espino DV. Health Status of Hispanic Elderly. In: Martin LG, Soldo BJ, eds. *Racial and Ethnic Differences in the Health of Older Americans*. Washington (DC): National Academies Press (US); 1997:285-300.
- Wong R, Michaels-Obregon A, Palloni A. Cohort profile: the Mexican Health and Aging Study (MHAS). *Int J Epidemiol*. 2017;46:e2..
- McCammom RJ, Fisher GG, Halimah H, Faul JD, Rogers W, Weir DR. *Health and Retirement Study Imputation of Cognitive Functioning Measures*. Ann Arbor, Michigan: Survey Research Center, University of Michigan; 2019:1992-2016.
- Mejia-Arango S, Wong R, Michaels-Obregon A. Normative and standardized data for cognitive measures in the Mexican Health and Aging Study. *Salud Publica Mex*. 2015;57(Suppl 1):S90-S96.
- Glosser G, Wolfe N, Albert ML, et al. Cross-cultural cognitive examination: validation of a dementia screening instrument for neuroepidemiological research. *J Am Geriatr Soc*. 1993;41:931-939.
- Jorm AF. A short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): development and cross-validation. *Psychol Med*. 1994;24:145-153.
- Cherbuin N, Jorm AF. *The IQCODE: Using Informant Reports to Assess Cognitive Change in the Clinic and in Older Individuals Living in the Community*. Cognitive Screening Instruments; 2017:275-295.
- Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189-198.
- Downer B, Garcia MA, Saenz J, Markides KS, Wong R. The role of education in the relationship between age of migration to the United States and risk of cognitive impairment among older Mexican Americans. *Res Aging*. 2018;40:411-431.
- Casanova M, Aguila E. Gender differences in cognitive function among older Mexican immigrants. *J Econ Ageing*. 2019;16:100226.
- Aguila E, Park JH, Vega A. Living arrangements and supplemental income programs for older adults in Mexico. *Demography*. 2020;57:1345-1368.
- Angel JL, Angel RJ, Lopez-Ortega M, Robledo LM, Wallace RB. Institutional context of family eldercare in Mexico and the United States. *J Cross Cult Gerontol*. 2016;31:327-336.

31. Rote SM, Angel JL, Moon H, Markides K. Caregiving across diverse populations: new evidence from the National Study of Caregiving and Hispanic EPESE. *Innov Aging*. 2019;3:igz033. <https://doi.org/10.1093/geroni/igz033>.
32. Angel RJ, Angel JL, Hill TD. Longer lives, sicker lives? Increased longevity and extended disability among Mexican-origin elders. *J Gerontol B Psychol Sci Soc Sci*. 2015;70:639-649.
33. Parker SW, Saenz J, Wong R. Health insurance and the aging: evidence from the seguro popular program in Mexico. *Demography*. 2018;55:361-386.
34. Aguilar-Navarro SG, Fuentes-Cantu A, Avila-Funes JA, Garcia-Mayo EJ. Validity and reliability of the screening questionnaire for geriatric depression used in the Mexican Health and Age Study. *Salud Publica Mex*. 2007;49:256-262.
35. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1:385-401.
36. Black SA, Markides KS, Miller TQ. Correlates of depressive symptomatology among older community-dwelling Mexican Americans: the Hispanic EPESE. *J Gerontol B Psychol Sci Soc Sci*. 1998;53:S198-S208.
37. Haan MN, Mungas DM, Gonzalez HM, Ortiz TA, Acharya A, Jagust WJ. Prevalence of dementia in older Latinos: the influence of type 2 diabetes mellitus, stroke and genetic factors. *J Am Geriatr Soc*. 2003;51:169-177.
38. Corrada MM, Brookmeyer R, Paganini-Hill A, Berlau D, Kawas CH. Dementia incidence continues to increase with age in the oldest old: the 90+ study. *Ann Neurol*. 2010;67:114-121.
39. Parker S, Pederzinni C. Gender differences in education in Mexico. Retrieved 2/23/2020 from <http://documents.worldbank.org/curated/en/659741468752986916/Gender-differences-in-education-in-Mexico>. 2000.
40. Blau FD, Kahn LM. *Gender and Assimilation Among MEXICAN Americans*. Chicago: University of Chicago Press; 2007:57-106.
41. Yaffe K, Middleton LE, Lui L-Y, et al. Mild cognitive impairment, dementia, and their subtypes in oldest old women. *Arch Neurol*. 2011;68:631-636.
42. Stern Y. Cognitive reserve in ageing and Alzheimer's disease. *Lancet Neurol*. 2012;11:1006-1012.
43. Roberts RO, Cha RH, Mielke MM, et al. Risk and protective factors for cognitive impairment in persons aged 85 years and older. *Neurology*. 2015;84:1854-1861.
44. Langa KM, Larson EB, Crimmins EM, et al. A comparison of the prevalence of dementia in the United States in 2000 and 2012. *JAMA Intern Med*. 2017;177:51-58.
45. Mejia-Arango S, Zuniga-Gil C. Diabetes mellitus as a risk factor for dementia in the Mexican elder population. *Rev Neurol*. 2011;53:397-405.
46. Angel JL, Rote SM, Brown DC, Angel RJ, Markides KS. Nativity status and sources of care assistance among elderly Mexican-origin adults. *J Cross Cult Gerontol*. 2014;29:243-258.
47. Montes de Oca V, Garay S, Rico B, García SJ. Living arrangements and aging in Mexico: changes in households, poverty and regions, 1992-2009. *Int'l J Soc Sci Stud*. 2014;2:61.
48. Montes de Oca V, Hebrero M. Family dynamics, aging, and functional impairment in Mexico. *Rev Kairos*. 2008;11:143.
49. Mejia-Arango S, López-Ortega M, Barba-Ramírez L. *Behavioral and Psychosocial Treatments of Dementia in Mexico*. In: Adames H, Tazeau Y. (eds) *Caring for Latinxs with Dementia in a Globalized World*. New York, NY: Springer; 2020:267-280.
50. Aguila E, Diaz C, Fu MM, Kapteyn A, Pierson A. *Living Longer in Mexico: Income Security and Health*. Washington, D.C: AARP; 2011.
51. Mejia-Arango S, Singelmann J, Sáenz R. Cognitive Decline Among the Elderly: A Comparative Analysis of Mexicans in Mexico and in the United States. In: Singelmann J, Poston Jr, DL. (Eds.) *Developments in Demography in the 21st Century*. Cham, Switzerland: Springer; 2020. p. 179-194.
52. Weir D, Faul J, Langa K. Proxy interviews and bias in the distribution of cognitive abilities due to non-response in longitudinal studies: a comparison of HRS and ELSA. *Longit Life Course Stud*. 2011;2:170.
53. Chang C-CH, Zhao Y, Lee C-W, Ganguli M. Smoking, death, and Alzheimer's disease: a case of competing risks. *Alzheimer Dis Assoc Disord*. 2012;26:300.
54. World Health Organization. *The Epidemiology and Impact of Dementia: current State and Future Trends*. Geneva, Switzerland: World Health Organization; 2015.

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