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Authors

Luo, Huabin

Wu, Bei

González, Hector M

et al.

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Research Article

Tooth Loss, Periodontal Disease, and Mild Cognitive Impairment Among Hispanic/Latino Immigrants: The Moderating Effects of Age at Immigration

Huabin Luo, PhD,[1,*] Bei Wu, PhD,[2] Hector M. González, PhD,[3] Ariana Stickel, PhD,[4] Linda M. Kaste, PhD,[5] Wassim Tarraf, PhD,[6] Martha L. Daviglus, MD, PhD,[7] Anne E. Sanders, PhD,[8] and Jianwen Cai, PhD[9]

[1]Department of Public Health, Brody School of Medicine, East Carolina University, Greenville, North Carolina, USA. [2]Rory Meyers College of Nursing, New York University, New York City, New York, USA. [3]Department of Neurosciences and Shiley-Marcos Alzheimer's Disease Research Center, University of California, San Diego, San Diego, California, USA. [4]Department of Neurosciences, University of California, San Diego, San Diego, California, USA. [5]Department of Pediatric Dentistry, College of Dentistry, University of Illinois at Chicago, Chicago, Illinois, USA. [6]Department of Healthcare Sciences, Wayne State University, Institute of Gerontology, Detroit, Michigan, USA. [7]Institute for Minority Health Research, University of Illinois at Chicago, College of Medicine, Chicago, Illinois, USA. [8]Division of Pediatric and Public Health, Adams School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA. [9]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA.

*Address correspondence to: Huabin Luo, PhD, Department of Public Health, Brody School of Medicine, East Carolina University, 115 Heart Drive, Greenville, NC 27834, USA. E-mail: Luoh@ecu.edu

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Abstract

Background: The objectives were to assess (a) the association between poor oral health and mild cognitive impairment (MCI) in Hispanic/Latino immigrants and (b) potential modification effects on this association by age at immigration.

Methods: Data were from the Hispanic Community Health Study/Study of Latinos and its ancillary study—the Study of Latinos–Investigation of Neurocognitive Aging. MCI, a binary outcome variable, defined by the National Institute on Aging-Alzheimer's Association criteria. The main exposure was significant tooth loss (STL), defined as a loss of 8 or more teeth, and periodontitis, classified using the Centers for Disease Control and Prevention and American Academy of Periodontology case classification. Multiple logistic regression was used to assess the association between STL/periodontitis and MCI and test moderation effects of age at immigration. The analytical sample comprised 5 709 Hispanic/Latino adult immigrants.

Results: Hispanic/Latino immigrants with STL (adjusted odds ratio [AOR] = 1.36, 95% confidence interval [CI]: 1.01–1.85) were more likely to have MCI than those with greater tooth retention. Overall, migration to the United States after age 18 was associated with greater odds of MCI than migration at a younger age. A significant interaction effect between STL and age at immigration revealed that the effect of STL on MCI is even higher in those who immigrated to the United States at ages 35–49 years.

Conclusions: STL is a significant risk factor for MCI and age at immigration had a modification effect on the association between STL and MCI. Better access to dental care, health education on risk factors of MCI, and promotion of good oral health may mitigate the burden of cognitive impairment in Hispanics/Latinos.

Keywords: Hispanics/Latinos, Immigrants, Mild cognitive impairment, Periodontal disease, Tooth loss

Mild cognitive impairment (MCI) is the intermediate stage between the cognitive changes of normal aging and dementia; early detection and intervention may be possible during this stage (1,2). Among individuals with MCI, about 32% develop Alzheimer's disease and dementia (ADRD) within 5 years (2,3). The high conversation rate to ADRD than those with normal cognition underscores the need to identify the risk factors of this devastating disease. Identification of risk factors is a key step in developing and implementing relevant public health programs to delay the onset of cognitive impairment and slow the progression to ADRD.

Periodontal disease is a chronic inflammatory disease caused by host response to predominantly Gram-negative anaerobic bacteria (4,5). Pro-inflammatory molecules, bacteria, and bacterial products derived from periodontal disease increase the risk of developing an inflammatory state in the central nervous system (6). Prior research found significant relationships between periodontal infection and lower cognitive scores (7). Yet, recent systematic reviews have shown that research on the association between periodontitis and cognitive impairment is limited and more studies are needed (8,9). Furthermore, tooth loss in older adults represents the final outcome of dental conditions, such as caries and periodontitis (10) and has been related to worse cognitive function (11,12).

A growing number of studies have shown an association between poor oral health (tooth loss and/or periodontal disease) and ADRD (11,13–16). Tooth loss and periodontal disease may be putative modifiable risk factors for MCI, but limited research has been conducted on the association between poor oral health and MCI (17–20). Evidence on poor oral health as a potential risk factor for MCI would have important implications for ADRD prevention. The findings of this study can contribute to designing programs and interventions to promote oral health and to delay the onset of the cognitive decline.

Hispanics/Latinos (henceforth Latinos) are 1.5 times as likely to be clinically diagnosed with ADRD than non-Hispanic Whites. They are projected to have the largest increase in ADRD cases in the coming decades (21) Furthermore, many Latinos in the United States are immigrants (22). Immigration is a key life event that can result in dramatic changes in one's life (23). Age at immigration has far reaching implications for an individual's language acquisition, socioeconomic status, acculturation, and cognitive health in later life (24,25). (26) For most immigrants, age at immigration also determines the duration and levels of exposure to the inadequate health care and limited education in their home countries (23). Thus, the impact of these preimmigration antecedents on their health outcomes may vary by age of immigration (27).

To our knowledge, no research has been conducted to assess the relationship between poor oral health and MCI among Latino immigrants in the United States; nor has the role of age at immigration been investigated. The current study assessed the association between poor oral health (eg, significant tooth loss [STL] and periodontal disease) and MCI in a diverse group of Latino immigrants in the United States, and assessed moderation effects of age at immigration on the association. We hypothesized that (a) immigrants with poor oral health would be more likely to have MCI; (b) those who immigrated to the United States at an older age would be at an even higher risk of MCI.

Method

Data were from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), and its ancillary study—the Study of Latinos–Investigation of Neurocognitive Aging (SOL-INCA).

HCHS/SOL is a large, multicenter, population-based, longitudinal prospective cohort study of Hispanic/Latino adults (ages 18–74 years, n = 16 415) from 4 U.S. metropolitan areas: Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA, consisting of individuals from Cuban, Dominican, Mexican, Puerto Rican, Central and South Americans backgrounds. The first 2 data collections (ie, 2006–2013 [Visit 1] and 2013–2018 [Visit 2]) have been completed. The third data collection period is from 2018 to 2024. Participants were recruited based on a multi-stage complex sampling design (28,29). Sampling details can be found elsewhere (29). Participants underwent comprehensive clinical examinations (medical and dental), cognitive assessment, and behavioral and sociodemographic interviews at baseline (Visit 1). Participants were asked if they had any natural teeth. If the answer was "no," they were directed to edentulous specific questions. Data from edentulous participants were not included in this study. The dental examination included tooth count, assessment of caries, dental restorations, and periodontal status.

For the SOL-INCA study, the HCHS/SOL Coordinating Center identified 7 420 potentially eligible participants, 50 years and older with baseline neurocognitive testing from Visit 1, who were screened at Visit 2 and completed the SOL-INCA Eligibility and Screening form. Out of this group, 222 were considered ineligible, 569 were eligible and refused, and 6 377 were eligible and agreed to participate (29). Out of them, 6 255 participants completed the cognitive tests at Visit 2. Among these 6 255 participants, there were 5 709 immigrants (not born in one of the 50 U.S. states), 555 non-immigrants, and 1 participant with missing data on immigrant status. The sample in this study consisted of 5 709 immigrants ages 50–74 years (see Figure 1 for the study sample selection).

Outcome Variable: Mild Cognitive Impairment

MCI was a binary outcome in this study and we assessed the prevalence of MCI. In HCHS/SOL (Visit 1), 4 tests on cognitive function are included: (a) Six-Item Screener (mental status), (b) Brief-Spanish English Verbal Learning Test (verbal episodic learning and memory), (c) Word Fluency, and (d) Digit Symbol Subtest (processing speed, executive function). In SOL-INCA (Visit 2), cognitive tests were administered to eligible HCHS/SOL participants who returned for Visit 2. In addition to these 4 tests, the following tests were also included in Visit 2: the Trail Making Test (parts A and B [executive function]), and NIH Toolbox Picture Vocabulary Test (PVT) self-reported

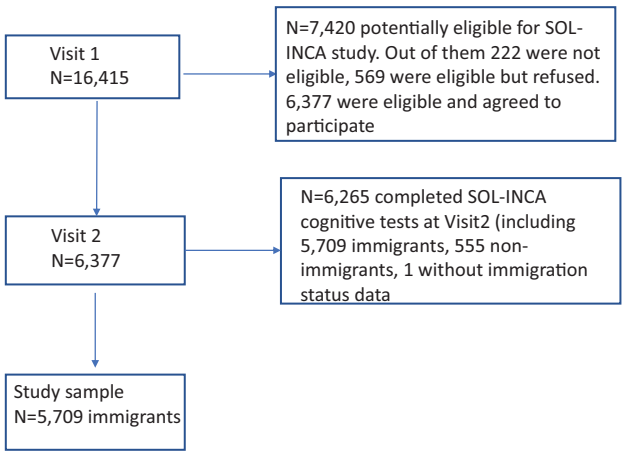

Figure 1. A flow chart of sample selection. SOL-INCA = Study of Latinos – Investigation of Neurocognitive Aging.

cognitive decline (Everyday Cognition-12), and instrumental activities of daily living (IADL) (29,30).

The assessment of MCI is based on the cognitive test scores in Visit 1 and Visit 2 and has been described elsewhere (29–31). Briefly, MCI diagnostic criteria include 4 core National Institute on Aging–Alzheimer's Association (NIA-AA) criteria (32): (a) any cognitive score in the mildly impaired range, that is, from −1 to −2 *SD*s compared with the SOL-INCA internal robust norms (age-, education-, sex-, and PVT-adjusted scores), (b) significant cognitive decline (greater than or equal to −0.055 *SD*/year) from Visit 1, (c) self-reported cognitive decline, and (d) no or minimum IADL impairment (32). Cognitive impairment and significant cognitive decline criteria were used to reduce false-positive bias. Individuals with severe cognitive impairment (below −2 *SD* relative to SOL-INCA robust norms and with significant functional impairment) were not included in these MCI prevalence estimates (30).

Independent Variable: Oral Health

Oral health status was measured by 2 variables: (a) Significant tooth loss (STL), measured as a binary variable (ie, 8 or more vs less than 7 tooth loss) (33), which indicates significant loss in functional dentition status. (b) Periodontal disease—no periodontal disease, mild, moderate, and severe (34), coded as 1, 2, 3, and 4. The dental examination was conducted at Visit 1. Tooth loss was based on a maximum of 28 permanent teeth (exclusion of the third molars). The definition of periodontal disease was based on the Centers for Disease Control and Prevention and American Academy of Periodontology case definitions for mild, moderate, and severe periodontitis (34,35). Detailed descriptions can be found elsewhere (36,37). Briefly, periodontal disease was estimated as severe (≥2 interproximal sites with attachment loss [AL] ≥6 mm [not on same tooth], and ≥1 interproximal sites with pocket depth [PD] ≥5 mm), moderate (≥2 interproximal sites with AL ≥ 4 mm [not on the same tooth], or ≥2 interproximal sites with PD ≥ 5 mm [not on same tooth]), and mild (≥2 interproximal sites with AL ≥ 3 mm and ≥2 sites with PD ≥ 4 mm (not on the same tooth, or ≥1 site with PD ≥ 5 mm).

Moderator Variable: Age at Immigration

Self-reported age at immigration to the United States was assessed as a moderator variable in this study. Following prior research (24,25,38), we classified the immigrants into 4 groups according to their age at immigration: <18, 18–34, 35–49, and 50+ years.

Covariates

Covariates were selected based on prior research on risk factors of MCI (30,31,39). Data of covariates were from Visit 1. They included (a) Demographics: age at Visit 2, sex, Hispanic/Latino background (7 groups: Dominican, Central American, Cuban, Mexican, Puerto Rican, South American, and Mixed Hispanic/Latino heritage); (b) Socioeconomic status: annual household income (<$10 000, $10 000–<$20 000, $20 000–<$40 000, $40 000–<$75 000, ≥$75 000 or Unknown [income data missing]), education (<high school, high school, and above high school), and health insurance; (c) Self-reported health behavior variables: alcohol consumption (current drinker, former drinker, and never drinker), smoking cigarettes (current, former, or never smokers), and diet quality (above or below the top 40th percentile). Dietary intake was ascertained by two 24-hour dietary recalls administered 6 weeks apart. A diet score was calculated by assigning participants a score of 1–5 according to sex-specific quintile of daily intake of saturated fatty acids, potassium, calcium, and fiber (with 5 as the most favorable quintile). The total scores were summed and the highest 40 percentile considered a healthier diet (40,41); (d) Self-reported chronic conditions: hypertension, myocardial infarction, stroke, diabetes—all binary variables (Yes/No), body mass index (measured as weight in kilograms divided by height in meters squared), depressive symptoms (measured by Center for Epidemiologic Studies Depression scale-10 [CES-D] [Yes, elevated depressive symptoms, ≥10 CES-D, No, <10 CES-D]) (42). In addition, 3 other covariates were included—participant's high sensitivity C-reactive protein (hs-CRP) from baseline, time elapsed since Visit 1 (in years), and field centers (ie, Bronx, Chicago, Miami, and San Diego).

Analysis

First, we provided descriptive statistics to characterize the SOL-INCA population by MCI status. Second, we ran 6 logistic regression models sequentially to assess the association between poor oral health and MCI: Model I assessed the crude association of STL with MCI; Model II assessed the crude association of periodontal disease with MCI; Model III included both STL and periodontal disease; Model IV added demographics (age, sex, and Hispanic/Latino background), SES variables (household income, education level, and health insurance), field center, and time elapsed between Visits 1 and 2 to Model III; Model V, added health behavior variables (alcohol consumption, cigarettes smoking status, and diet quality), chronic conditions variables (hypertension, myocardial infarction, stroke, and diabetes), high-sensitivity C-reactive protein (hsCRP), and age at immigration to Model IV; finally in Model VI, we tested the interaction between poor oral health and age at immigration. Data analysis was performed using Stata 16 (College Station, TX: StataCorp LLC). All analyses used survey procedures (with strata, cluster, and weight statements) to account for the complex sampling design of HCHS/SOL. A significance level of .05 was used.

Results

Out of 6 377 participants who completed cognitive tests in Visit 1, 112 (1.7%) did not complete the cognitive tests at Visit 2. We compared the characteristics between participants who completed the cognitive tests at both Visit 1 and Visit 2 with those who did not complete the cognitive tests at Visit 2. We did not find significant differences between these 2 groups.

In the analytical sample (n = 5 709), the prevalence of MCI was 11.4% (95% confidence interval [CI]: 10.2–12.8%). Table 1 presents the descriptive statistics of immigrants in the SOL-INCA population (n = 5 709 immigrants). By MCI status, the proportions of immigrants who developed MCI were higher in those with STL, or having a less than high school education, less than $10,000 family income, health insurance; having hypertension, stroke, depression symptoms, diabetes, or not drinking alcohol (all $p < .001$). The average age of those with MCI was older than those without ($p < .001$). In addition, the proportion who developed MCI was higher for those who immigrated to the United States at ages 50+ years ($p < .001$). There is no statistically significant difference in the proportion of immigrants who developed MCI by periodontal disease status.

Table 2 shows logistic regression model results for the association between poor oral health and MCI across all statistical models. The crude association between STL and MCI was significant ($p < .001$) and the crude association between periodontal disease was not significant ($p = .25$; see Models I and II). In Models III and IV,

Table 1. Characteristics of Hispanic/Latino Immigrants in the Target Population of SOL-INCA, Overall and by MCI Status (unweighted $n = 5\,709$)

	Overall			MCI						
Variables	%, Mean*	95% CI		Yes (%, Mean) *	95% CI		No (%, Mean) *	95% CI		*p*
Significant tooth loss										<.001
No	65.2	62.7	67.6	8.4	7.0	10.0	91.6	90.0	93.0	
Yes	34.8	32.4	37.3	15.3	12.9	18.1	84.7	81.9	87.1	
Periodontal disease										.312
No	34.2	32.2	36.2	10.4	8.3	13.0	89.6	87.0	91.7	
Mild	7.2	6.1	8.6	13.1	8.3	20.1	86.9	79.9	91.7	
Moderate	43.1	41.0	45.2	9.3	7.8	11.0	90.7	89.0	92.2	
Severe	15.5	14.2	16.9	12.3	9.1	16.3	87.7	83.7	90.9	
Age (mean)	63.5	63.1	63.8	66.9	65.8	68.0	63.0	62.6	63.4	<.001
Sex										.290
Male	41.9	40.2	43.6	10.7	8.9	12.7	89.3	87.3	91.1	
Female	58.1	56.4	59.8	12.0	10.4	13.9	88.0	86.1	89.6	
Hispanic/Latino backgrounds										.140
Dominican	9.9	8.4	11.7	11.6	8.4	15.8	88.4	84.2	91.6	
Central American	7.3	6.3	8.4	11.3	7.6	16.4	88.7	83.6	92.4	
Cuban	29.9	25.5	34.7	10.7	8.6	13.2	89.3	86.8	91.4	
Puerto Rican	31.2	27.5	35.1	10.3	8.3	12.7	89.7	87.3	91.7	
South American	13.7	11.9	15.7	15.9	12.1	20.7	84.1	79.3	87.9	
Mexican	6.4	5.5	7.3	10.1	6.9	14.5	89.9	85.5	93.1	
Mixed Latino heritage	1.7	1.2	2.2	16.7	7.7	32.6	83.3	67.4	92.3	
Education										<.001
<High school	38.2	36.1	40.5	15.8	13.5	18.4	84.2	81.6	86.5	
High school	21.3	19.7	22.9	10.1	8.1	12.4	89.9	87.6	91.9	
> High school	40.5	38.4	42.6	8.2	6.7	10.0	91.8	90.0	93.3	
Family income										<.001
<$10 000	16.8	15.2	18.6	17.0	13.9	20.6	83.0	79.4	86.1	
$10 000–<20 000	30.7	28.8	32.7	11.2	8.9	14.0	88.8	86.0	91.1	
$20 000–<40 000	28.7	26.9	30.5	9.4	7.5	11.7	90.6	88.3	92.5	
$40 000–<75 000	11.2	9.8	12.7	5.9	3.8	9.1	94.1	90.9	96.2	
>=$75 000	3.2	2.5	4.3	7.5	3.9	14.2	92.5	85.8	96.1	
Unknown	9.4	8.2	10.7	17.0	12.7	22.3	83.0	77.7	87.3	
Health insurance										<.001
No	45.4	42.7	48.0	8.8	7.4	10.5	91.2	89.5	92.6	
Yes	54.6	52.0	57.3	13.5	11.8	15.4	86.5	84.6	88.2	
Body mass index	29.7	29.5	29.9	30.3	29.7	30.9	29.7	29.4	29.9	.056
Smoking status										.540
Current smokers	56.8	54.7	58.8	11.6	9.9	13.4	88.4	86.6	90.1	
Former smokers	25.7	23.9	27.5	10.4	8.3	12.9	89.6	87.1	91.7	
Never smoked	17.5	15.9	19.3	12.5	9.7	15.9	87.5	84.1	90.3	
Alcohol use										<.001
Current drinker	43.5	41.5	45.4	8.9	7.6	10.4	91.1	89.6	92.4	
Former drinker	31.6	29.6	33.6	12.9	10.7	15.4	87.1	84.6	89.3	
Never drinker	25.0	23.0	27.0	14.1	11.5	17.2	85.9	82.8	88.5	
Depression										<.001
No	69.4	67.5	71.2	9.2	7.9	10.7	90.8	89.3	92.1	
Yes	30.6	28.8	32.5	16.2	13.7	19.1	83.8	80.9	86.3	
Hypertension										<.001
No	56.9	54.8	59.1	8.5	7.3	9.9	91.5	90.1	92.7	
Yes	43.1	40.9	45.2	15.4	13.0	18.0	84.6	82.0	87.0	
Stroke										<.001
No	98.1	97.6	98.5	11.0	9.8	12.3	89.0	87.7	90.2	
Yes	1.9	1.5	2.4	34.9	23.2	48.8	65.1	51.2	76.8	
Myocardial infarction										.114
No	96.9	96.0	97.6	11.3	10.1	12.6	88.7	87.4	89.9	
Yes	3.1	2.4	4.0	18.3	9.8	31.5	81.7	68.5	90.2	
Diabetes										<.001
No	70.1	68.3	71.9	8.4	7.3	9.6	91.6	90.4	92.7	
Yes	29.9	28.1	31.7	18.8	16.0	22.0	81.2	78.0	84.0	

Table 1. Continued

Variables	Overall			MCI						
	%, Mean*	95% CI		Yes (%, Mean) *	95% CI		No (%, Mean) *	95% CI		*p*
Dietary quality above 60%										.381
No	44.2	41.8	46.6	12.1	10.3	14.2	87.9	85.8	89.7	
Yes	55.8	53.4	58.2	10.9	9.2	12.9	89.1	87.1	90.8	
Age at immigration										<.001
<18 years	13.6	11.9	15.5	7.9	5.3	11.7	92.1	88.3	94.7	
18–34 years	37.7	35.4	40.2	12.1	10.3	14.2	87.9	85.8	89.7	
35–49 years	32.5	30.6	34.5	10.0	8.0	12.5	90.0	87.5	92.0	
50+ years	16.1	14.1	18.4	15.8	12.6	19.7	84.2	80.3	87.4	
hs-CRP (mean)	4.2	3.8	4.5	4.6	3.9	5.4	4.1	3.7	4.4	.191
Time since Visit 1 (mean years)	7.0	6.9	7.1	7.1	6.9	7.2	7.0	6.9	7.0	.140
Field center										
Bronx	22.7	19.8	26.0	26.3	20.1	33.5	21.8	18.9	25.0	.339
Chicago	13.3	11.5	15.4	13.9	10.7	18.0	13.4	11.5	15.5	
Miami	40.3	35.2	45.6	37.2	30.2	44.8	41.0	35.8	46.4	
San Diego	23.6	20.0	27.7	22.6	17.2	29.1	23.9	20.1	28.1	

Notes: hs-CRP = high-sensitivity C-reactive protein; MCI = mild cognitive impairment.
*Weighted percent/mean.

STL was associated with MCI ($p < .001$) while periodontal disease (mild, moderate, or severe) was not (all $p > .05$).

In Model V, immigrants with STL (adjusted odds ratio [AOR] = 1.36, 95% CI: 1.01–1.85) were more likely to have MCI than those with fewer than 7 teeth loss. Overall, periodontal disease was associated with MCI ($p = .04$), but no results were found comparing mild, moderate, and severe periodontal disease with non-periodontal disease (all $p > .05$). Immigrants who came to the United States at ages 18–34 years (AOR = 1.83, 95% CI: 1.09–3.08), and at ages 50+ years (AOR = 1.88, 95% CI: 1.02–3.45) were more likely to have MCI than those who immigrated to the United States before age 18 years. Immigration at ages 35–49 was marginally associated with MCI (AOR = 1.62, $p = .08$). Immigrants having a high school or more than high school education were less likely (all $p < .05$) to have MCI than those with less than high school education. Having elevated depression symptoms, stroke, and diabetes were significant risk factors for MCI (all $p < .05$).

We tested if age at immigration modified the associations between each of the oral health measures (STL and periodontal disease, separately) with MCI status (Model VI). The interaction term was significant ($p = .02$) between STL and age at immigration but the interaction term between periodontal disease and age at immigration was not ($p = .10$). There was an increased risk of having MCI for those immigrants who had STL and immigrated to the United States at ages 35–49 years (see Figure 2).

As additional analyses, we explored the potential moderating effects of diet and hsCRP. We tested diet × STL, hsCRP × STL, diet × periodontal disease, and hsCRP × periodontal disease. We did not find significant results.

Discussion

In recent years, many studies have investigated poor oral health as a potential risk factor for ADRD. Overall, we found support for poor oral health, specifically STL, as a risk factor for MCI among Hispanic/Latino immigrants. One systematic study found that individuals with suboptimal dentition (<20 teeth) had a 20% higher risk of having cognitive decline and dementia than those with optimal dentition (≥20 teeth) (11). Another systematic review found that each additional tooth loss was associated with a 1.41% increase in the risk of cognitive impairment (14). Within Hispanic populations in the United States, an analysis of data from the Hispanic Established Populations for Epidemiologic Studies of the Elderly found that fewer teeth were associated with greater cognitive decline (43).

However, a paucity of evidence exists specifically on the association between poor oral health and MCI (19,44). A Japanese study (18) found that a loss of 8–15 teeth or loss of all the 32 teeth was significantly associated with MCI, in comparison to a loss of fewer than 8 teeth.

To our knowledge, our study is the first to assess the association between poor oral health determined by clinical examination and MCI in a diverse group of Latino immigrants in the United States. Our study provides new empirical evidence on tooth loss as a risk factor for MCI, and the results are consistent with prior research (20).

Overall, periodontal disease was significantly associated with MCI in the adjusted model (Model V). However, in comparison to those without periodontal disease, we did not observe disease severity as a significant risk factor for MCI. It should be noted that current disease status does not always reflect past disease, particularly if the participant has undergone treatment or has had several teeth extracted in the past. It should also be noted that existing findings on the association between periodontal disease and dementia are inconclusive (15,45). More research is needed to explicate the relationship. Recent research has shown that bacteria that cause gum disease are also associated with the development of Alzheimer's disease and related dementias, especially vascular dementia (46). Periodontal care may assist in preventing or ameliorating Alzheimer's disease (47). Potential pathways between poor oral health and cognitive impairment include impairment in masticatory function, which in turn diminishes stimulation of the central nervous system (48,49), leads to change in diet and nutritional status (50), and increases total body inflammatory load (51). With ADRD projected to increase among Hispanics/Latinos in the United States, dental care may be an important point of intervention for preventing later-life cognitive impairment.

Table 2. Logistic Regression Model* Results of Factors Associated With MCI (n = 5 709)

	Model I				Model II				Model III			
Variables	AOR	95% CI		p	AOR	95% CI		p	AOR	95% CI		p
STL	1.98	1.49	2.62	<.001					1.97	1.48	2.62	<.001
Periodontal disease								.25+				.11+
(vs None)												
Mild					1.33	0.75	2.34	.33	1.56	0.88	2.74	.13
Moderate					0.88	0.64	1.21	.44	0.86	0.63	1.19	.37
Severe					1.21	0.81	1.80	.36	1.17	0.78	1.77	.45

	Model IV				Model V				Model VI			
Variables	AOR	95% CI		P	AOR	95% CI		p	AOR	95% CI		P
STL	1.46	1.09	1.95	.01	1.36	1.01	1.85	.04	0.71	0.26	1.89	.48
Periodontal disease				.07+				.04+				.04+
(vs None)												
Mild	1.41	0.81	2.43	.22	1.41	0.84	2.36	.20	1.43	0.85	2.41	.18
Moderate	0.78	0.57	1.06	.11	0.76	0.56	1.04	.08	0.76	0.56	1.04	.08
Severe	1.02	0.67	1.54	.93	1.01	0.66	1.55	.95	1.00	0.66	1.51	1.00
Age at immigration (vs <18)								.12+				.04+
18–34					1.83	1.09	3.08	.02	1.49	0.79	2.82	.22
35–49					1.62	0.95	2.77	.08	0.96	0.50	1.87	.91
50+					1.88	1.02	3.45	.04	1.87	0.84	4.17	.12
STL by age at immigration interaction												.02+
(vs Non-STL and immigration age <18)												
STL by immigration age 18–34									1.78	0.67	4.77	.25
STL by immigration age 35–49									3.41	1.20	9.72	.02
STL by immigration age 50+									1.35	0.41	4.47	.63

Notes: AOR = adjusted odds ratio; BMI = body mass index; hs-CRP = high-sensitivity C-reactive protein; MCI = mild cognitive impairment; STL = significant tooth loss.

Model I: crude model, only included STL as the independent variable; Model II: only included periodontal disease as the independent variable; Model III: included both STL and periodontal disease as the independent variables; Model IV: added other covariates: age, sex, race, education, income, health insurance, time since visit 1, and field centers to Model III; Model V: added body mass index, smoking status, alcohol use, dietary quality, depression, hypertension, stroke, myocardial infarction, diabetes, and hs-CRP to Model IV; Model VI: same covariates as in Model V, plus a product term of age at immigration and STL.

*Analyses accounted for the survey design of HCHS.

+The overall p value from an overall test that tests the null hypothesis that all subgroups for each variable have the same odds of MCI.

Our data showed that about one third of immigrants had STL and two-thirds had periodontal disease. Tooth loss is considered the ultimate outcome of periodontal disease and dental caries (52). Given the disproportional burden of dementia among Latinos in the United States, more efforts are needed to promote good oral hygiene behaviors among Latino immigrants and improve access to dental care including restorative services, such as use of denture. Research has found that denture use would attenuate the detrimental effects of tooth loss, especially for partial tooth loss, on cognitive impairment (20,53).

Overall, our results (Model V) show that Latinos who immigrated to the United States when they were adults (ie, age at immigration, 18–34, 35–49, or 50+ years) were more likely to have MCI than those who immigrated when they were children (ie, age at immigration <18 years). Although not directly comparable due to different study designs, our findings are in line with prior studies that examined cognitive health among Mexican Americans (24,25,38). For example, one study found that late-life (ages 50+ years) immigrant women had a 46% higher risk of cognitive impairment compared to U.S.-born Mexican American women (24). One explanation for our findings is that child immigrants may have better opportunities to obtain higher education/new occupational skills, get greater exposure to public health information, and use preventive health care in the United States. They may be able to accumulate socioeconomic resources which can positively affect cognitive health in later life (54). Conversely, adult immigrants may have disadvantages, including English language barriers and limited education and career opportunities, which would negatively affect their health outcomes. For these immigrants, assistance should be provided in access to dental care.

Moreover, in this analysis, age at immigration moderated the association between STL and MCI. The significant interaction between STL and age at immigration revealed that the risk for MCI associated with STL varied by the age of immigration; the variation by age at immigration was not linear. The likelihood of MCI was significantly increased among Latino immigrants who immigrated at ages 35–49 years. It is probable that this group of immigrants may find it harder to adapt to a new life in the United States: Job/income opportunities and opportunities to learn new skills may be more limited for them. Such frustration may take a toll on their wellbeing including mental health. Another explanation is that before immigration to the United States, the limited and sub-optimal health/dental services in their home country (55,56) may have affected these adult immigrants more than child immigrants, and may predispose them to poor health including tooth loss, subsequently impacting their mental health (45), compared with child immigrants. More research is needed to investigate the associations between age at immigration, poor oral health, mental health, and MCI among these immigrants.

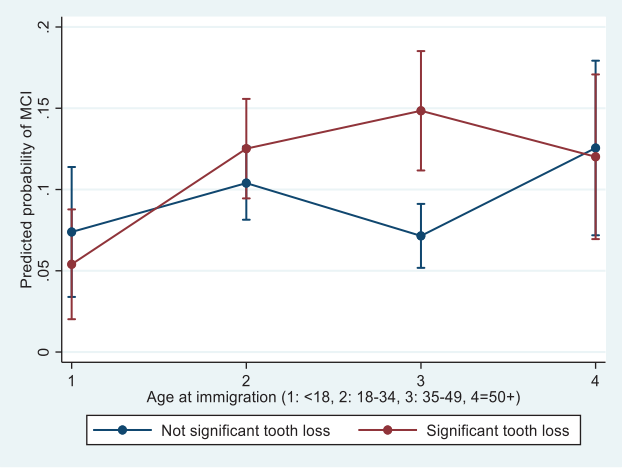

Figure 2. Predictive probability by Age at immigrantion × Significant tooth loss. Note: Results were generated from a logistic regression model (same as Model VI): MCI is the dependent variable; periodontal disease and tooth loss are the independent variables; covariates included. The independent variables significant tooth loss, periodontal disease, and covariates were age, sex, race, income, health insurance, time since visit 1, filed centers, body mass index, smoking status, alcohol use, dietary quality, depression, hypertension, stroke, myocardial infarction, diabetes, hs-CRP, age at immigration, and age at immigration by significant tooth loss interaction. hs-CRP = high-sensitivity C-reactive protein; MCI = mild cognitive impairment.

Our study has several strengths. We included a large sample of community-dwelling Latino from 6 different background groups. Also, oral health data were from clinical dental examinations and MCI was defined by objective and well-accepted standards. Our study also has limitations. First, the cause for tooth loss, whether dental caries or trauma, is not known. Second, the time of tooth loss was not available. Third, denture use data were not available, which could mitigate the effects of missing teeth on cognitive health (57) Edentulous participants were not included in the dataset, hence, the association between total tooth loss and MCI was not available. Nevertheless, edentulism reflects a different status of oral health. The focus of this study was on the effects of both missing teeth and periodontal disease on MCI. Fourth, the reason of immigration (eg, family reunion or career development) is not available in the dataset, which would affect an immigrant's health. Fifth, we are examining MCI prevalence and do not know for certain the temporal order of poor oral health and cognitive impairment. Further, there may be a bidirectional relationship between poor oral hygiene and cognitive impairment (58).

Conclusion

STL is a significant risk factor for MCI and age at immigration had a modification effect on the association between STL and MCI. Good oral hygiene practice and regular dental visits to maintain good oral health should be promoted among Latino immigrants. Better access to dental care, health education on risk factors of MCI, and promotion of good oral health may mitigate the burden of dementia in Latinos.

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Conflict of Interest

None declared.

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