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Neighborhood language isolation and depressive symptoms among elderly US Latinos

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Abstract

Purpose: Neighborhood segregation related to cultural factors, such as language use, may influence elderly Latino depression. We examined the association between neighborhood-level Spanish language segregation and individual depressive symptoms among elderly Latinos.

Methods: We linked US Census language use data with geocoded population-based data from 1,789 elderly Latinos (mean age=70.6 years) participating in the Sacramento Area Latino Study on Aging (1998–2008). Neighborhood language segregation was measured with the Index of Concentration at the Extremes, which demonstrates the extent to which residents are concentrated at extremes of deprivation and privilege. We fit two-level generalized linear mixed models with random intercepts for census tracts to quantify the association between neighborhood-level language segregation and depressive symptoms, adjusting for identified confounders.

Results: After adjusting for age, sex, and nativity, residents of highly segregated Spanish-speaking neighborhoods had more depressive symptoms than those in highly segregated English-only speaking neighborhoods (β=−4.410; 95% confidence interval [CI]=−6.851−−1.970). This

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association was largely attenuated upon adjustment for individual-level education (β=−2.119; 95% CI=−4.650–0.413).

Conclusions: Linguistically segregated communities may benefit from targeted outreach given the high depression prevalence in these neighborhoods. Further, our findings suggest that limited access to fundamental social protections, such as education, may drive the segregation-depression association among US Latinos.

Keywords

Segregation; neighborhood; depression; education; language; Mexican Americans; elderly

INTRODUCTION

Across the United States (US), older Latinos report the highest levels of depression compared to other populations[1]. Residential segregation may play a key role in the mental health of historically marginalized populations, such as US Latinos. Over the last decade, Latino residential segregation has increased in the US, with Latinos often residing in ethnic enclaves[2]. However, most studies on residential segregation and mental health have been conducted among non-Hispanic White and Black communities.

Among Black communities, segregation has been found to adversely impact numerous health outcomes; this association is thought to exist because the existence of such ethnically homogenous neighborhoods reflects structural discrimination that constrains where an individual can reside and reinforces racial hierarchy and white privilege[3]. The mechanisms driving segregation may differ for Latino communities compared to Black communities, however, and may therefore impact Latino health differently. Latino segregation may reflect preference, especially among immigrants, to reside among co-ethnics, which affords social and cultural resources and eases the transition into the new environment[4]. However, like Black individuals, Latinos also experience housing market discrimination, and the cultural and social resources provided by living among co-ethnics may not sufficiently offset the adverse effects of the poverty that often accompanies segregation[5].

Past segregation studies of depressive symptoms among US Latinos have utilized neighborhood racial/ethnic composition as a proxy for more direct cultural segregation measures[6–8]. However, neighborhood segregation in relation to the cultural factor of language use may be especially salient for the mental health of elderly Latinos[9–11]. Qualitative studies interviewing US Latinos indicate that inadequate proficiency in the predominant language is viewed as a life stressor, emphasizing the trauma, loneliness, and isolation associated with their language preference: ‘The language difference is traumatizing; it is more difficult when you are old,’ and ‘I felt lonely. I couldn’t talk to anyone[12].’ Language use is linked to mental health through its influence on resource acquisition, creation of social ties, maintenance of familial shared values, and a sense of belonging or isolation from one’s community[9,11]. English proficiency has been shown to increase access to health information and mental health services[13,14]. Further, language use may more accurately capture neighborhood cultural orientation because even if

neighborhood Latino composition remains stable over time, the linguistic makeup may change more quickly.

Nevertheless, factors with greater face validity as cultural orientation measures, such as language use, have not been sufficiently examined at the neighborhood level[15]. While a few studies have described an association between neighborhood-level language isolation and diet and lower BMI,[15,16] studies assessing neighborhood language isolation in relation to mental health are currently non-existent.

Furthermore, the direction of the association between neighborhood linguistic characteristics and depression may depend upon individual-level language preference. For example, discordance between an individual's language preference and the predominant language of the surrounding neighborhood may impact mental health by causing social exclusion, discomfort, and emotional distress[17,18]. Additionally, for English-speaking Latinos, residing in predominantly Spanish-speaking neighborhoods may represent blocked social and spatial mobility, and thereby also contribute to worse mental health[19,20]. However, studies aiming to assess the impact of neighborhood Latino composition and segregation on mental health adjusted for individual-level cultural factors, such as language preference, which may have masked the effect of neighborhood composition and segregation on mental health by ignoring the potential modifying role of language preference[8,21].

To address the gaps in the existing literature, this study utilized geocoded data from the Sacramento Area Latino Study on Aging to examine the association between neighborhood-level Spanish language segregation and individual depressive symptoms among an elderly Latino population. We further examined whether the influence of neighborhood-level language segregation varied by individual-level language preference.

MATERIAL AND METHODS

Study population

Participants in this analysis were members of the Sacramento Area Latino Study on Aging (SALSA), taking place from 1998 to 2008[22]. SALSA is a longitudinal study of 1,789 elderly Latinos, predominantly of Mexican origin. SALSA's study design has been described previously[22]. Briefly, participants were self-identified Latinos aged 60+ years at baseline and residing within Sacramento, Yolo, Sutter, Solano, San Joaquin, and Placer Counties in California[22]. The sample was representative of older Latinos residing in the target area. During home visits, participants reported health conditions, lifestyle, and sociodemographic factors, and trained bilingual interviewers collected clinical data. This analysis linked geocoded baseline SALSA data with language data from the 2000 US Census. Informed consent was obtained from all participants, and study procedures were approved by institutional review boards at participating institutions. Further, the study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Measures

Depressive symptoms—Depressive symptoms were measured with the Center for Epidemiological Studies Depression Scale (CES-D)[23]. The CES-D is a 20-item 4-point Likert-type scale assessing the extent to which respondents experienced depressive symptoms during the prior week[23]. This scale has been validated in Spanish-speaking and older Latino populations[24–27]. The CES-D is based on clinical depression symptoms and correlates well with other depression scales[23]. CES-D scores range from 0 to 60[23].

Neighborhood-level language segregation—We utilized the Index of Concentrations at the Extremes (ICE) to measure neighborhood-level language segregation. The ICE was developed to demonstrate the extent to which an area's residents are concentrated at the extremes of deprivation and privilege[28,29]. The index ranges from −1 to 1; a value of −1 indicates that 100% of the population is concentrated in the least privileged group, and a value of 1 indicates that 100% of the population is concentrated in the most privileged group[28,29]. The ICE was originally developed for use with economic measures but has recently been utilized to assess extreme concentrations of race and other cultural factors[28–30]. The ICE is preferable to other segregation measures, such as the Index of Dissimilarity, because it distinguishes which group is concentrated at the extreme. Neighborhoods that are 100% Latino would have the same Index of Dissimilarity as neighborhoods that are 100% White; the ICE appropriately assigns these two neighborhoods distinct scores[28,29]. Additionally, unlike the Index of Dissimilarity or Isolation Index, the ICE can be meaningfully used with smaller geographic units, such as census tracts[28–30].

We utilized census tract level language use data from the 2000 US Census to calculate the language segregation ICE variable. The ICE was calculated:

$$ICE_i = \frac{E_i - S_i}{T_i}$$

Where E_i is the number of English-only speakers in census tract i, S_i the number of Spanish speakers in census tract i, and T_i is the total population for whom language preference is known in census tract i[28]. The numerator was determined utilizing the 2000 US Census questions: 1) 'Does this person speak a language other than English at home?' and 2) 'What was this language?' A value of −1 indicated an entirely Spanish-speaking census tract, a value of 1 indicated an entirely English-only speaking tract.

Statistical analysis

We created and examined directed acyclic graphs to identify potential confounders and adjusted our final models for individual-level age, sex, birth country, and years of education as these are the potential key confounders of the neighborhood segregation-depression association. To quantify the association between neighborhood-level segregation and CES-D scores, we fit a two-level generalized linear mixed model with a random intercept for each census tract utilizing PROC MIXED in SAS 9.4 (SAS Institute, Inc., Cary, NC). Level 1 represented withinneighborhood variation in CES-D scores; level 2 represented between-neighborhood variation in CES-D scores due to neighborhood language segregation. We

calculated Intraclass Correlations (ICC) to examine the proportion of the total variance in CES-D scores accounted for by neighborhood clustering.

Functional form assessments indicated the best model forms for continuous variables relative to depressive symptoms. We compared each model graphically with the Loess smoother and used likelihood ratio tests and Akaike Information Criteria to compare nested and non-nested models, respectively. This assessment indicated that the continuous, linear functional form was appropriate the ICE, age, and education variables. However, ICE quartiles were also utilized in Table 1 for ease of interpretation of descriptive characteristics.

The association between language segregation and depressive symptoms may differ by individual-level language preference,[31] therefore we assessed a cross-level interaction between individual-level language (English or Spanish) and neighborhood Spanish language ICE. We examined the Wald test for an interaction term between individual- and neighborhood-level language with a significance criterion of $P \leq 0.1$. We further examined effect estimates stratified by individual-level language preference.

RESULTS

Participants had an average age of 70.6 years, and 58.4% were female (Table 1). Additionally, 57.8 identified Spanish as their primary language, and 51.0% of participants were foreign-born. The average number of years in the US among foreign-born participants was 37.6, ranging from 1–85 years. Average education was 7.2 years, with 70.8% of participants completing <12 years of education. The average CES-D score was 10.0, and 25.5% had a CES-D score ≥16. Compared to participants living in neighborhoods most segregated toward Spanish use (i.e. the lowest Spanish language ICE quartile), those living in neighborhoods most segregated toward English-only use were more likely to be US-born, consider English their primary language, have more years of education, have lived in their current neighborhoods for less time, and have lower CES-D scores.

Participants resided in 249 of 586 census tracts comprising the six targeted counties (Figure 1). There was a mean±SD of 7.1±9.2 participants per tract (range: 1–82). Participants lived in their homes for 22.3 years on average (range: 0–74 years). Spanish speakers made up 12.3%±9.7% of each census tract, ranging 1–50% (Figure 2). The Spanish language ICE ranged from −0.03 to 0.90 with a mean±SD of 0.58±0.20 at the census-tract level.

The ICCs indicated that between-neighborhood variance accounted for a small, although non-negligible, proportion of the variance in CES-D scores, even after accounting for neighborhood segregation (Tables 2 and 3). These ICCs were similar in magnitude to other neighborhood depression studies[32]. After adjusting for age, sex, and nativity (Model 3, Table 2), residing in a neighborhood more segregated toward English-only use (a higher ICE score) was associated with lower CES-D scores ($\beta = -4.410$; 95% confidence interval [CI]= −6.851−−1.970). The beta estimate indicates that a single unit increase in ICE score was associated with a decrease in CES-D score of approximately 4 points. In other words, residing in a census tract with more English-speaking only residents compared to Spanish-speaking residents was associated with fewer depressive symptoms. This association

attenuated toward the null upon adjustment for education (Model 4, Table 3, β=−2.119; 95% CI=−4.650–0.413), indicating that after accounting for individual-level education, Spanish-language segregation no longer appeared to strongly influence depressive symptoms. The association was not modified by individual language preference (Model 6, Table 3, interaction *P* value: 0.9613).

We additionally conducted several sensitivity analyses to assess potential interactions and to examine whether our findings were robust to the inclusion of other possible variables of interest. Some studies suggest that the association between segregation and mental health may vary by participant nativity or participant sex[7,33]; however, sensitivity analyses examining modification by nativity and sex showed no evidence of this among our study population. Further sensitivity analyses indicated that adjusting for other variables related to nativity, such as time in the US, time lived in the neighborhood, and neighborhood-level Latino composition, did not impact the direction, magnitude, or strength of our results. Our findings were also robust to adjustment for marital status, access to health insurance, and various financial indicators including household size, monthly income, and employment status.

DISCUSSION

This study assessed the impact of neighborhood-level language segregation on depressive symptoms among an elderly Latino population, predominantly of Mexican origin. Prevalence of high depressive symptoms, defined as CES-D scores ≥16, was 25.5% in our population; this is comparable to US-representative samples of Latino adults[34]. We found a strong unadjusted association between language segregation and depressive symptoms that remained significant upon adjustment for age, sex, and nativity; in our population, individuals residing in highly segregated Spanish-speaking neighborhoods had more depressive symptoms than individuals in highly segregated English-only speaking neighborhoods. These associations attenuated toward the null upon adjustment for confounding effects of individual-level education.

Few studies have assessed the impact of formal segregation measures on depressive symptoms among US Latinos. Consistent with our unadjusted results, Lee et al. found a strong association between residential segregation, measured with the Isolation Index, and depressive symptoms among Mexican Americans in Chicago[21]. Traditionally in segregation and cardiovascular health literature, segregation appears to adversely influence health among Black communities but to benefit Latino communities[5]. This pattern may depend upon the time spent in the US of the Latino community and the health outcome of interest, as studies suggest worsening mental health among Latinos with increased time in the US[35]. As subsequent generations of Latino immigrants acculturate to US society, their experience of systemic and structural discrimination and the resulting mental health influence of residential segregation may begin to look more similar to that of Black individuals. Further, for long-term immigrants or US-born Latinos, residence in Latino enclaves may reflect blocked upward mobility that negatively impacts health[19,20]. This may explain why our results differ from traditional segregation literature, as our population largely comprises long-term immigrants or US-born individuals.

Previous segregation studies have focused almost exclusively on segregation in terms of racial composition, finding that increased Latino composition afforded a protective mental health effect among elderly Latino populations[6–8]. Shell et al. found that this mental health benefit was only present among English speakers, suggesting the importance of language use when examining these associations[6]. Our study incorporated Spanish language segregation, a more specific aspect of cultural segregation that may be especially important for Latino health[15,16]. Only one previous study examined segregation regarding language use in relation to mental health, assessing the association between linguistic isolation and depressive symptoms among Latinos in Los Angeles[36]. Vega et al. found that neighborhood linguistic isolation protected against depressive symptoms. They hypothesized that linguistically isolated communities may allow immigrants to maintain their culture and language as a medium for everyday tasks and social connections, creating a cultural comfort zone in which to adjust to the US context[36].

The protective effect of linguistic isolation found by Vega et al. opposes our unadjusted results, possibly as a result of differences in study population. Vega's study participants were younger and more likely to be foreign-born than SALSA participants. Newer immigrants tend to have fewer depressive symptoms compared to long-term immigrants, especially those experiencing blocked upward social mobility[35,20]. Long-term residents of linguistically isolated communities may lack access to health services and the social resources that allow for effective navigation of the US educational system and job market; this could in turn cause exclusion from advancement opportunities, further socioeconomic hardship, and thereby increased susceptibility to poor mental health[37].

The opposing directions of our results compared to those of Vega et al. may also be due to the utilization of different language segregation measures. Vega et al. obtained their neighborhood linguistic isolation directly from the 2000 Census data; the U.S. Census Bureau defines "linguistic isolation" as living in a household in which all members aged 14+ years speak a non-English language and none speak English "very well"[38]. We chose to use the ICE in relation to Spanish language use rather than the Census variable of linguistic isolation because the Census variable does not differentiate between those who speak Spanish at home or another non-English language, whereas the Spanish language use ICE variable does make this distinction. This differentiation may be especially important in California communities where new immigration from Asian countries has surpassed new immigration from Latin American countries,[39,40] and individuals who speak Chinese, Korean, or Vietnamese at home are more likely to classify as linguistically isolated than Spanish-speaking individuals[40]. Given that our study and that of Vega et al. were specific to Latino populations residing in California, the Spanish language segregation ICE variable may provide a more accurate illustration of Spanish language segregation in this region than the more general Census variable of linguistic isolation.

Neighborhood segregation in relation to cultural factors, such as language use, may be especially salient for the mental health of elderly Latinos. Qualitative studies among elderly individuals living in neighborhoods undergoing gentrification revealed that participants were more emotionally impacted by changing cultural factors in their neighborhoods than by changing socioeconomic composition[41]. Cultural neighborhood characteristics may play

an important role for the mental health of elderly US Latinos in particular because older individuals tend to spend more time at home and in the immediate outdoor environment than younger people[42] and have been shown to derive a strong sense of emotional attachment from their home and the surrounding community[43].

Neighborhood language use may also be especially important for elderly Latinos because elderly individuals from ethnic minority groups seek formal health care later than those from non-minority groups[44]. Lack of culturally appropriate community services that accommodate the language needs of a community's residents may impede access to information about and treatment for mental health conditions[44]. Latino patients are also more likely to seek health care from Latino physicians than other physicians,[45] and many Latinos consider a physician's Spanish-speaking ability when choosing a physician[46,47]. However, the educational differential between US Latinos and non-Latino Whites makes interacting with a Latino or Spanish-speaking clinician a rare experience. Fewer than 2% of American Psychological Association members identify as Latino[48]. These considerations are especially important for elderly Latinos who may be more confined to their residential environment and also carry a high depression burden and are therefore in greater need of these services.

In contrast to the findings of Lee et al. and Vega et al., our results attenuated toward the null upon adjustment for individual-level education. This suggests that crude associations between segregation and depressive symptoms were partially due to lower educational attainment being disproportionately present among individuals living in highly segregated Spanish-speaking neighborhoods. Participants' education levels likely placed constraints, both financial and social, on where they were able and wanting to live. For these reasons, living in a highly Spanish-speaking community likely did not cause depression, but rather represents a structural measure of discrimination that leads to the sorting of individuals by ethnicity or language use into neighborhoods with more or less of the resources, including education, occupation, and health opportunities, that may prevent depression. The non-significant interaction between individual-level language preference and neighborhood-level language also supports this interpretation. This lack of interaction suggests that language isolation may not be the primary driver of increased CES-D scores among those living in highly segregated Spanish-speaking neighborhoods; something else characterizing these census tracts, such as fewer educational resources and opportunities for upward social mobility, led to the association.

It is important to note that that educational attainment is a marker for overall socioeconomic position and that this variable likely represents socioeconomic factors operating early in life that have continued to impact the lives, living situations, and neighborhoods of the SALSA participants into their old age. Low education may set individuals on a trajectory for being more likely to be constrained to living situations and neighborhoods where they have inadequate access to other resources, services, programs, and information that are related to educational attainment and may be important for the mental health of elderly adults. Thus, improving access to educational resources may not directly benefit the mental health of the elderly individuals already living in these circumstances, rather these individuals would more likely benefit from improvement to access of the health-promoting resources, services,

and programs that educational attainment likely represents. Nevertheless, this does not negate the importance of improving educational resources as access to or lack of access to these resources has long-lasting consequences across the life course and even across generations[49].

We conceptualized individual-level education as a confounder of the language segregation-depressive symptom association, although education has been considered a mediator between segregation and health in other populations[50]. SALSA was comprised of elderly, mostly foreign-born, individuals; therefore, participants likely completed their education before settling into their current neighborhoods. Indeed, 93% of immigrant participants completed their education in their birth country. However, participant age does not entirely rule out education as a mediator if determinants of participants' current neighborhoods were associated with past residential history and participants' educational contexts, whether in the US or abroad. Nevertheless, for our elderly mostly foreign-born population, we believed education was more likely a common cause of the participants' neighborhood selection and depressive symptoms.

Our study had several strengths including use of geocoded data from a population-based sample representative of elderly Latinos residing in Sacramento, California. We utilized trained bilingual interviewers and validated surveys to collect sociodemographic and depression data. Further, our study was the first to implement the novel ICE measure to examine the impact of language segregation on depressive symptoms among a Latino population. To our knowledge, no existing studies have assessed the influence of this more direct measure of spatial social polarization, especially regarding cultural factors such as language isolation, on mental health.

Our study also had limitations. Firstly, language segregation, socioeconomic position, and depression are dynamic constructs that may change over time for neighborhoods and residents. However, the cross-sectional nature of SALSA baseline data did not allow us to determine the temporal direction of the association of interest nor to rule out reverse causality. Mental health status may cause an individual to self-select into certain neighborhoods rather than the neighborhood causing their mental health status. However, SALSA participants were residentially stable, with an average neighborhood residence of 22.3 years; thus, our neighborhood measure likely captures effects acting earlier in life[51]. Further, due to the cohort's residential stability, we anticipate little selection bias due to repatriation to birth country.

Additionally, we utilized education as a measure of socioeconomic position, which may not fully capture this construct. SALSA did collect income and employment data; however, education is often preferred in studies of older age individuals since it predicts occupation and wages and is less influenced by age-related changes in these characteristics[52]. The elderly SALSA participants may be retired and therefore may not have incomes representative of their earlier occupations. Nevertheless, we conducted sensitivity analyses using other economic indicators, including employment status and monthly income, and found that inclusion of these variables did not influence the results we observed when adjusting for educational attainment.

Further, as can been seen from the baseline geographic distribution of SALSA participants in Figure 1, most SALSA participants resided in a concentrated area within the targeted counties. This may cause concern regarding selection bias and generalizability. However, the 249 census tracts represented in the analysis do appear to be largely representative of the 596 census tracts that made up the six counties targeted for the SALSA study. For example, regarding Spanish speaking composition, among the 249 census tracts in which SALSA participants resided, the mean±SD percentage of Spanish speakers in each census tract was 12.3%±9.7%. When considering the total 586 census tracts that made up the six counties targeted for the SALSA study, the mean±SD percentage of Spanish speakers in each census tract was 13.2%±11.4%, based on US Census data from 2000[53]. Therefore, the census tracts in which participants resided did not appear to greatly differ from the census tracts in which participants did not reside in terms of Spanish speaking composition. Further, the SALSA sample was designed to be highly representative of older Latinos residing in the target area: households were selected in such a way to represent this population, and more than 89% of eligible and enumerated households had an individual who participated in the study[22].

Finally, SALSA participants were predominantly elderly individuals of Mexican-origin living in California's Sacramento Valley. Consequently, our findings may not apply to other Latino subpopulations or age groups, and we cannot draw broad conclusions regarding depressive symptom prevalence among all US Latinos. However, Mexican Americans are the largest, fastest-growing US Latino subgroup,[54] and studies across the US suggest that older Latinos report the highest levels of depression compared to other populations[1]. Therefore, examining factors associated with depression in these groups holds particular importance.

CONCLUSIONS

Our study found higher depressive symptoms among elderly Latinos residing in highly segregated Spanish-speaking neighborhoods compared to those residing in predominantly English-only speaking neighborhoods. However, individual-level educational attainment may partially account for this association. These findings suggest that inadequate access to educational resources in highly segregated communities may have enduring consequences across the life course and influence the mental health of US Latinos into old age. Our study contributes to a more comprehensive and contextual understanding of depression etiology and the community and socioeconomic pathways shaping Latino mental health. Accumulation of sociocultural risk factors within Latino neighborhoods is a complex issue influenced by years of discrimination, exclusionary policies, and unequal resource allocation. Despite this formidable complexity, depression among Latinos is a major public health issue that may greatly benefit from community-level intervention. Highly segregated minority communities may be in need of more targeted outreach, screening, and treatment efforts given the high depression burden concentrated in these neighborhoods. Further, improving educational opportunities in underresourced communities deserves high priority to begin the process of dismantling the social structures that lead to racial hierarchy in resource allocation and improve the long-term mental health of the residents of these communities.

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Abbreviations:

US	United States
SALSA	Sacramento Area Latino Study on Aging
CES-D	Center for Epidemiological Studies Depression Scale
ICE	Index of Concentrations at the Extremes
ICC	Intraclass Correlations
CI	Confidence interval

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Highlights:

- Prevalence of high depressive symptoms was 25.5% among study participants.
- Increased Spanish language isolation was associated with more depressive symptoms.
- Individual language use did not modify the segregation-depression association.
- Individual education attenuated the cultural segregation-depression association.

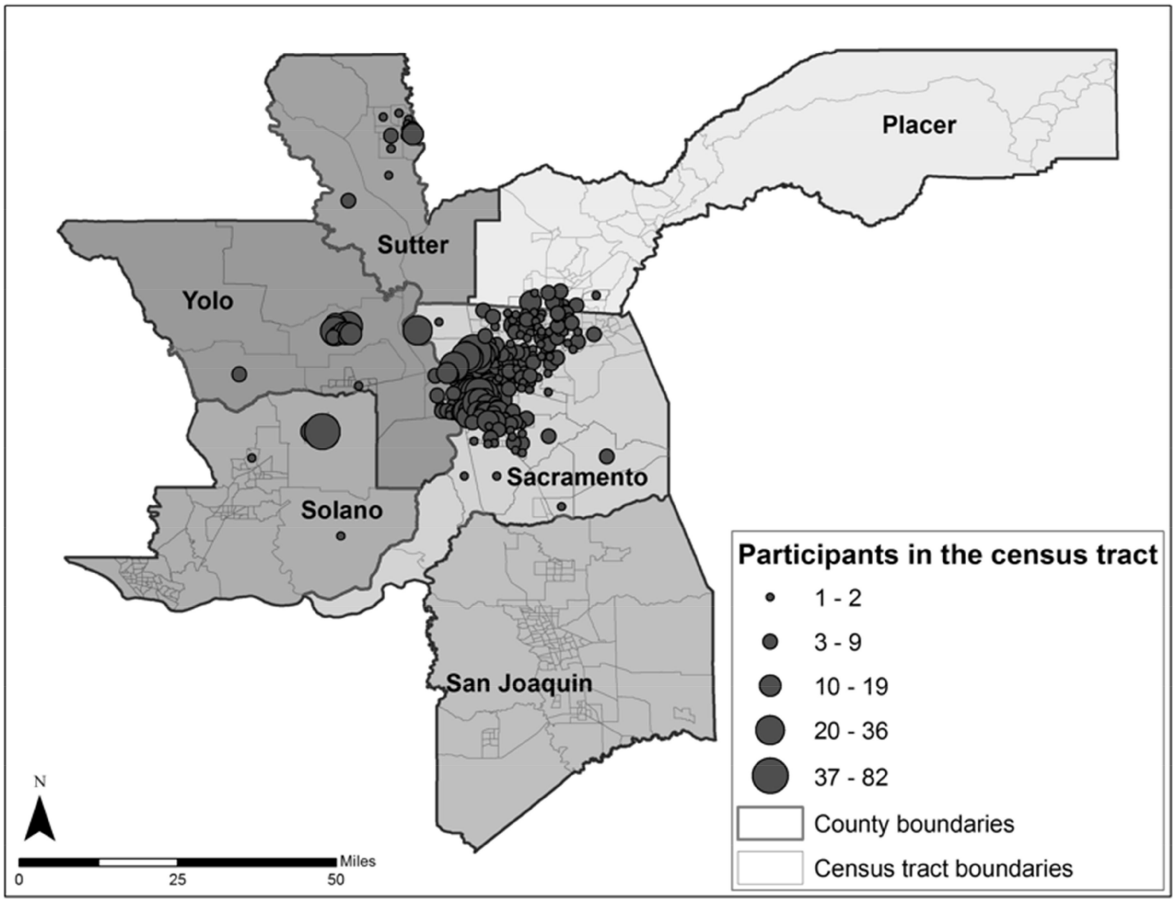

Figure 1.
Baseline geographical distribution of participants in the Sacramento Area Latino Study on Aging (1998–1999)

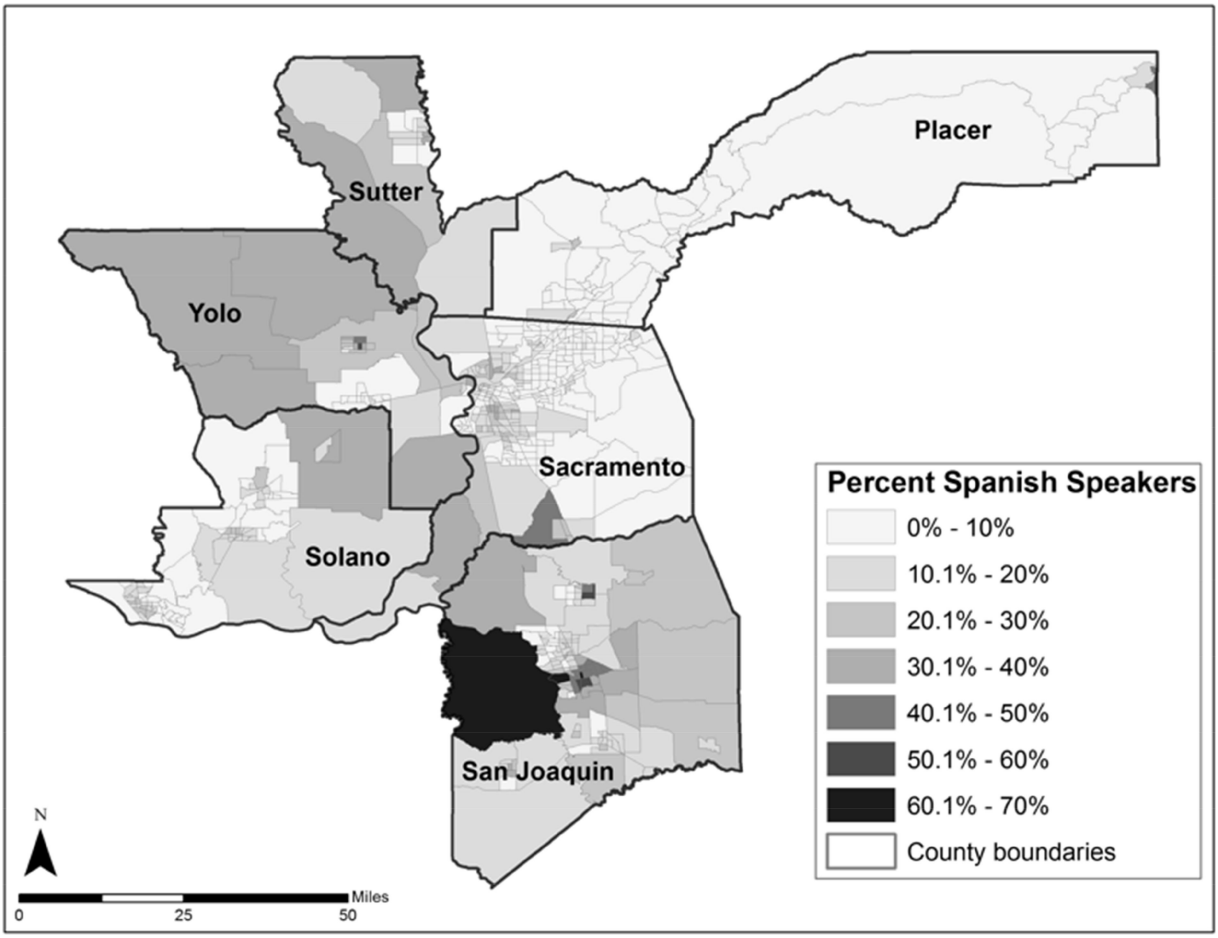

Figure 2.

Spanish language use by census tract in the Sacramento Area Latino Study on Aging (U.S. 2000 Census)

Table 1.

Descriptive characteristics of the SALSA population (baseline 1998–1999), overall and stratified by neighborhood-level Spanish language use ICE quartile

Individual-level characteristics		Overall (N=1786)	Neighborhood-level Spanish language use ICE quartile[a]			
			1: Most Spanish	2	3	4: Least Spanish
Covariates	Age, mean (SD)	70.6 (7.1)	70.9 (7.4)	70.9 (7.1)	70.1 (7.1)	70.7 (7.0)
	Female, n (%)	1038 (58.4)	257 (58.8)	239 (56.8)	270 (59.5)	261 (58.8)
	Nativity, n (%)					
	Foreign-born	908 (51.0)	247 (56.5)	240 (57.0)	220 (48.5)	186 (41.9)
	US-born	871 (49.0)	190 (43.5)	181 (43.0)	234 (51.5)	258 (58.1)
	Language preference, n (%)					
	Spanish	1029 (57.8)	293 (67.1)	269 (63.9)	265 (58.4)	184 (41.4)
	English	750 (42.2)	144 (33.0)	152 (36.1)	189 (41.6)	260 (58.6)
Socioeconomic	Education (years), mean (SD)	7.2 (5.3)	5.7 (4.8)	6.0 (4.9)	7.6 (5.2)	9.7 (5.4)
Position	Education (years), n (%)					
	<12	1260 (70.8)	363 (83.1)	337 (80.1)	307 (67.6)	233 (52.5)
	12	225 (12.7)	33 (7.6)	40 (9.5)	66 (14.5)	85 (19.1)
	13–16	227 (12.8)	33 (7.6)	36 (8.6)	66 (14.5)	90 (20.3)
	>16	67 (3.8)	8 (1.8)	8 (1.9)	15 (3.3)	36 (8.1)
Neighborhood characteristics	Time spent in neighborhood, mean (SD)	22.3 (14.7)	24.8 (15.1)	21.9 (14.8)	21.8 (14.8)	21.2 (13.9)
	% Spanish language use quartile[b]					
	1: Most Spanish	433 (24.5)	338 (76.6)	95 (22.4)	0 (0.0)	0 (0.0)
	2	464 (26.3)	103 (23.4)	235 (55.3)	126 (27.7)	0 (0.0)
	3	427 (24.2)	0 (0.0)	95 (22.4)	256 (56.3)	76 (17.1)
	4: Least Spanish	442 (25.0)	0 (0.0)	0 (0.0)	73 (16.0)	369 (82.9)
Depression	CES-D score, mean (SD)	10.0 (10.6)	11.0 (10.8)	10.8 (11.1)	9.6 (9.9)	8.7 (10.6)
	High depressive symptoms, n (%)[c]	439 (25.5)	120 (28.6)	106 (25.9)	114 (25.9)	90 (20.8)

SALSA, Sacramento Area Latino Study on Aging; SD, standard deviation; ICE, Index of Concentration at the Extremes; CES-D, Center for Epidemiological Studies Depression Scale

[a]Quartiles of Spanish language ICE score: −1–0.20, 0.21–0.40, 0.41–0.60, and >0.60

[b]Quartiles of % Spanish language use: >29.9%, 18.5–29.9%, 10.7–18.4%, and 0–10.6%

[c] Defined as CES-D score ≥16

Table 2.

Estimates from two-level generalized linear naïve model and models 1–3 predicting differences in CES-D scores by neighborhood-level Spanish language use ICE, SALSA (baseline 1998–1999) and U.S. 2000 Census

	Naïve Model		Model 1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Intercept	9.808	9.216 – 10.401***	10.006	9.438 – 10.573***	7.505	6.697 – 8.313***	6.318	5.382 – 7.253***
Individual-level variables								
Age[a]	--	--	--	--	0.059	−0.013 – 0.131	0.047	−0.025 – 0.119
Sex (Ref = male)	--	--	--	--	4.342	3.348 – 5.336***	4.236	3.248 – 5.223***
Nativity (Ref = US-born)	--	--	--	--	--	--	2.464	1.474 – 3.454***
Education (years)	--	--	--	--	--	--	--	--
Language preference (Ref = English)	--	--	--	--	--	--	--	--
Neighborhood-level ICE variables								
Spanish language use[b]	--	--	-5.072	−7.523 - −2.621***	-5.196	−7.623 - −2.768***	-4.410	−6.851 - −1.970***
Cross-level variables								
Spanish language use ICE*Language preference	--	--	--	--	--	--	--	--
Random Variance components								
Level-1 (within neighborhood) variance		109.80***		109.61***		104.73***		103.22***
Level-2 (between neighborhood) variance		3.0422**		1.9199*		2.0908*		2.1449**
ICC[c]		0.027		0.0127		0.0196		0.0204
Goodness of fit components								
AIC		12872.4		12858.5		12788.2		12766.5
-2*Log Likelihood		12866.4		12850.5		12776.2		12752.5

CES-D, Center for Epidemiological Studies Depression Scale; ICE, Index of Concentration at the Extremes; SALSA, Sacramento Area Latino Study on Aging; CI, confidence interval; ICC: Intraclass correlation; AIC=Aikike's Information Criterion

*$P < 0.1$;

**$P < 0.5$;

***$P < 0.01$

[a]Age centered at 70.6 years

[b] Spanish language use ICE centered at 0.42 (the mean ICE at the individual level); higher ICE score indicated more segregated toward English-only use

[c] ICC calculated as the between neighborhood variance divided by the sum of the between and within neighborhood variances

Table 3.

Estimates from two-level generalized linear models 4–6 predicting differences in CES-D scores by neighborhood-level Spanish language use ICE, SALSA (baseline 1998–1999) and U.S. 2000 Census

	Model 4		Model 5		Model 6	
	β	95% CI	β	95% CI	β	95% CI
Intercept	9.828	8.435 – 11.220***	9.029	7.417 – 10.641***	9.025	7.404 – 10.646***
Individual-level variables						
Age[a]	0.008	−0.064 – 0.080	0.009	−0.063 – 0.081	0.009	−0.063 – 0.081
Sex (Ref = male)	4.013	3.035 – 4.990***	4.023	3.054 – 5.006***	4.031	3.054 – 5.007***
Nativity (Ref = US-born)	1.011	-0.057 – 2.078*	0.354	-0.903 – 1.612	0.356	-0.903 – 1.615
Education (years)	-0.361	-0.468 - −0.255***	-0.316	-0.432 - −0.200***	-0.316	-0.432 - −0.200***
Language preference (Ref = English)	--	--	1.379	-0.020 – 2.778*	1.379	-0.020 – 2.778*
Neighborhood-level ICE variables						
Spanish language use[b]	-2.119	−4.650 – 0.413	-1.994	−4.530 – 0.542	-1.937	−5.365 – 1.491
Cross-level variables						
Spanish language use ICE*Language preference	--	--	--	--	-0.109	−4.500 – 4.283
Random Variance components						
Level-1 (within neighborhood) variance		100.40***		100.15***		100.15***
Level-2 (between neighborhood) variance		2.3502**		2.3852**		2.3864**
ICC[c]		0.0229		0.0233		0.0233
Goodness of fit components						
AIC		12724.7		12723		12725
-2*Log Likelihood		12708.7		12705		12705

CES-D, Center for Epidemiological Studies Depression Scale; ICE, Index of Concentration at the Extremes; SALSA, Sacramento Area Latino Study on Aging; CI, confidence interval; ICC: Intraclass correlation; AIC=Aikike's Information Criterion

*$P < 0.1$;

**$P < 0.5$;

***$P < 0.01$

[a]Age centered at 70.6 years

[b] Spanish language use ICE centered at 0.42 (the mean ICE at the individual level); higher ICE score indicated more segregated toward English-only use

[c] ICC calculated as the between neighborhood variance divided by the sum of the between and within neighborhood variances