# GENERATIONAL AND NEIGHBORHOOD SOCIOCULTURAL FACTORS & DEPRESSION AMONG LATINOS

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## ABSTRACT

Julia B. Ward: Generational and Neighborhood Sociocultural Factors & Depression Among Latinos
(Under the direction of Allison E. Aiello)

Socioeconomic position (SEP) and acculturation have been identified as two salient factors for Latino mental health. These factors may change and accumulate over multiple generations and within neighborhoods, especially among Latino populations. However, existing literature examining the mental health effects of SEP and acculturation is limited to examination of individual-level variables within a single generation. The role of the accumulation of socioeconomic and cultural factors across generations and within neighborhoods in shaping Latino mental health remains virtually unexplored. Linking data from the Sacramento Area Latino Study on Aging, the Niños Lifestyle & Diabetes Study, and 2000 US Census, this dissertation addressed three gaps in our understanding of depression etiology: the association of (1) socioeconomic and (2) acculturation trajectories across generations with depressive symptoms; and (3) the association of neighborhood cultural factors with depressive symptoms.

Overall, our study populations had a high depressive symptom prevalence comparable to that of larger, more representative samples of US Latinos. Our results suggested that intergenerational and community-level factors may play a role in this high prevalence. Firstly, we found that compared to stable-low educational mobility, stable-high education and upward educational mobility were associated with fewer depressive symptoms. Downwardly mobile participants also had slightly fewer depressive symptoms compared to stable-low participants.

Secondly, decreased Spanish use and stable-equal English/Spanish use across generations appeared to protect against depressive symptoms in offspring, compared to stable-high Spanish use. Notably, stable-low Spanish use across generations did not confer a mental health benefit. Finally, we found a strong positive association between neighborhood cultural segregation measures and depressive symptoms that was attenuated toward the null upon adjustment for individual-level education. Overall our study suggests the importance of access to educational resources across generations and within neighborhoods in addition to exposure to cultural heritage and ties for Latino mental health.

Our study highlights the importance of collecting and examining data regarding how socioeconomic and cultural contexts change across generations and accumulate within communities to impact depression in minority populations. This dissertation contributes to a more comprehensive and contextual understanding of depression etiology and the dynamic community and intergenerational pathways that shape Latino mental health.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| AIC | Akaike Information Criterion |
| AOS | Anglo Orientation Subscale |
| ARSMA-II | Acculturation Rating Scale for Mexican-Americans II |
| CES-D | Center for Epidemiological Studies Depression Scale |
| CESD-10 | Center for Epidemiological Studies Depression Scale-10 |
| CI | Confidence Interval |
| DAG | Directed Acyclic Graph |
| DALY | Disability-Adjusted Life Years |
| DFD | Depression-Free Days |
| DSM | Diagnostic and Statistical Manual of Mental Disorders |
| HPA | Hypothalamic-Pituitary-Adrenal |
| ICC | Intraclass Correlation |
| ICE | Index of Concentrations at the Extremes |
| MDD | Major Depressive Disorder |
| MOS | Mexican Orientation Subscale |
| NLDS | Niños Lifestyle and Diabetes Study |
| PD | Prevalence Difference |
| PHQ-9 | Patient Health Questionnaire-9 |
| PR | Prevalence Ratio |
| QALY | Quality-Adjusted Life Years |
| SALSA | Sacramento Area Latino Study on Aging |
| SD | Standard Deviation |

| | |
|---|---|
| SEP | Socioeconomic Position |
| US | United States |

# CHAPTER 1: SPECIFIC AIMS

**Depression is a debilitating mood disorder that adversely impacts one's quality of life.** Depression increases risk of numerous physical and mental conditions including heart disease, cancer, HIV/AIDS, substance abuse, anxiety disorders, and suicide[1–9]**. In the United States (US), Latinos suffer a disproportionate burden of depression.** Prevalence of high depressive symptoms is estimated to be 20.7% and 32.8% for Latino men and women, respectively, and depression prevalence is frequently found to be higher among Latinos, especially among elderly Latinos, than among non-Latino Whites[10–16]. Despite the high prevalence of depressive symptoms in US Latinos, depression remains greatly under-diagnosed in this population[17]. Given that Latinos are now the largest and fastest growing US minority group[18], continued under-identification of depression could lead to a rapid upsurge in the number of Latinos with undiagnosed and untreated depression, a commensurate rise in depression co-morbidities, and a resulting increase in ethnic mental health disparities. Thus, identifying the factors that put Latinos at risk of depression is of great importance in order to gain a more comprehensive understanding of depression etiology among US Latinos and thereby increase identification and treatment of poor mental health in this population.

The Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), identifies several clinical risk and prognostic factors for depressive disorders in the overall population, including a genetic predisposition, negative affect, and experiences of trauma[19]; however, these factors do not sufficiently explain the high burden of depression among Latino

populations[20,21]. **Two factors that may be especially salient for Latino mental health in particular are acculturation and socioeconomic position**[22–27]. Acculturation, the process by which attitudes and behaviors of individuals from one culture are altered or retained upon contact with a different culture[22,28,29], may impact Latino mental health by influencing acquisition of health-promoting resources in a new culture, creation of social ties and relationships, and maintenance of shared cultural values[30,31]. Additionally, the acculturation process influences and is influenced by socioeconomic position (SEP). SEP has been shown to impact Latino mental health both through its relationship with acculturation and independent of acculturation[27,32]. Studies show that those of low SEP lack the personal and financial resources that buffer the impacts of chronic stress on depression[22,27], and Latinos in the US are more highly exposed to low SEP as they face greater barriers to education, higher income potential, and access to insurance compared to individuals identifying as non-Hispanic White, Black, or Asian[18].

The existing literature examining the mental health effects of SEP and acculturation is at present relatively myopic in scope, as it is limited to examination of individual-level variables within a single generation[32–35]. These studies assume that each person exists in a vacuum where only their individual characteristics influence their current disease status. However, the complex reality is that health is the manifestation of an interaction between one's individual characteristics and the social and cultural environment into which one is born, is raised, and eventually helps to shape[36]. Indeed, a growing body of research demonstrates that historical, environmental, and life course experiences play a key role in determining long-term mental health outcomes[37–42]. Therefore, **the lack of studies examining the dynamic relationships between individuals and changes in their social and cultural contexts, incorporating individual, familial, and community measures, represents a critical gap in our**

**understanding of how the Latino experience in the US shapes this community's mental health.**

Socioeconomic position and acculturation are dynamic factors that have been shown to accumulate and transmit between individuals within neighborhoods and across generations[33,38,42–47]; accordingly, **the neighborhood and intergenerational frameworks may represent novel and key contexts in which to examine how socioeconomic and cultural factors ultimately influence Latino mental health**. Latinos are uniquely susceptible to intergenerational and neighborhood accumulation of risk factors as a result of 1) obstructed opportunities for upward social mobility due to multiple generations of marginalization and 2) the increased residential isolation of US Latinos over the past decade[48–51]. Within individuals, one way in which socioeconomic disadvantage and the acculturative process influence depression is by acting as chronic stressors, disrupting components of the body's stress system that contribute to mental health[52–54]. The propensity of these stressors to accumulate over generations and within neighborhoods may lead to long-term sustained disruption of the stress system, resulting in poorer mental health and potentially explaining the greater burden of depression among US Latinos. Yet, there are no studies, to our knowledge, that have incorporated intergenerational or neighborhood components to capture these dynamics. Thus, examining the association of SEP and acculturation with depression within a multi-generational and neighborhood framework is essential for a broader understanding of depression etiology among US Latinos.

We aimed to examine the effect of socioeconomic and acculturative factors across generations and within neighborhoods on depressive symptoms in elderly Latinos, a population at especially high risk of depression. We combined data from the longitudinal Sacramento Area

Latino Study on Aging (SALSA) and the Niños Lifestyle and Diabetes Study (NLDS), which comprise parent and offspring pairs across the two cohort studies. These two studies were ideally suited to examine the mental health effects of intergenerational and neighborhood sociocultural factors given that they collected data from multiple generations of Latinos representative of those residing in California's Sacramento Valley, including immigrant and non-immigrant individuals of predominantly Mexican origin. The long-term goal of this study was to better understand how the intergenerational and neighborhood sociocultural experience of Latinos living in the US impacts mental health. These results provide the first evidence highlighting the importance of collecting and examining data on the dynamic socioeconomic and cultural mechanisms that may affect depression in an under-diagnosed and under-treated ethnic population. Our specific objectives were to:

**Aim 1. Examine whether changes in (a) socioeconomic position and (b) acculturation over two generations of a Mexican-origin population are associated with depressive symptoms in the offspring.**

Hypothesis 1a. Stable-low educational attainment across two generations will be associated with high depressive symptoms among offspring over a 10-year period, compared with stable-high, downwardly mobile or upwardly mobile educational attainment.

Hypothesis 1b. Stable-high Latino orientation and stable-high Spanish language use across generations will be associated with high depressive symptoms among offspring.

**Aim 2. Examine whether neighborhood-level cultural segregation (Spanish language isolation and ethnic segregation) is associated with depressive symptoms in an older Mexican-origin population.**

Hypothesis 2. At the neighborhood level, increased Spanish language isolation and ethnic segregation will be associated with more depressive symptoms among an older Mexican-origin population.

**Aim 2a. Assess whether individual-level language preference modifies the association between neighborhood language isolation and depressive symptoms.**

Hypothesis 2a. The association between neighborhood-level language isolation will vary by individual language preference. English-speaking individuals residing in predominantly English-speaking neighborhoods will have fewer depressive symptoms compared to all other combinations of individual- and neighborhood-level language use.

The extant body of literature examining risk factors for depression does not sufficiently characterize depression among Latinos. While socioeconomic and acculturative factors have been identified as important drivers of Latino mental health, previous studies present only a snapshot of the influence of these sociocultural factors by restricting analyses to the individual level and ignoring intergenerational and neighborhood influences. Our study provides an unprecedented opportunity to combine socioeconomic, cultural, and psychiatric data from multiple generations of Mexican-origin individuals participating in the SALSA and NLDS studies in order to examine the dynamic influence of intergenerational and neighborhood accumulation of socioeconomic and acculturative factors on depression among US Latinos. This project contributes to a more comprehensive and contextual understanding of depression etiology and the complex community and socioeconomic pathways that shape Latino mental health.

# CHAPTER 2: BACKGROUND AND SIGNIFICANCE

## Section 2.1 Depression in the United States

Depression is a debilitating mood disorder greatly affecting one's physical health, sense of well-being, and overall quality of life. This illness is characterized by persistent feelings of sadness, guilt, and low self-worth; loss of interest; fatigue; difficulty concentrating; and disordered eating and sleeping patterns[3,19]. Depression may take one of several forms, including major depressive disorder, persistent depressive disorder, and high depressive symptoms. Major depressive disorder represents the classic depressive condition. This disorder is characterized by discrete episodes of clear-cut affective, cognitive, behavioral, and somatic symptoms with a duration of at least two weeks[19]. While a single episode of major depression is possible, the disorder is more often observed to be recurrent[19]. Persistent depressive disorder is a chronic form of depression with a diagnosis that requires depressive symptoms to continue for at least two years[19]. Hence forth, the group of depressive disorders identified in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), will all be referred to as depression.

The psychological and physical costs of depression are enormous; depression increases risk of numerous health conditions including heart disease, diabetes, obesity, cancer, HIV/AIDS, substance abuse, anxiety disorders, cognitive decline, and suicide[1–9,55]. Depression is also an immense economic burden in the US, costing the government an estimated $210.5 billion in 2010[56]. Lifetime prevalence of major depressive disorder is estimated to be 16.2% in the US; and in 2014, an estimated 15.7 million US adults aged 18 years or older had at least one major

depressive episode in the past year, representing 6.7% of all adults in the US[57,58]. For these reasons, the World Health Organization estimates that by 2030 depression will be the leading cause of disease burden in high-income countries[59].

**Section 2.2 Latinos and depression**

Depression prevalence is of particular concern in the US Latino community. Historically, researchers noted a "Hispanic paradox", where US Latinos reported equal or lower prevalence of many physical and mental health conditions compared to non-Latino Whites, despite the Latino community's socioeconomic disadvantage[60]. For example, one nationally-representative study suggested that depression prevalence, diagnosed with the World Mental Health Survey Initiative Version of the Composite International Diagnostic Interview, was 22.3% among non-Latino Whites and 15.4% among Latinos[61]. Several explanations have been made to account for this unexpected phenomenon. For example, a healthy migrant effect or cultural factors such as social support may impact depression prevalence among US Latinos[60,62]. More likely, this paradox is an artifact caused by substantial under-identification of depression among US Latinos[17].

This under-diagnosis may be due in part to social and cultural factors. Depression may be perceived, experienced, and manifested differently across cultures; consequently, the use of culture-specific terms associated with depression or with perceptions of depression may skew the results of depression screenings that utilize tools developed for non-Latino Whites. For example, an individual's culture may impact the sources of distress, the experience and presentation of the depression, how an individual interprets the symptoms, the help-seeking behavior and coping mechanisms utilized, and the social response to the disorder[63]. Qualitative studies have found that Latinos may also conceptualize depression differently than the biomedical model traditionally utilized in the US. Some Latino communities have been found to consider

depression to be a social problem or emotional reaction that is under an individual's control rather than a biological condition requiring mental health treatment[64,65]. Latinos have also been shown to express positive affect differently than non-Latino Whites[21]. Additional studies have demonstrated that the term "discouraged" (desanimado) may be more appropriate for depression screenings than the more often used "depressed" (deprimido) or "sad" (triste)[66]. These cultural variations in the way Latinos view depression and report symptoms may make recognizing the disorder more difficult and may therefore account for some of the under-diagnosis of depression within this population[65].

Given the pervasiveness of under-diagnosis of depression in Latino communities, statistics suggesting low depression prevalence among this population likely do not reflect reality. In fact, many studies have indicated that depression may actually be more prevalent among Latinos than non-Latino Whites[14–16,67,68]. Indeed, a recent review of studies measuring depression across the US found that depression prevalence among Latinos, and older Latinos in particular, was consistently greater than among non-Latino Whites and often more prevalent than among other minority groups[69]. A recent population-based study across four major US cities found prevalence estimates of high depressive symptoms of 27.0% among Latinos overall and 32.8% among Latino women[11].

Regardless of the source of under-identification of depression among US Latinos, the mental health of this community remains of great concern. Latinos in the US face greater socioeconomic barriers to accessing health care treatment[70], and Latinos have been shown to be less likely than non-Latino Whites to seek mental health care specifically[17,71]. Many Latino adults feel more comfortable with health professionals with similar values and beliefs[65], however, the educational differential between US Latinos and non-Latino Whites makes

interacting with Latino clinicians a rare experience. In fact, fewer than 2% of American Psychological Association members identify as Latino[72]. The Latino community is now the largest and fastest growing minority population in the US[18]. Continued under-identification of depression could lead to a rapid increase in the number of Latinos with undiagnosed and untreated depression, a commensurate rise in common depression co-morbidities, and a widening in ethnic disparities in mental health.

**Section 2.3 Depression in elderly Latinos**

Depression in late life is widespread and has been shown to delay recovery or worsen outcomes of other illnesses and increase the risk of suicide among the elderly[73]. Furthermore, individuals developing depression later in life have been shown to have a worse prognosis for the disorder, a higher risk of medical comorbidities, and a higher relapse rate compared to patients developing symptoms at a younger age[74]. Depression may also have differential daily impacts on individuals of different ages. For example, younger depressed patients are more likely to complain that the disorder negatively impacts their relationships, whereas older depressed patients are more likely to describe the disorder's negative impacts on their ability to carry out basic living and housekeeping activities[75]. Failure to perform basic functions of daily living, such as shopping for food, preparing meals, and general housekeeping, may represent a significant threat to the independence of depressed older individuals who live alone.

Only recently has it been acknowledged that successful aging is possible and that depression need not be a normal part of the aging process[76]. Nevertheless, this disorder often goes undetected among elderly populations because common depression symptoms such as fatigue, appetite loss, and trouble sleeping are often mistaken for part of the aging process or a physical illness[77]. Older Latinos in particular have been reported to be at increased risk for

under-diagnosis and -treatment of depression[78]. Yet even with this under-diagnosis, studies among ethnic minorities and non-Latino Whites across the US have suggested that older Latinos report the highest levels of depression[69]. Consequently, accurate diagnosis and treatment of depression among elderly Latino populations is particularly important.

Diagnosing depression among elderly Latinos has proven to be a complex undertaking. Stigma against depression may be pervasive among elderly Latinos, where some communities have been shown to believe that depression may be caused by losing one's mind or even a result of witchcraft[14]. Such beliefs lead these individuals to accept treatment only under very strict confidentiality[14]. A qualitative study interviewing 50 elderly Latinos suggested that rather than viewing depression as an illness or medical condition, participants believed depression was a result of personal weakness in the face of life stressors[65]. This group expressed great concern about stigma, stereotyping, and medication dependency with regard to depression treatment[65]. Given that age and culture both add a level of complexity to depression diagnosis, elderly Latino populations may be especially vulnerable to under-identification of depression and represent an important population upon which to focus depression research.

**Section 2.4 Socioeconomic factors and depression**

The DSM-5 identifies multiple risk and prognostic factors for depressive disorders in the overall population including a genetic predisposition, negative affect, and traumatic events throughout the lifetime[19]. However, these clinical risk factors do not sufficiently describe the epidemiology of depression nor do they fully explain the high burden of depression among Latino populations[20,21]. Further studies on the epidemiology of depression indicate that socioeconomic disadvantage is consistently associated with increased depression prevalence and sustained non-remission from a major depressive episode[79,80]. Several studies, largely among

non-Latino Whites, have demonstrated that various measures of adult SEP, such as income, education, assets, and occupational status, are associated with depression[27]. Certain populations, however, may be uniquely susceptible to these risk factors. More recent studies have documented the socioeconomic patterning of depression among US Latinos[33–35]. Latinos face immense socioeconomic disparities in the US, with lower overall educational attainment, higher high school dropout rates, lower individual income, and fewer insured individuals than individuals identifying as non-Hispanic White, Black, or Asian[18]. Consequently, the Latino population may be more greatly exposed to the adverse impacts of low SEP on long-term mental health.

Socioeconomic factors may play a key role in Latino mental health through a number of mechanisms. Studies show that one such mechanism may be that exposure to chronic stressors, such as socioeconomic disadvantage, can disrupt the body's biological stress system and affect mental health[81–83]. For instance, stress exposure has been shown to lead to hyperactivity of the amygdala and the hypothalamic-pituitary-adrenal (HPA) axis and to increase secretion of cortisol and corticotrophin-releasing hormone, all of which have been individually associated with depression[53,82,84]. Individuals of lower SEP may also lack access to the personal and financial resources that buffer the impacts of chronic stress on depression; for example, socioeconomic disadvantage may result in decreased locus of control and self-esteem, fewer resources to cope with the chronic stress, and inadequate access to treatment for mental illness[22,27].

The trajectory of socioeconomic attainment across multiple generations may affect health outcomes of future generations. Examination of poverty cycles and SEP across generations indicates that parental education greatly impacts the educational attainment of offspring, especially among US Latinos[42,47]. Immigration status may also influence socioeconomic mobility

among Latinos in the US. Given that approximately a third of this community is comprised of recent immigrants[18], subsequent generations of Latinos may be raised in socioeconomic and cultural contexts that greatly differ from those of prior generations. Consequently, considering how these contexts change across generations and within communities is becoming increasingly important in order to understand the pathways that shape Latino mental health.

Latinos may be uniquely susceptible to intergenerational accumulation of socioeconomic risk factors due to obstructed opportunities for upward social mobility across generations; these barriers to mobility likely result from the historical and present-day marginalization and discrimination faced by Latino communities[48,49]. Additionally, elderly Latinos may be especially vulnerable given that stress induced by socioeconomic disadvantage may have accumulated both over multiple generations and also throughout the life course. Consequently, to more comprehensively understand the social patterning of depression among US Latinos, intergenerational SEP should be taken into account.

Multiple generations of low SEP exposure may impact the mental health of subsequent generations by resulting in sustained disruption of the body's physiological response to stress[81–83]. Indeed, studies have shown that accumulated strain from coping with daily life challenges while lacking adequate resources, over time, leads to more physiological damage than does a single dramatically stressful event[85]. Accordingly, downstream mental health effects may be particularly pronounced when the chronic stress associated with poor socioeconomic conditions has accumulated over multiple generations.

A growing body of research on gene-environment interactions demonstrates that the health disparities caused by intergenerational accumulation of socioeconomic disadvantage may also be partially explained by epigenetic changes in gene expression that can be passed on to

future generations[37]. Exposure to maternal psychosocial stress and adverse developmental environments, such as those caused by socioeconomic disadvantage, in utero or throughout childhood has been shown to induce epigenetic alterations that impact one's physiology and later adult health; these alterations are then perpetuated through future offspring[86–89]. Evidence from animal models demonstrates that depression can be caused by abnormalities in gene expression, neural circuit function, and behaviors induced by exposure to chronic environmental stress; these maladaptations are then sustained by epigenetic alterations in the brain that may lead to depression and be transmitted to subsequent generations[90,91]. Further, human studies have demonstrated that maternal psychosocial stress during pregnancy may alter offspring cortisol excretion and HPA activity[92,93], components of the stress system that have been associated with depression[53,82,84]. Thus, epigenetic modification in specific areas of the brain in response to sustained chronic stress may be another mechanism by which socioeconomic disadvantage experienced across generations impacts mental health of Latinos[94].

The socioeconomic measures used in most previous studies have been limited to a single generation. Individual educational attainment has shown a strong association with depression among Latinos[33–35]. Additionally, a small number of studies have looked at the independent effects of parental SEP on depression in adult offspring, finding that low parental SEP was associated with depression among both non-Latino Whites and Latinos[38,42,95–97]. However, all of these previous studies have been limited to the independent socioeconomic effect of a single generation, either that of the parent or that of the offspring, on offspring depression; these studies do not consider the interaction between parental and offspring education and how this intergenerational educational mobility may impact offspring mental health. To our knowledge, outside of our own work, only one study has examined the association between intergenerational

socioeconomic trajectories and depressive symptoms, finding that compared to participants with stable-low social mobility, those with upward mobility had fewer depressive symptoms[42]. However, this study was comprised mostly of non-Latino Whites. Thus, despite the potential importance of SEP over multiple generations for Latino mental health, studies examining such effects among this population are virtually non-existent in the literature.

**Section 2.5 Acculturation and depression**

Cultural behaviors and identity are particularly salient for Latino mental health. Acculturation refers to the process by which attitudes and behaviors of individuals from one culture are altered or retained upon contact with a different culture[22,28,29]. Acculturative stress can result from cultural adjustment and adaptation that stems from loss of practices associated with one's cultural background and the rapid acquisition of behaviors from the new context[98,99]. Immigrants to the US may experience culture shock and isolation upon encountering the new environment, and this may lead to a sense of displacement, stress, and anxiety[100]. In the US, this type of chronic stressor has the potential to greatly influence mental health in Latino immigrants and their offspring[26]. In fact, qualitative studies indicate that many Latinos do not perceive depression as an illness, but rather as a result of the disruption caused by the immigration process and the hardships Latinos confront while trying to survive in the US[101].

Studies examining the association between an individual's degree and style of acculturation and depression have mixed results. Some studies indicate that acculturation to the dominant culture is positively associated with depression[23,61], while others suggest that this positive association exists in girls but not boys[24]. Still others show that in terms of acculturation styles, integration rather than segregation is associated with lower depression prevalence, and

difficulty integrating into mainstream US culture and a lower degree of acculturation predict higher depression prevalence[22,32,102]. These inconsistent results may have several explanations.

Cultural orientation and identity are inextricably linked to socioeconomic factors, and acculturation trajectories may differentially impact those of varying levels of SEP [103]. In general, higher SEP is associated with increased access to resources and social connections and thereby improved health[79]; however, in Latino immigrant communities, the beneficial effects of higher SEP may compete with the acculturation process which may involve exposure to discrimination and other social stressors that negatively influence mental health[100]. In fact, our recent work suggests that the negative impact of perceived discrimination on the mental health of Latinos may be stronger among the more highly educated[104]. Consequently, the impact of acculturation on Latino mental health may vary by levels of SEP, yet the existing literature either adjusts away possible socioeconomic effects[44] or ignores socioeconomic factors entirely[43,105].

Cultural behaviors and identity are also likely to be influenced by family members and to accumulate within communities. Acculturation is an inherently relational concept given that it depends upon contact with and interactions between multiple individuals from varying contexts[22,28,29]. Family conflict may increase as the generations become more educated, move further from their country of origin, and differentially adopt the attitudes and behaviors of the new environment[45]. Such intra-familial conflict may create additional stress and increase the risk of depression. Indeed, theories related to the acculturative process suggest that acculturation conflict between individuals within families and communities and changing degrees of acculturation over time actually drive the association between cultural orientation and mental health outcomes[43–45]. The presence of intra-familial warmth has been shown to protect against mental illness relapse in Latino families[106]. Additionally, several studies have found that familial

conflict among Latino families and changing structure of Latino families across generations is associated with emotional distress and other health risk behaviors[10,107,108]. A qualitative study interviewing elderly Latinos indicated that conflicting values between parents and children are perceived to be life stressors that may contribute to depression[65]. Participants in this study expressed great concern over the acculturative gaps within families: "Our children's values are different here; they work constantly to achieve material things and have no time for family, much less for old people" and "Older people are forgotten here; they are left to die in nursing homes. There is no time for family[65]." Hence, Latino family conflict and support may differ depending on the manner in which Latino families navigate the cultural differences between first and second generation immigrants and beyond[109], and these intergenerational differences in cultural orientation may play an important role in Latino mental health.

Consequently, given this relational nature of cultural orientation, the effects of an individual's acculturation level should be examined in concert with the cultural orientation of that individual's family members and community. However, the current acculturation literature among Latinos lacks a relational element that captures each individual's acculturation degree in relation to other family members and in relation to the community in which that individual resides. Prior studies of acculturation and depression only assess degree of acculturation of *individuals* within a *single generation*. Few acculturation studies gather intergenerational data, and those assessing the association between familial acculturative conflict and depression have been limited to individual-level variables without considering community-level data[105,110].

**Section 2.6 Acculturation measurement among Latinos**

Prior work on the health effects of cultural orientation has often utilized proxies for acculturation. Such proxies include place of birth (of self, parents, and grandparents),

generational status, immigration history, and time in the US[111]. These are generally considered limited indicators of acculturation as they do not capture the multiple factors that comprise an individual's cultural orientation[111]. These prior studies are an initial step to establishing an understanding of the association between acculturation and mental health. However, the literature lacks studies utilizing and comparing multiple acculturation measures to more comprehensively assess the impact of the acculturative process along the key dimensions important for mental health.

Acculturation scales are one measure that may allow for a more comprehensive assessment of the multiple factors that comprise an individual's cultural orientation[112]. Nevertheless, the use of acculturation scales in general in public health research has been the subject of recent scrutiny[103]. In health research, acculturation scales may be limited in that they combine diverse aspects of acculturation into a single score. This measurement technique becomes problematic when considering the identifiability assumptions required for making causal inference[113]. An average causal effect is considered identifiable when the distribution of observed data is compatible with a single value of the effect measure; this requires that three key conditions – consistency, exchangeability, and positivity – hold[113]. Measuring acculturation through the use of these scales raise a question of consistency of exposure. Consistency requires that if exposure can vary within a given exposure level, that these variations in exposure are irrelevant[113,114]. For example, with regard to acculturation scales, an individual who speaks little Spanish but still spends much time with other Latinos may have the same acculturation score as an individual who is proficient in Spanish but mostly associates with non-Latino Whites. The consistency assumption requires that a single acculturation score has the same effect on health regardless of how that acculturation score

was achieved. Such an assumption may not be plausible for acculturation. Thus, while a single overall construct of acculturation may exist, measuring it in the form of a composite scale score may not provide clear understanding into disease etiology.

Anthropologists have also begun to question the validity of many acculturation measures, and even the idea of a single acculturation construct in general, given that they assume the existence of two distinct cultures, one of which is an "invented majority" to which the ethnic groups adapt[103]. Critics argue that these acculturation measures lack a clear definition and have come to function as an ideologically convenient black box[103]. Critics of acculturation scales further contend that specific cultural factors, such as language use, that may facilitate access to structural health benefits and positive health outcomes have not been adequately explored in a public health context[103]. Thus, while acculturation scales may provide some insight into the impact of overall cultural orientation on mental health, they would likely be most informative if examined in concert with more specific cultural factors.

## Section 2.7 Language use and depression

### Section 2.7.1 *Socio-cultural literature*

Acculturation scales are useful in that they can simultaneously assess multiple dimensions of the acculturation process; however, studies of Latinos may also benefit from focusing on the specific aspects of acculturation that are most logically linked with the outcome of interest. When considering mental health, the cultural factor of language use has been shown to be of particular importance[30,31,115]. Qualitative studies interviewing Latinos residing in the US indicate that language use is viewed as a life stressor; multiple participants emphasized 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[65]." Language use is intricately linked to mental health through its influence on acquisition of resources, creation of social ties, formation of relationships of trust, maintenance of familial shared values, and a sense of belonging or isolation from one's community[30,31]. Additionally, studies demonstrate that language use accounts for the majority of the variability in acculturation scales[116].

Language is related to how Latinos establish the social linkages that are important for mental health[109]. Proficiency in the English language has been shown to increase access to health information as well as to mental health services[117,118]. At the same time, for Latinos living in the US, maintaining the Spanish language throughout the acculturation process may have positive health effects by fostering familial connectedness across generations and promoting other social and cultural connections[109]. Cultural beliefs and values are embedded in language, connecting the speakers to their cultural past through the oral traditions, lexical variation, literary forms, music, history, and customs conveyed in this language[119]. For bilingual individuals, understanding and using their primary language facilitates access to important cultural information that is connected with their cultural identity, self-concept, and social-emotional development[120]. Consequently, preservation of one's primary language in addition to developing a second language supports the maintenance of cultural and familial ties while enabling improved access to resources in the new cultural context[48]. Among second generation immigrants in the US, fluent bilingualism has been shown to be beneficial for family relationships and psychosocial adjustment when compared to both monolingualism and limited bilingualism[121]. Proficiency in both English and Spanish has also been shown to foster social connections in the school setting and to assist in acquiring the institutional support necessary for academic success and social mobility[122]. An additional study found that levels of familism, a

measure of connectedness to one's family, were highest among children who preferred to use both English and Spanish rather than either English or Spanish alone[123]. This association between language use and familism is important because low levels of familism have been associated with depression[124]. A study of a Mexican-origin population demonstrated that US-born youths reported more stress from needing improved Spanish fluency to better connect with their families while foreign-born youths reported more stress from needing better English fluency in order to succeed academically[125].

Overall, these studies suggest that the beneficial effects of maintaining Spanish may depend upon how well the Spanish-speaker also speaks English and that the benefits of English proficiency may depend upon the maintenance of the Spanish language. In other words, Spanish or English proficiency alone may not indicate the greatest access to healthful connections and resources. There has been a call for further research into the mental health effects of these varying language use preferences[109]. Given the current lack of intergenerational studies among the acculturation literature, yet the demonstrated importance of both familial relations and the language aspect of acculturation for mental health, further investigation into the role of intergenerational language use in Latino mental health is needed and may help disentangle the mechanisms by which cultural factors promote or decrease mental health[109].

**Section 2.7.2** ***Psychological literature***

The relationship between language use and mental health also has a sound basis in the psychological literature. It has been argued that language may be the basis for all psychological pathology given that language enables reflexive thinking and, accordingly, helps individuals comprehend bodily experiences[126]. Numerous studies indicate that language provides individuals with the ability to reflect on and communicate inner experiences and thereby makes important

contributions to mental health[127]. One of the primary functions of language is epistemological; through language, individuals develop a sense of self and create a self-concept[128]. In other words, the epistemic function is related to an individual's perception of whether their language is a reliable tool for expressing inner psychological experiences[127]. Language contributes to mental health, in part, through this epistemic function. Language and words allow individuals to categorize, develop meaning, and know experiences[129]. For each individual, a gap exists between the personal experience of the world and the ability of language to describe this experience, and the size of this gap differs for each individual[128]. Several studies have shown that individuals with smaller experience-language gaps have greater potential for a clearer self-concept and lower levels of depression[127]. Self-reflection and self-rumination have been shown to be crucial mediators in this link between the language-experience gap and depression[130]. Anxiety has also been shown to mediate the association between the language-experience gap and depression due to the fact that a disconnect between having experiences and being able to give words and meaning to those experiences decreases one's sense of control and increases anxiety levels[127]. Individuals lacking clear self-concepts more frequently view the world as chaotic and unpredictable, which greatly contributes to anxiety and depression levels[131].

The second function of language identified in the psychology literature is to communicate inner psychological activity and the meaning of this activity to others via language, known as the communicative function[128]. In other words, the communicative function relates to individual perception of whether language is a reliable tool for communicating inner psychological experiences to others[127]. It has been consistently shown that translating problematic experiences into language directly and positively contributes to mental and physical health[127]. Giving words to emotionally charged and traumatic experiences is a hallmark of successful therapy[132].

Expressing these internal states to others and the feeling of awareness that accompanies this expression helps to give meaning to the experiences and also allows for a greater understanding of oneself[127,133]. Communication of one's inner experiences also likely contributes to better inter-personal relationships and better integration into one's community, which, in turn, improves mental health[127]. Accordingly, more psychological problems have been found among those who struggle with communicating their inner psychological states to others[134].

The mental health implications of the language-experience gap, the clarity of one's self-concept, and the ability of an individual to effectively communicate their inner experiences to others may vary depending on one's native language and therefore may be especially deserving of consideration among US Latinos. In general, the English language has a larger vocabulary than the Spanish language, and Spanish speakers have been shown to have dramatically fewer verbs to express manner and motion[135]. In fact, only 51% of English manner verbs get translated into Spanish[135]. For this reason, English translations often add information not found in the original Spanish versions[135]. On the other hand, the Spanish language also has expressions that have no translation in the English language. As suggested by the studies regarding the language-experience gap and mental health, individuals with the vocabulary that best allows them to give words to their experiences and self-concept should experience a mental health benefit. Thus, bilingual individuals may benefit simply from the larger number of words at their disposal to give words to their inner states. Such a theory is supported by studies demonstrating the mental health benefits of being bilingual, as these individuals may be the most capable of expressing themselves[136]. Overall, there exists significant psychological support for a link between language and depression, and examining this association among Latinos in the US is of particular

importance as this population navigates the fluency challenges of straddling the Spanish- and English-speaking worlds.

### Section 2.7.3 *Linguistic literature*

In addition to the psychological literature, numerous studies in the field of linguistics indicate that one's native language may impact mental health by shaping the lens though which one views the world. The language one speaks has been shown to influence reasoning[137], perception of time and geography[138], visual imagery[139], and how individuals construct agency and recall past events[140,141]. These varying linguistic influences on perception and thought have the potential to profoundly impact mental health by changing the nature of one's abstract mental representations of and attitude toward the world. Studies show that speaking in one language may activate memories experienced in the same language and thereby serve as a cue for attitude and emotion activation[142]. For example, one study showed that language used to elicit attitudes regarding different ethnic groups selectively activated positive or negative associations depending on which language was utilized[142]. Thus, language was found to alter the emotions and attitudes of participants. This may have important mental health implications for Latinos navigating multiple languages and cultural influences.

Linguists have shown that language use may impact mental health by influencing one's perception of individually experienced past events and one's concept of "the past" in general. Certain languages utilize spatial metaphors to place the past behind the observer (e.g., the worst is already behind us) and the future in front (e.g., the best is still ahead of us), while other languages utilize metaphors to reverse this pattern and place the past in front of the observer[143]. Additional studies have shown that the language one speaks can also

determine how relevant one considers past experience to be, the detail to which one remembers past events, and how close to the present the past is perceived to be[144]. Given that the experience of traumatic past experiences is closely tied to mental health, the relevance and temporal location of these events in relation to one's self has important implications for mental health. The psychological literature demonstrates that self-rumination, a neurotic self-attentiveness with recurrent thoughts of past actions, is associated with increased depression levels[130]. Therefore, the perception of the past may be a potential mechanism by which language use may impact mental health.

Linguistic patterns have been shown to shape what individuals encode, internalize, and remember about the events they witness or experience[140,141], and these linguistic differences may be of particular importance when examining the mental health of English vs. Spanish speakers. The Spanish and English languages employ different metaphors and idiomatic expressions[145], and various linguistic studies have demonstrated that the specific metaphors utilized can shift how individuals build mental representations of problems and how potential solutions are evaluated[137]. Further, studies of English and Spanish speakers have demonstrated that English speakers more frequently employ agentive language than Spanish speakers[141]. Agentive descriptions (e.g., she broke the vase) includes a person as the subject. Non-agentive descriptions (e.g., the vase broke) do not place the person as the subject[146]. In English, non-agentive language is utilized less frequently because it often sounds evasive[141]. In Spanish, however, non-agentive expressions are more frequently employed to distinguish accidental actions that are not under an individual's control from intentional actions. For example, Spanish speakers often utilize non-agentive expressions with the clitic "se" to describe accidents (e.g., "se rompió el florero", generally translated as "the vase broke itself").

These subtle linguistic differences can change how individuals perceive and interpret an event, ascribe blame, and determine the deserved punishment. Non-agentive phrasing allows the speaker to distance individuals involved in the event from responsibility and thereby remove guilt. Accordingly, further linguistic studies demonstrate that agentive descriptions elicit higher levels of blame, guilt, and financial penalties than do non-agentive descriptions[146]. For instance, of the 197,745 trials held at London's central criminal court from 1674 to 1913, cases with agentive phrases such as "broke it" or "burned it" in the court records resulted in guilty verdicts significantly more often than did cases with non-agentive phrases such as "it broke" or "it burned[146]." The psychological literature has shown that how individuals internalize their experiences can shape their mental health; and the linguistic literature shows that slight linguistic differences may determine how individuals internalize feelings of guilt, blame, and lack of control. Consequently, these seemingly inconsequential differences in speech patterns may have significant potential to influence one's mental health. Given that differences in the English and Spanish language can influence the speaker's thoughts and perception of themselves, others, and the world around them, language use and proficiency is of particular importance when examining mental health among US Latinos.

**Section 2.7.4** ***Socio-cognitive development literature***

For much of the early 20th century, bilingual language acquisition was thought to be burdensome and to trigger confusion and developmental disruption[147,148]. However, more recent evidence, documented in numerous studies, attests to the significant socio-cognitive advantages of bilingualism[149]. Bilingual children have been shown to have a better understanding of the social cues and communication needs of their conversational partners and to be more proficient at interpersonal communication that monolingual children[150]. Bilingual speakers of Spanish and

English have demonstrated greater nonverbal intelligence and mental flexibility than monolingual speakers of either language[151]. Bilingual children score higher on tests of cognitive ability and problem solving than monolingual children[152–154]. Bilingualism has also been shown to promote metalinguistic awareness[154,155]. These enhanced cognitive skills may aid bilingual individuals in developing the representational abilities that improve communication with and understanding of others. For example, the knowledge of two words that name the same concept may help children understand that objects or events can be represented in multiple ways, potentially facilitating a better understanding of the perspectives of others[149]. Indeed, bilingual individuals have been shown to have a greater capacity for reorganizing their perceptions in response to feedback[153]. Overall, bilingualism is likely advantageous for socio-cognitive development, with bilingual individuals exhibiting better understanding of the beliefs of others, increased ability to pick out important problem solving variables, and the capacity for entertaining two potential interpretations of a single stimulus at one time.

Numerous studies have also demonstrated the social-emotional advantages afforded bilingual individuals compared to monolingual English-speakers. Bilingual students have been shown to demonstrate higher levels of self-control and interpersonal skills, and lower levels of externalizing and internalizing behaviors and other problem behaviors, compared to their English-speaking monolingual peers[120]. Enhanced socio-emotional development may occur for individuals growing up in bilingual and bicultural environments because they are likely exposed to various different socialization practices through their interactions with family members, care providers, and educators and may thereby be better able to differentiate between these practices and form appropriate relationships with and attachments to the figures with whom they interact[120]. For example, studies have indicated that teachers often characterize their relationships

with bilingual students as closer and less conflict-ridden than their relationships with monolingual English speakers[156]. Further, as previously mentioned, for immigrants and their offspring, bilingualism may represent the preservation of an individual's ethnic values and beliefs in addition to successful adaptation to the new culture[48]. Thus, social and emotional outcomes manifest differently for bilingual individuals compared to monolingual individuals due to the unique cultural, linguistic, and contextual factors that impact bilingual development[120]. Consequently, the cognitive advantages and emotional intelligence afforded to bilingual individuals may play a key role in their mental health status and may prove to be protective against poor mental health outcomes.

#### Section 2.7.5 *Summary of language use and mental health literature*

Overall, there exists significant support across disciplines for the role that language use may play in mental health outcomes. For this reason, a focus on the cultural factor of language use may be appropriate when trying to unpack the effects of the black box of "acculturation" on mental health outcomes in US Latinos. Yet, as with other cultural factors, language use does not occur in a vacuum as it requires interactions between individuals and their social networks, such as their families and neighborhoods. Nevertheless, the literature is largely limited to studies of individual language use and does not account for interactions (or isolation) between multiple generations or between individuals and their communities. Accordingly, an intergenerational and population-level framework is necessary to better understand the role of language use in depression etiology.

### Section 2.8 Neighborhood factors and depression

#### Section 2.8.1 *Neighborhood-level main effects*

Neighborhood-level social factors have been associated with mental health in other

racial/ethnic groups but are understudied among Latinos. However, neighborhood-level factors may play an important role for the mental health of elderly US Latinos. Research among older populations shows that with advancing age comes increasing geographic limitations causing the elderly to be more reliant upon their immediate environment[157]. As individuals age, they are increasingly confronted with functional limitations and a decrease in activities such as employment. As a result, older individuals tend to spend more time at home and in the immediate outdoor environment than do younger people[157] and have consequently been shown to derive a strong sense of emotional attachment from both their home and the surrounding community[158]. Research has also suggested that those at an advanced age show greater vulnerability to life stressors[159,160]. Therefore, it is unsurprising that the association between neighborhood characteristics and wellbeing has been shown to be stronger among older individuals than younger individuals[161,162]. Yet to date little has been written on these community-level associations among US Latinos in general, and especially among elderly Latinos whose mental wellbeing may be particularly vulnerable to neighborhood-level factors.

Neighborhood-level segregation may be an important lens through which to examine the impact of neighborhood-level factors on the mental health of historically marginalized populations, especially Latinos in the US. Immigration and assimilation into a new culture are difficult processes that may induce high levels of stress[163], and the way social connections either exacerbate or mitigate this stress for US Latinos is complex. Further, over the last ten years, residential isolation of US Latinos has increased, with Latinos often residing in ethnic enclaves[51]. Consequently, examining the potential mental health implications of residential segregation in this population is of great importance now more than ever.

Residential segregation may impact mental health through a number of mechanisms.

While neighborhood homogeneity may buffer the experience of interpersonal racism in the immediate residential environment, the existence of such ethnically homogenous (i.e. segregated) neighborhoods is likely the result of structural discrimination that puts constraints on where an individual is able to reside and reinforces racial hierarchy and white privilege[164]. Institutional racism, which often results in highly-segregated neighborhoods, has been defined as differential access to goods, services, and other social and economic opportunities due to one's race or ethnicity[165,166]. This type of racism can influence health by creating residential patterns of racial and ethnic minorities in impoverished neighborhoods with little potential for socioeconomic mobility across the life course[167,168]. Indeed, highly-segregated communities have been shown to have worse schools, fewer high-paying and stable employment opportunities, worse neighborhood infrastructure and physical environments, higher residential turnover, worse housing conditions, higher crime and incarceration rates, a greater presence of alcohol and tobacco advertising, and less access to medical care and other health-promoting resources, all of which may lead to the psychosocial distress and trauma that influence mental health[168]. The literature examining neighborhood segregation factors and depression is mixed, with some studies showing an association while others do not[169]. However, the majority of residential segregation studies have been conducted among non-Latino White and Black communities, and the associations among US Latinos remain less clear.

Neighborhood segregation in relation to cultural factors may be especially salient for the mental health of elderly Latinos. Qualitative studies interviewing elderly individuals living in neighborhoods undergoing gentrification revealed that participants were more emotionally impacted by the changing cultural factors in their neighborhoods than by the changing socioeconomic composition[170]. Previous studies of the influence of residential cultural

segregation on mental health outcomes among Latinos have utilized Hispanic composition as a proxy for segregation of cultural factors[171–176]. The segregation measure of neighborhood Spanish language isolation may provide a more direct measure of neighborhood-level cultural segregation than neighborhood-level ethnic or foreign-born composition, and thus may be of particular importance among Latino populations [177]. However, cultural factors that have greater face validity as measures of acculturation status, such as language use, have not been sufficiently examined at the neighborhood level [178]. Further, while a small number of studies have found an association between neighborhood-level language isolation and various physical health outcomes [177,178], studies assessing measures of neighborhood language isolation in relation to mental health are virtually non-existent.

Nevertheless, this measure may have important implications for Latino mental health. Social connections related to mental health for Latinos are closely tied to language capabilities, and the Spanish/English language capacity of both the individual and the dominant language in the surrounding community may impact the relationship between an individual's social ties and how these ties facilitate knowledge about and access to mental health care. Further, 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[70,179]. Indeed, this may be why elderly individuals from visible ethnic minorities, and Latinos in particular, are reported to seek formal health care later than those from non-minority groups[70] and why ethnic minorities living in homogeneous neighborhoods have been shown to be more likely to use health care services than those living in heterogeneous communities[180].

### Section 2.8.2 *Cross-level interactions between neighborhood- and individual-level factors*

Individual-level characteristics may affect the role that neighborhood factors play on Latino mental health. The direction of the association between neighborhood cultural characteristics and depression likely depends upon the cultural orientation of the individuals comprising the neighborhood. For example, discordance between the language preference of an individual and the predominant language use or racial/ethnic composition of the surrounding neighborhood may result in experiences of social exclusion, discomfort, dissatisfaction, and emotional distress potentially affecting one's mental status[181,182]. This is in line with social comparison and cognitive dissonance theories, which predict that distress can result from experiencing a discrepancy between an individual's personal attributes and the characteristics of those around them[183]. Examination of these cross-level interactions is necessary if we are to truly understand how socioeconomic and cultural experiences in the US shapes mental health outcomes of the Latino community.

When considering language incongruence with respect to individual and neighborhood-level Spanish use, one might conceive of four different categories of individuals (ignoring bilingualism for simplification and illustration purposes): 1) English-speaking individuals residing in predominantly English-speaking neighborhoods, 2) Spanish-speaking individuals residing in predominantly Spanish-speaking neighborhoods, 3) English-speaking individuals residing in predominantly Spanish-speaking neighborhoods, and 4) Spanish-speaking individuals residing in predominantly English-speaking neighborhoods. We might expect English speakers residing in English-speaking neighborhoods to fare the best in terms of mental health given the social connectedness created by their individual and neighborhood language concordance and the

access to health-promoting information and resources afforded by their English proficiency. Spanish-speaking individuals residing in Spanish-speaking neighborhoods may also benefit from the social cohesion, social support, and stronger sense of belongingness that occur from living within a linguistically homogeneous community[184].

Language discordance between individuals and their communities may create stress and impact mental health outcomes. Compared to those with individual-neighborhood language concordance, Spanish speakers residing in English-speaking neighborhoods and English speakers residing in Spanish-speaking neighborhoods may be more likely to experience social exclusion and lack of social support due to the discordance between their individual language preference and the language spoken within their community. Such discordance is likely to impact mental health[183]. When considering these two types of language discordance, we may expect worse mental health outcomes among Spanish speakers residing in English-speaking neighborhoods. In addition to distress from social exclusion, these individuals may be more likely to experience interpersonal racism due to their minority status both within their community and within the nation at large[164]. Living within a predominantly English-speaking environment may lead to greater exposure to and awareness of such discrimination[185]. Further, as a result of their linguistic isolation, these individuals may not be able to take advantage of existing neighborhood resources, and thereby not reap the benefits of residing in a less segregated neighborhood[70,179]. Thus, unlike the beneficial mental health impact of living in a predominantly English-speaking area that we might expect to see for English-speakers, the neighborhood language effect could conceivably switch direction for Spanish speakers. This illustration suggests that the mental health effect of neighborhood-level language use may depend upon individual language preference and vice versa. In other words, not only do the independent effects of one's

community and one's individual characteristics matter for mental health, but the combination of these factors may shape mental health over and above their isolated effects.

A small number of studies have examined cross-level interactions between neighborhood- and individual-level characteristics[174,175,181,182,186], but few of these studies have been conducted among Latinos or have examined cultural factors specifically. Moreover, the studies that do account for individual-level cultural factors adjust away these effects rather than investigating their potential modifying role[174,187]. Studies examining the interaction between neighborhood- and individual-level cultural factors among US Latinos are lacking but likely necessary for a better understanding of the social and cultural pathways influencing depression.

**Summary:** Conventional risk factors for depression do not sufficiently characterize the high prevalence of depressive disorders among US Latinos, and socioeconomic position and acculturation may play a more important role in explaining the depression burden among this population. These sociocultural factors are dynamic in nature, and may have intergenerational and community-level effects over and above their impact on mental health at the individual-level. Accumulation of socioeconomic and cultural stressors across multiple generations of Latinos or within neighborhoods may affect depression prevalence by exposing certain members of this population to long-term sustained chronic stress. Major unresolved questions are: (1) what role does the socioeconomic experience of US Latinos across generations play in depression prevalence, (2) how do acculturation and linguistic differences between generations impact offspring depression prevalence, (3) does neighborhood cultural segregation influence Latino depression over and above individual-level factors, and (4) how does the interaction of neighborhood- and individual-level cultural factors impact Latino depression? Answering these questions is essential for a broader understanding of depression etiology and the unique aspects

of the Latino experience in the US that shape this population's mental health.

**Section 2.9 Significance**

The Latino community in the US has been shown to carry a disproportionate burden of depressive disorders relative to other ethnic groups, even though depression remains greatly underdiagnosed in this population[10–17]. The conventional clinical-risk factors that characterize depression, such as genetic predisposition, negative affect, and experiences of trauma[19], do not sufficiently explain the high burden of depression among Latino populations[20,21]. Socioeconomic position and acculturation, on the other hand, have been identified as two factors that may be more salient for Latino mental health[22–27]. Recent immigrants represent a heterogeneous mix of socioeconomic position and cultural orientation and comprise a large proportion of the US Latino community[18,47]. Consequently, in the US many Latinos are growing and aging in social and cultural contexts that greatly differ from those of previous generations. Furthermore, socioeconomic and cultural factors have been shown to accumulate and transmit over generations and within communities[33,38,42–47]. Because of the dynamic nature of the Latino context, the neighborhood and intergenerational frameworks represent novel and key frameworks from which to examine how sociocultural factors influence Latino mental health. Previous mental health studies present only a snapshot of the influence of socioeconomic and cultural factors by restricting analyses to the individual level and ignoring intergenerational and neighborhood components. Yet, a generational and neighborhood perspective may be necessary to gain a more comprehensive and contextual understanding of depression etiology and the dynamic social and cultural pathways that shape Latino mental health.

Our study combines individual- and neighborhood-level data from multiple generations of Latinos to examine how socioeconomic and cultural contexts change across generations and

accumulate within communities to impact depression. Consequently, the results from our study provide the first evidence highlighting the importance of collecting and examining data on the contextual socioeconomic and cultural mechanisms that may affect depression in an under-diagnosed and under-treated ethnic population. Depression in Latino communities is a major public health issue that deserves high priority for intervention at the individual, family, and community levels. Our study will allow for a better understanding of how sociocultural pathways at multiple levels that have been hitherto ignored shape the mental health of US Latinos.

**Section 2.10 Innovation**

The high burden of depression among Latino populations is not adequately explained by the traditional genetic and environmental risk factors for depression described by the DSM-5[20,21]. Socioeconomic position and acculturation, on the other hand, have been identified as two especially salient factors for Latino mental health[22–27]. These factors have the propensity to change and accumulate over multiple generations and within neighborhoods, especially among Latino populations[33,38,42–47]. However, the role of the accumulation of socioeconomic and cultural factors across generations and within neighborhoods in shaping Latino mental health remains virtually unexplored and represents a critical gap in our understanding of depression etiology among US Latinos. Our study was innovative because:

1) We examined the socioeconomic experience and the process of acculturation across multiple generations in relation to depression. No existing studies have directly collected socioeconomic and cultural data from multiple generations of Latinos at multiple time points in order to investigate the effect of accumulation of these factors across generations to impact depression prevalence. Utilization of the Sacramento Area Latino Study on Aging (SALSA) and the Niños Lifestyle and Diabetes Study (NLDS) provided

an unprecedented opportunity to combine individual- and neighborhood-level socioeconomic, cultural, and psychiatric data from multiple generations and assess both intergenerational and neighborhood effects on depression prevalence, and depression prevalence in later life in particular.

2) We assessed the influence of neighborhood cultural segregation (regarding language use and ethnic composition) within the Latino community in the US, adding an additional novel neighborhood dimension to better understand the impact of context on depression. The last decade has shown an increase in the residential isolation of the Latino community in the US, highlighting the importance of examining contextual effects on Latino mental health[51]. Residential cultural factors have been shown to play an important role in the mental health of elderly Latinos[170]. Our project was unique in that it examined the mental health effects of two measures of neighborhood-level cultural segregation among SALSA participants, a sample that is highly representative of older Latinos residing in the Sacramento Valley. We utilized language and race/ethnicity data from the 2000 US Census to assess the mental health effects of both neighborhood language isolation and Hispanic segregation. Further, we utilized the Index of Concentrations at the Extremes (ICE) to capture these two aspects of neighborhood-level cultural segregation; this metric, first described by Massey in 2001, is a novel measure of segregation that does not rely on living near a metropolitan area[188]. The ICE is also preferable to other measures of segregation because it is able to distinguish which group is concentrated at the extreme. For example, neighborhoods that are 100% Hispanic would have the same Index of Dissimilarity as neighborhoods that are 100% White; the ICE, on the other hand, appropriately assigns these two neighborhoods distinct scores[188,189]. To our knowledge,

no existing studies have examined the influence this more direct measure of spatial social polarization, especially in terms of cultural factors such as language isolation or ethnic segregation, on mental health. Additionally, our study was the first to implement the ICE in terms of Spanish language use; this cultural factor has greater face validity as a measure of cultural orientation as compared to ethnic composition and has not been sufficiently examined at the neighborhood level[178].

3) We integrated acculturation theory from multiple fields and examined and compared the mental health effects of multiple measures of acculturation in order to counterbalance the advantages and disadvantages of each measure in prior research. NLDS and SALSA contain a version of the Acculturation Rating Scale for Mexican-Americans II (ARSMA-II), an established measure of cultural orientation that assesses multiple dimensions of the acculturative process[112]. Acculturation scales are useful in that they combine diverse aspects of acculturation into a single score; however, studies may also benefit from focusing on specific aspects of acculturation that are most logically linked with the outcome of interest. Consequently, we also utilized data on language use due to its connection with mental health[30,31]. This project was the first to investigate the mental health effects of multiple measures of cultural orientation, allowing us to disentangle the aspects of acculturation that are most salient for Latino mental health.

The interplay of community-level variables with socioeconomic and cultural trajectories across multiple generations of Latinos is potentially of enormous importance in elucidating how multiple dimensions of the US Latino experience impact this population's mental health. However, investigation of this interplay is non-existent in the current literature. Our study was the first to examine the dynamic relationships between individuals and changes in their social

and cultural contexts in order to gain a more comprehensive understanding of how the Latino experience in the US shapes this community's mental health.

# CHAPTER 3: METHODS

## Section 3.1 Study Design

Our project utilized data derived from two large biologically-related longitudinal cohort studies: The Sacramento Area Latino Study of Aging (SALSA) and the Niños Lifestyle and Diabetes Study (NLDS). The original goal of SALSA was to identify vascular, metabolic, and sociocultural predictors of dementia, mortality, and cognitive decline among elderly Latinos[190]. SALSA participants (Gen 1) additionally reported sociodemographic data for their parents (Gen 0). The study completed seven waves of follow-up from 1998 to 2008. The aim of NLDS was to collect data from at least 500 adult biological offspring of original SALSA participants in order to examine intergenerational social and cultural risk factors for prevalent type 2 diabetes in adult Latinos. The study is ongoing and has at present completed two waves of follow-up (March 2013-November 2014). NLDS comprises biological adult offspring (Gen 2), adult grandchildren (Gen 3), and other referred adult biological relatives of SALSA participants. Each NLDS participant was assigned a unique family identifier, allowing us to link participants in SALSA with relatives in NLDS.

Linking existing data from SALSA and NLDS, our project addressed three critical gaps in our understanding of depression etiology: the association of (1) socioeconomic and (2) acculturation trajectories across generations with depressive symptoms; and (3) the association of neighborhood cultural factors with depressive symptoms. We used longitudinal data from SALSA for Aim 1a, cross-sectional baseline data from both SALSA and NLDS for Aim 1b, and

baseline data from SALSA and the 2000 US Census to address Aim 2 (Figure 1). These two studies were ideally suited to answer our questions of interest given that they collected data from multiple generations of Latinos and were geocoded and representative of Latinos residing in the Sacramento Valley, allowing for examination of both intergenerational and neighborhood effects.

**Section 3.2 Study Population**

SALSA population. SALSA is a longitudinal cohort of 1,789 elderly Latinos, largely of Mexican origin (Gen 1). Study design and survey information on SALSA have been described in numerous published studies[32,190,191]. Briefly, eligible participants were self-identified Latinos aged 60+ years at baseline and residing within Sacramento, Yolo, Sutter, Solano, San Joaquin, and Placer Counties in California[32,190]. These counties were chosen because they had densities of Latinos >10% based on updated 1990 US Census information[192]. The recruitment method was designed to enumerate all Latino households within these census tracts. The first stage of the sampling involved characterizing the 1990 Census tracts in the six targeted counties by the percentage of eligible residents (aged 60+ years and Latino). All tracts with ≥5% eligible were selected for the target population. Because the recruitment occurred eight years after the 1990 Census, a phone and address list was purchased of people aged 60+ years with Latino surnames in the target area. This list was used to identify census tracts where the eligible population might have changed since 1990 and to contact individuals in the selected census tracts. Participants were contacted in three stages: by mail, by phone, and, finally, by door-to-door neighborhood enumeration. Approximately 22% of the total eligible population of Sacramento County was recruited. The sample was highly representative of older Latinos residing in the target area, and more than 89% of eligible and enumerated households had an individual who participated in the

study. Annual attrition in the SALSA study averaged 5% from baseline through 2008. Approximately half of the attrition over the study period was due to death (49.5%), and the remaining loss to follow-up was due to dropout.

NLDS population. During baseline interviews, SALSA participants provided the names and contact information of their offspring. From 2013 to 2014, adult offspring of SALSA participants were contacted for participation in the NLDS cohort. Figure 2 depicts the temporal relation of SALSA and NLDS. SALSA originally comprised 1,228 families with 4,428 offspring. Offspring were randomly contacted to meet the NLDS sample size goal of 500 participants. In addition, NLDS participants had the opportunity during their interviews to refer other immediate family members to the study. Any living biological relatives of original SALSA participants aged 18+ years who spoke English or Spanish and lived in the greater Sacramento area were eligible to participate. Of the 1,059 eligible participants that were contacted during the study period, a total of 728 (69%) were recruited to participate in the NLDS. Figure 3 depicts the baseline geographic distribution of SALSA and NLDS participants over the six targeted counties. Of the 728 NLDS participants, 670 (92%) provided a baseline phone survey. Of the 670 providing a phone survey, 638 could be linked to a biological parent in either the SALSA or NLDS studies. The NDLS participants linked to a parent resembled the total NLDS population in terms of demographic and health characteristics (Table 1). Additionally, SALSA participants linked to NLDS offspring were representative of the overall SALSA cohort with respect to demographic and health covariates (Table 1). Therefore, the linked NLDS and SALSA participants are likely a representative sample of parent-offspring pairs from the original SALSA cohort.

Our study utilized various subsets of the SALSA and NLDS data for Aims 1 and 2, as described in Table 1. In both the SALSA and NLDS studies, participants were contacted annually by trained professional research study staff via telephone and home interviews. Our project utilized the data collected via in-home interviews for SALSA participants and via phone interview for NLDS participants. Surveys were conducted in English or Spanish by participant preference and included basic sociodemographic data, lifestyle factors, health history, measures of acculturation, and depressive symptoms.

**Section 3.3 Preliminary data**

SALSA and NLDS provide a wealth of social, cultural, biological, and psychiatric data. Thus, we have numerous preliminary studies, predominantly from SALSA, that provide important evidence supporting further investigation of the generational, cultural, and social pathways of interest. Here, we present previous studies and preliminary analyses that have used SALSA and NLDS data.

Prevalence of high depressive symptoms in SALSA and NLDS. Of the 1,789 SALSA participants, 25.5% were classified as having high depressive symptoms at baseline, based on Center for Epidemiological Studies Depression Scale (CES-D) scores[32]. High depressive symptom prevalence was 32.0% and 16.3% among female and male participants, respectively[32]. The prevalence of depression was higher among women, immigrants, those with <12 years of education, low-income participants, and bicultural and Latino-oriented participants[32]. Additionally, analyses of the NLDS data indicated that 29.2% of NLDS participants had high depressive symptoms at baseline based on CESD-10 scores (Table 1).

Socioeconomic position and health in SALSA. Cross-sectional evidence from SALSA suggested that lower SEP is associated with numerous adverse health outcomes including lower

survival rates, higher rates of cardiovascular mortality, lower cognitive performance, and higher depressive symptoms[193–195]. Further, studies of life course SEP among SALSA participants indicated that low SEP across the life course may be associated with type 2 diabetes, central obesity, dementia, cognitive impairment, and other measures of poor cognitive function and memory[196,197]. However, no extant studies, using SALSA or other data, have examined whether intergenerational measures of SEP influence depressive symptoms over time among Latinos.

We have conducted previous analyses among NLDS participants investigating the association between educational mobility across generations and depressive symptoms in offspring[198]. We found that those experiencing stable-low educational attainment across generations had the highest prevalence of depressive symptoms and that stable-high and upward educational mobility were both protective against depressive symptoms (Table 2). These analyses indicated that educational mobility may play an important role in the mental health of the NLDS population. However, no studies have examined the association between intergenerational educational mobility with depressive symptoms measured at multiple time points.

Acculturation and health in SALSA. Several studies have been conducted within the SALSA cohort examining the associations between various cultural orientation measures and a number of health outcomes. Within the SALSA cohort, significant associations have been found between nativity and cognitive decline; immigration age and cardiovascular mortality; generation status and type-2 diabetes; and acculturation scores and dementia, systolic blood pressure, low-density lipoprotein, high-density lipoprotein, cardiovascular disease, and overall survival[193,199–203]. Fewer studies among SALSA participants have examined the association between acculturation and depressive symptoms. The two studies examining this relationship in SALSA

provide evidence that acculturation may influence psychosocial stressors and ultimately depressive symptoms[32,195]. In both studies, higher depressive symptoms were found among the more highly Latino-oriented participants. However, these studies examined acculturation only among the single SALSA generation. By combining NLDS and SALSA data, our study examined how acculturation changes between generations impacted depressive symptoms among the offspring. Nevertheless, these preliminary studies highlight the importance of acculturation in predicting health outcomes in SALSA.

Neighborhood socioeconomic factors and health in SALSA. Prior work in SALSA has suggested that higher neighborhood SEP may be associated with lower type 2 diabetes prevalence and rates of cognitive decline[194,204]. These previous findings indicated that there was sufficient neighborhood heterogeneity within the SALSA population to detect a variety of health effects (see 3.4 for explanation of variable creation). However, no studies in SALSA have examined the association between neighborhood cultural factors and depressive symptoms. Furthermore, no studies, in SALSA or otherwise, have examined the potential interaction between individual-level cultural orientation and neighborhood-level cultural data and how this interaction may affect depressive symptoms in Latinos.

**Section 3.4 Exposure Assessment**

The main exposure variables for Aims 1a, 1b, and 2 included intergenerational socioeconomic and acculturation trajectories and neighborhood cultural segregation (Table 3). The data required to create these variables had already been collected from SALSA and NLDS participants by trained bilingual interviewers. The survey measurements used across the SALSA and NLDS studies were consistent and have been well-characterized; the internal/external, content, and criterion validity has been confirmed for the questionnaires and assessments utilized

in both studies[32,190].

**Section 3.4.1** ***Intergenerational socioeconomic mobility***

For Aim 1a we examined socioeconomic mobility across generations. We assessed socioeconomic mobility among SALSA participants only given the longitudinal nature of our study aim; SALSA comprised seven waves of data collection compared to only two waves in the NLDS.

Socioeconomic position was measured in SALSA by educational attainment (number of years), monthly household income, and lifetime occupation. We utilized educational attainment as the primary measure of socioeconomic position. This was consistent with other studies among Latino populations[197,205]. Further, education is often the preferred measure since it not only predicts future occupation and wages, but is also less influenced by age-related changes in these characteristics[79,206]. SALSA ages ranged from 60 to 101 years at baseline; therefore, educational attainment may be a more salient SEP marker because this largely retired population (~90% retired) may not have had incomes at baseline representative of their earlier occupations. Finally, education is the more commonly considered type of intervention when endeavoring to raise SEP over the course of multiple generations[207].

During baseline home visit interviews, SALSA participants responded to the questions: "How many years of education have you completed?", "How many years of school did your father have?", and "How many years of school did your mother have?". We first utilized these questions to create individual-level SEP variables. For the parents of SALSA participants (Gen 0), we classified maternal and paternal education levels as "low" if they completed <6 years of education (i.e., did not complete elementary school) or "high" if they completed ≥6 years of education (i.e., completed elementary school or beyond). For SALSA participants (Gen 1), we

classified educational attainment as "low" if they completed <12 years of education (i.e., did not complete high school) or "high" if they completed ≥12 years of education (i.e., completed high school or beyond). We utilized a lower education cut point for Gen 0 than Gen 1 to account for age- and location-related differences in education levels between the two generations. These cut points were appropriate given the data distribution in both generations of the SALSA cohort: approximately 73% of mothers and fathers of SALSA participants completed <6 years of education[91], and nearly 71% of SALSA participants completed <12 years of education (Table 1). Additionally, our choice of education cut points was in line with the educational cut points used in prior SALSA publications[196,197]. Further, we chose to dichotomize educational attainment for each generation because it allowed for the creation of the following cross-generational social mobility categories: (1) stable-high, (2) stable-low, (3) upwardly mobile, and (4) downwardly mobile.

**Section 3.4.2** ***Intergenerational acculturation trajectory***

For Aim 1b we examined acculturation trajectories across generations in SALSA and NLDS. These studies have a wealth of cultural orientation data; therefore, we assessed this construct with three different acculturation trajectory variables regarding: 1) Spanish language use, 2) "overall" US orientation combining the domains of language use, socialization, and communication, and 3) "socialization" US orientation regarding socialization and communication/media use. To create these cross-generational variables, we utilized a unique family identifier present in both SALSA and NLDS to link NLDS participants' data with the baseline socioeconomic, acculturation, and demographic data collected from their biological parents in either the SALSA or NLDS studies.

Spanish language use trajectory. Language use is intricately linked to mental health

through its influence on acquisition of resources, creation of social ties, formation of relationships of trust, maintenance of familial shared values, and a sense of belonging or isolation from one's community[30,31]. Additionally, studies demonstrate that language use accounts for the majority of the variability in acculturation scales[116]. Consequently, we determined that language use would be a key cultural factor to assess in relation to depressive symptoms.

We constructed the intergenerational Spanish language use variable utilizing two questions from the NLDS survey. Participants were asked, "When you were growing up, how often did your parents speak to you in Spanish?", and "In your current adult life, how often do you speak Spanish?", with five possible responses ranging from "never" to "always." We collapsed the top two and bottom two categories to create three individual Spanish language use categories for each parent and each offspring of: (1) high Spanish use, (2) equal English/Spanish use, and (3) low Spanish use. Utilizing these parental and offspring categories, we created five mutually exclusive cross-generational language categories: (1) stable-high Spanish use, (2) stable-low Spanish use, (3) stable-equal English/Spanish, (4) increased Spanish use, and (5) decreased Spanish use.

It is worth noting that in our study, decreased Spanish use across generations was characterized by high exposure to the Spanish language as a child and increased English language use as an adult. Therefore, both the stable-equal English/Spanish and decreased Spanish use categories comprise individuals who have experienced exposure to both languages across generations. In fact, bilingual offspring likely comprise both the stable-equal English/Spanish and decreased Spanish use categories. Of the 224 participants classified as having decreased Spanish use, 117 reported speaking Spanish half the time and their parents

speaking Spanish all/most of the time. Thus, while these individuals had decreased Spanish use across generations, they would likely consider themselves bilingual. Given the overlap of bilingual individuals in both the stable-equal English/Spanish and decreased Spanish use categories, we conducted two sensitivity analyses first separating into their own category the 117 individuals who reported speaking Spanish half the time and their parents speaking Spanish all/most of the time and then combining these individuals with the stable-equal English/Spanish participants. Our findings were robust across these various categorizations; thus, we kept the 117 individuals in the decreased Spanish use category.

"Overall" acculturation trajectory. To create the "overall" acculturation trajectory variable, we first assessed parent and offspring acculturation levels, separately. Both NLDS and SALSA employed versions of the Acculturation Rating Scale for Mexican-Americans II (ARSMA-II), an established measure of cultural orientation that assesses the acculturative process along multiple dimensions[112]. The ARSMA-II is widely used to assess the degree of cultural adaptation of Mexican Americans into mainstream US culture, and the scale's reliability and validity have been demonstrated among numerous Mexican-American populations[112,208]. The ARSMA-II asks subjects about language preference, Spanish/English media preference, food preparation, holidays celebrated, and associations in adulthood and childhood with people of Mexican or Latino and non-Hispanic White backgrounds. The ARSMA-II questions are grouped into the Anglo Orientation Subscale (AOS) and the Mexican Orientation Subscale (MOS), both of which have good internal reliabilities (Cronbach's Alpha=0.86 and 0.88 for the AOS and MOS, respectively) [112]. As recommended by Cuellar et al., the mean MOS was subtracted from the mean AOS to create an overall continuous acculturation score for each parent and offspring, with lower scores indicating higher Latino cultural orientation and a score of 0 indicating equal

US- and Latino-orientation [112].

We defined high Latino orientation as an acculturation score <0 and high US orientation as a score ≥0. If both parents of an NLDS participant participated in SALSA, the more highly US-oriented parent was linked to the NLDS participant. We then created the "overall" cultural orientation trajectory variable, classifying each participant into one of four categories: (1) stable-high Latino orientation (Latino-oriented parent and offspring), (2) increased US orientation (Latino-oriented parent and US-oriented offspring), (3) stable-high US orientation (US-oriented parent and offspring), and (4) increased Latino orientation (US-oriented parent and Latino-oriented offspring).

"Socialization" acculturation trajectory. We created the "socialization" acculturation trajectory variable in the same way as the "overall" acculturation trajectory, differing only in that the language specific questions were excluded when calculating the AOS and MOS. This variable allowed us to separate the acculturative influence of language from the other aspects of acculturation.

**Section 3.4.3** ***Neighborhood-level exposures***

For Aim 2 we examined neighborhood-level exposures. We conducted Aim 2 among SALSA participants only given the larger sample size and geographic distribution of the SALSA study. Additionally, recruitment for SALSA was carried out with the express purpose of enumerating a sample that was highly representative of older Latinos residing in the Sacramento Valley. The data structure comprises 1,766 individuals (level 1) nested within 249 neighborhoods (level 2) within the 6 counties targeted by SALSA. Each census tract had a mean±SD number of 7.1±9.2 participants, with a range of 1 to 82 participants. Figure 4 portrays the baseline geographic distribution of SALSA participants.

We utilized the Index of Concentrations at the Extremes (ICE) to measure neighborhood-level cultural segregation; this metric, first described by Massey in 2001, is a novel measure of segregation that does not rely on living near a metropolitan area[188]. The ICE was developed to demonstrate the extent to which an area's residents are concentrated at the extremes of deprivation and privilege[188,189]. The index ranges from -1 to 1, with a value of -1 indicating that 100% of the population is concentrated in the most deprived group and a value of 1 indicating that 100% of the population is concentrated in the most privileged group[188,189]. The ICE was originally developed to be used with economic measures[188]; however, this same concept has more recently been utilized to assess extreme concentrations of race and other cultural factors as an indicator of segregation[189,209,210]. The ICE is preferable to other measures of segregation, such as the commonly used Index of Dissimilarity, because it is able to distinguish which group is concentrated at the extreme. For example, neighborhoods that are 100% Hispanic would have the same Index of Dissimilarity as neighborhoods that are 100% White; the ICE, on the other hand, appropriately assigns these two neighborhoods distinct scores[188,189]. Additionally, unlike the Index of Dissimilarity or Isolation Index, the ICE can be meaningfully used outside of metropolitan centers and with smaller geographic units, such as census tracts[188,189,209,210].

To capture neighborhood-level segregation, we created two ICE variables with two sets of neighborhood-level cultural data: 1) Spanish language use, and 2) Hispanic composition. The first ICE variable was meant to serve as a measure of Spanish language segregation, while the second was meant to measure ethnic segregation. Language use was utilized because it is a commonly-used measure of cultural orientation and has been closely linked to mental health[30,31]; further, this variable is a more direct measure of a community's cultural orientation than other neighborhood-level cultural measures such as ethnic composition. Nevertheless, segregation

measures related to ethnic composition have been used as markers of residential segregation in most previous studies[172,187,211–213]; therefore, the additional use of Hispanic composition facilitated comparisons with past studies of neighborhood-level effects on depression.

We utilized census tract level language use and racial/ethnic composition data from the 2000 US Census to calculate the two ICE variables. The Spanish language ICE was calculated as the difference between the number of English-only speakers and Spanish speakers in a census tract divided by the total population of the census tract [188]. The numbers in the numerator were determined utilizing responses from two questions from the 2000 US Census: 1) "Does this person speak a language other than English at home?" and 2) "What was this language?" A Spanish language ICE value of -1 indicated an entirely Spanish-speaking census tract, a value of 1 indicated an entirely English-only speaking census tract, and a value of 0 indicated a census tract with an equal number of Spanish- and English-speaking residents. The Hispanic composition ICE was calculated as the difference between the number of non-Hispanic White residents and Hispanic residents in a census tract divided by the total population of the census tract[188]. A value of -1 indicated an entirely Hispanic census tract, a value of 1 indicated an entirely non-Hispanic White census tract, and a value of 0 indicated a census tract with an equal number of non-Hispanic White and Hispanic residents.

Neither of the ICE variables had previously been examined in the SALSA data; consequently, we examined multiple functional forms of both variables in order to determine the most appropriate forms as they relate to depressive symptoms. The functional form choices were informed by previous studies examining the health effects of neighborhood cultural variables and included continuous linear (centered around the grand mean)[213–217], continuous quadratic (centered around the grand mean), quartiles[218], deciles[175], and dichotomization at the 60th

percentile[213,219–222]. This functional form assessment indicated that the continuous, linear functional form was appropriate for both neighborhood variables.

When considering the total 586 census tracts that made up the six counties targeted for the SALSA study, the percentage of Spanish speakers in each census tract ranged from 0% to 68.4% with a mean±SD of 13.2%±11.4%, based on US Census data from 2000[223]. Among the 249 census tracts in which SALSA participants actually resided within these six counties, the percentage of Spanish speakers in each census tract ranged from 1% to 50% with a mean±SD of 12.3%±9.7%. Additionally, in the total 586 census tracts for the six targeted counties, the Hispanic composition of each census tract ranged from 2% to 71% with a mean±SD of 19.4%±13.1%[223]. Among the 249 census tracts in which SALSA participants resided, the Hispanic composition of each census tract ranged from 3% to 57% with a mean±SD of 18.4%±11.1%. Based on these distributions, we believed that there would be sufficient heterogeneity of neighborhood-level Spanish language use and Hispanic composition within the study population to detect mental health effects. Figures 5 and 6 depict the percentage of Spanish speakers and Hispanic composition, respectively, by census tract over the six targeted counties.

**Section 3.5 Outcome Assessment**

The outcome of interest for our proposed study was depressive symptoms, measured by Center for Epidemiological Studies Depression Scale (CES-D) scores for SALSA participants and Center for Epidemiological Studies Depression Scale-10 (CESD-10) scores for NLDS participants[224,225]. The CES-D was administered to all SALSA participants at baseline and each of the subsequent follow-up visits and is a widely used self-report survey designed to measure depressive symptomology in the general population[224]. The CES-D has also been commonly utilized in geriatric populations[226–228] and older Latinos[229,230]. This scale is a 20-item 4-point

Likert-type scale that assesses the extent to which an individual experienced depressive symptoms during the prior week. The CES-D was not designed for clinical depression diagnosis, but rather for research and screening purposes; nevertheless, this scale is based on clinical depression symptoms and correlates well with other depression scales[224]. The total score ranges from 0 to 60 and is dichotomized using a standard cutoff score of ≥16 to classify individuals with high depressive symptoms[224]. The CESD-10 was administered to all NLDS participants during the phone survey. This shorter 10-item scale was derived from the full-length 20-item CES-D and has a total score ranging from 0 to 30. The scale was developed to alleviate participant burden in older adults[225]. The CESD-10 has been shown to correspond closely to the full-length 20-item version[225] and to have high internal consistency and test-retest reliability[231,232]. Both the CES-D and CESD-10 have been validated in Spanish-speaking populations[233–236]. As suggested by previous validation studies utilizing this shortened scale, NLDS participants scoring ≥10 on the CESD-10 were considered to have high depressive symptoms[231,237].

We recognize that the CES-D and CESD-10 are limited in their ability to accurately detect depression. As a measure of major depressive disorder (MDD), the measures demonstrate high sensitivity, yet they suffer from low specificity and low positive predictive value[238]. In other words, while those with MDD are likely identified as such by the CES-D, the CES-D also picks up many individuals who would not be diagnosed with MDD. In fact, a review of CES-D validation studies utilizing 16 as a cut point for depression found the specificity across studies to range from 0.39 to 0.94, and the positive predictive value from 0.06 to 0.30[238]. Further, certain items in the survey may be of particular concern. For example, the item "I had crying spells" has been shown to elicit responses that differ by sex; this has resulted in artificially inflated female CES-D scores due to cultural norms regarding the expression of emotions, rather than actual sex

differences in depressive symptoms[239]. Further, two items regarding social interactions ("People were unfriendly" and "I felt that people disliked me") are also thought to assess the construct of perceived social competence and thereby be sensitive to symptoms of disorders other than depression such as Social Anxiety Disorder[239]. In fact, the CES-D has been shown to be as effective in predicting anxiety disorders as in predicting depression[240]. Additionally, the CES-D items that measure potential somatic concerns, such as "I felt that everything I did was an effort," may result in inappropriate inflation of CES-D scores for elderly populations or those experiencing chronic pain[239]. Finally, the CES-D does not assess suicidal ideation, one of the symptoms of MDD identified by the DVM-5[19]. Nevertheless, it is important to keep in mind that the CES-D was designed to be used in epidemiologic research studies as an indicator of depressive symptomology in the general population[224]; it was not designed to make clinical diagnoses of depression. When used as a measure of distress and a screening tool for depressive symptomology, as was intended, the CES-D performs quite well[240]. Thus, for the purposes of this study, we utilized the CES-D and CESD-10 as indicators of depressive symptoms and interpreted our findings as such.

### Section 3.5.1 *Depression-free days*

Depression-free days (DFD) were utilized as an additional outcome measure for Aim 1a in order to take advantage of the CES-D scores collected at multiple time points in SALSA. DFDs are an approximate summary of the severity of depressive symptoms over a period of time[241]. This metric is considered a valid and clinically-relevant measure of depression that integrates both occurrence and duration of depression-free time[242]. DFDs are also a better representation of the lived experience of depression compared to other metrics. Depression is often characterized by fully symptomatic periods, partial remission, recurrent episodes, and

relapse within episodes[243–245]. Consequently, longitudinal measures that incorporate duration of these clinical states may best reflect the depression experience. DFDs reflect the course of symptom change over time by estimating the duration of time spent in various stages of depression remission and the cycling between remission and relapse that commonly occurs with depression[246]. Given that often the goal of treatment is to shorten the course of depression by decreasing the percentage of time spent depressed, DFDs are commonly utilized by studies examining the effectiveness of depression treatments. Indeed, DFDs have been utilized to detect meaningful treatment differences in multiple studies[241,247–249]. Compared to other measures of depression, DFDs are also more easily mapped onto disability-adjusted life years (DALYs) and quality-adjusted life years (QALYs), which have been recommended as the best measures of effectiveness of depression treatments[248,250]. In tests of validity, the DFD metric has been shown to be robust to various cut points for asymptomatic and fully symptomatic depression and robust to truncation of data to shorter periods of time[241]. The construct validity of the DFD measure has been assessed in terms of its association to external, independent depression measures and has been found to be valid[241]. Further, DFDs have been successfully utilized in Latino populations[251]. Consequently, the DFD metric is relatively simple, yet valid, flexible, and interpretable measurement tool that may be appropriate for the SALSA study population and can sensitively discriminate between states and duration of minimal depression, sustained remission, transient remission, and sustained fully-symptomatic depression[241].

To calculate DFDs, we used linear interpolation to estimate daily depression severity across multiple assessment points. CES-D scores were collected in SALSA at baseline and at each of the subsequent 6 follow-up visits. Utilizing the depression survey mapping work by Schalet et al., we converted CES-D scores into Patient Health Questionnaire (PHQ-9) scores[252].

PHQ-9 scores were preferable to CES-D scores for estimating DFDs because the PHQ-9 cut points can distinguish between the fully symptomatic, partially symptomatic, and asymptomatic depressive states[253]. The PHQ-9 was also created to map directly onto the DSM-IV, making it a more clinically relevant measure for depressive disorders[253]. Using cut points established by Kroenke et al., we classified a PHQ-9 score of <5 as asymptomatic or fully depression free and scores >14 as fully symptomatic[254]. Depression-free days received a score of 1, fully symptomatic days received a score of 0, and linear interpolation was used to convert average scores between the upper and lower cut points into proportions between 0 and 1[242]. As done in previous studies, to determine the total number of DFDs over the study period, the scores for two consecutive assessments were averaged and multiplied by the average number of days between assessments; the values for all intervals were then totaled[247,255]. While the most accurate method of calculating DFDs would likely require daily assessment of depressive symptoms, daily measurement is expensive and has a high participant burden. However, studies have demonstrated that daily measurement is not necessary for accurate DFD estimation[241,242]. Further, given that SALSA assessment dates were administratively chosen, the seven CES-D assessments are a random sample of depressive symptoms throughout the study period. Thus, participants' depressive symptomology between assessments can be considered missing completely at random and is thereby unlikely to bias the study results[242].

**Section 3.6 Covariate Assessment**

Sociodemographic and cultural covariates were collected during the in-home interviews for SALSA participants and the phone interviews for NLDS participants. Given prior associations with mental health, the covariates that we assessed included: participants' age, sex, place of birth, location of education, and age at immigration. This allowed us to extensively

evaluate the potential for these covariates to influence any observed association between intergenerational and neighborhood sociocultural factors and depression. Age was measured in years; sex was reported as male or female; and nativity was reported as US-born or foreign-born, with the majority of foreign-born participants being of Mexican origin.

### Section 3.6.1 *Depression and cognitive function*

Cognitive function is of particular importance for elderly individuals, and there is a growing body of literature suggesting an association between cognitive function and depressive symptomology. However, the direction of this association is contested[256]. While the results from longitudinal studies examining the effect of depression on cognitive decline has been mixed[256–260], there does appear to be strong longitudinal support for an effect of cognitive function on depression[260,261]. Consequently, studies of depression among the elderly should adequately account for cognitive function.

Cognition measured in later life however, has been shown to be influenced by both education levels[262,263] and by language use[264]. Therefore, in our analysis, we considered cognitive function to be a mediator in the association between sociocultural factors and depressive symptoms and did not adjust for it in our final analysis.

## Section 3.7 Statistical Analyses

As a first step for all aims, directed acyclic graphs (DAG) were developed to assist our choice of control covariates[265]. Variables identified as potential confounders were adjusted for in analyses, and potential modifiers were included as interaction terms. We did not adjust for antidepressant use nor any potential mediators in our analyses due to the known methodological limitations of adjusting for variables that are a consequence of the outcome and variables that lie on the causal pathway[266,267]. Previous studies suggest that sociocultural differences between

parents and offspring may also influence parental mental health[268]. Consequently, we considered parental depressive symptoms to be a potential mediator between intergenerational sociocultural trajectories and offspring depression and did not adjust for it in the analyses. As an additional initial step, the distributions of participant demographic, socioeconomic, acculturation, and depressive characteristics by generation were summarized with descriptive and graphical analyses. All analyses were carried out in SAS 9.4 (SAS Institute, Inc., Cary, NC).

When examining CES-D score as a dichotomous outcome, we reported both prevalence difference and prevalence ratio estimates because absolute and relative measures may produce different conclusions[269]. Furthermore, we wanted to examine both the absolute public health impact of sociocultural factors on depressive symptoms and the relative inequalities in depressive symptoms[269]. Prevalence differences are more appropriate for demonstrating the public health impact of depression and better reflect the total population health burden of a health disparity[269]. However, examining the mechanisms underlying relative inequalities in depression can provide insights on novel and possibly reversible risk factors that could reduce mental health disparities[269]. Ratios are also the more commonly reported estimate in the existing literature examining sociocultural factors and depression; therefore, describing the associations in relative terms facilitated comparisons between the findings of our study and those of other studies.

### Section 3.7.1 *Aim 1a:* Examine whether changes in socioeconomic position over two generations of a Mexican-origin population are associated with depressive symptoms

To carry out Aim 1a we utilized SALSA participant data only (see section 3.4.1). To examine the association between intergenerational educational mobility and offspring depressive symptoms over the study period, we created an intergenerational educational mobility variable by classifying each participant into one of four educational mobility categories: (1) stable-low

(low parent and low participant education), (2) upwardly mobile (low parent and high participant education), (3) stable-high (high parent and high participant education), and (4) downwardly mobile (high parent and low participant education). As done in past studies examining the health effects of parental education, where SALSA participants reported the years of education of both parents, the educational attainment of the more highly-educated parent was utilized[97,197]. Figure 7 depicts the simplified DAG for this aim. Based on the confounding pathways identified by our DAG, the final models adjusted for age, sex, and offspring and parent nativity.

To quantify the association between intergenerational educational mobility and CES-D scores over the follow-up period, we fit a marginal model using generalized estimating equations with PROC GENMOD in SAS 9.4 to estimate the CES-D score differences between education mobility categories[270]. While our models did not include a main effect for time (see section 3.7.1.a), it is reasonable to assume that the seven within-individual CES-D scores were correlated over time. Consequently, we employed generalized estimating equations to correct standard error estimates and account for the correlation of repeated measurements collected from the same individual[270]. We specified an autoregressive correlation matrix because we believed that the correlation between two consecutive CES-D measurements would be greater than that between measurements occurring farther apart in time. As done in previous SALSA analyses, time was operationalized as visit number[191].

We replicated the above analysis utilizing dichotomous high depressive symptoms, defined as CES-D scores ≥16, as the outcome. We used log-binomial and linear-binomial models to estimate the prevalence ratios and prevalence differences, respectively, of high depressive symptoms, comparing levels of educational mobility[271]. As a final step, we examined the association between educational mobility and DFDs over the study period. We first transformed

DFDs into "percent of follow-up time spent depression free" to account for the differing follow-up periods between participants. We then utilized linear regression to estimate the difference in percent time spent depression free between educational mobility categories.

#### *3.7.1.a Time*

A recent review of longitudinal depression trajectories indicated that most elderly individuals have relatively stable depressive symptoms over time[272]. In US studies, the percent of participants belonging to categories characterized by stable depression ranged from 82-100%[272]. While the studies described in this review pertained largely to non-Hispanic populations[273–275], there is a growing body of Latent Class Analysis literature indicating that most elderly Latinos also belong in classes characterized by stable depressive symptoms over time[276,277]. Additionally, longitudinal studies suggest a negligible effect of time on depressive symptoms among elderly Latino populations[278,279]. For thoroughness, we also examined the impact of time on CES-D scores in our sample. These preliminary analyses indicated that CES-D scores remained largely stable over the follow-up period; thus, our final models did not include a main effect for time.

#### *3.7.1.b Multiple imputation*

From baseline to 2008, the average annual attrition rate in the SALSA study was 5%. Approximately half of this attrition was due to death (49.5%) and the other half was loss to follow up due to dropout. Restricting our analysis to complete cases would result in valid estimates only if this attrition occurred completely at random[280]. However, the assumption that missing data due to loss to follow up occurred completely at random is rarely met in longitudinal epidemiologic studies and therefore likely unrealistic for our study. Consequently, for Aim 1a we addressed the issue of missing data by utilizing the multiple imputation approach successfully implemented and described in detail by previous SALSA analyses[191,196,197]. To conduct the

imputation, a statistical team at the University of Michigan utilized a sequential regression multivariate imputation approach for the entire SALSA dataset using the Imputation and Variance Estimation Software. This approach conditioned on all data set variables as predictors in a sequence of multiple regressions[281,282]. The different imputations were run in a cyclic manner, overwriting previously drawn values and building interdependence between the imputed values. This multiple imputation approach utilized all available variables to improve statistical efficiency and to provide unbiased estimates compared to other analytical approaches such as complete-case analysis[282,283]. Five imputed data sets were produced for the SALSA study that included all study variables and were used for our analysis.

### Section 3.7.2 *Aim 1b:* Examine whether changes in acculturation over two generations of a Mexican-origin population are associated with depressive symptoms

For Aim 1b, we conducted separate analyses utilizing all three acculturation variables: the language use trajectory, the "overall" acculturation trajectory, and the "socialization" acculturation trajectory. Figure 8 depicts the simplified DAG for this aim, utilizing Spanish language use trajectory as the exposure. The DAGs utilizing "overall" and "socialization" acculturation trajectories as the exposures of interest are nearly identical, without offspring nativity as an additional potential confounder (as this is already captured by the acculturation variable). For all three analyses, we employed log-binomial models to estimate prevalence ratios (PR) and linear-binomial models to estimate prevalence differences (PD) of high depressive symptoms among offspring[271]. Given that one parent may be linked to multiple children, general estimating equations were used to account for within-family clustering[270].

We assessed all three trajectory variables as categorical variables, with stable-high Latino orientation and stable-high Spanish use utilized as referent categories (Table 3). Based on the

confounding pathways identified by our DAGs, we adjusted all final models for age, sex, and offspring education. The language use analysis further adjusted for offspring nativity.

We were also interested in potential modification of the association between each acculturation trajectory and depressive symptoms by offspring education. Past studies have either adjusted away possible socioeconomic effects[44] or ignored SEP entirely[43,105]. To determine if the association differed across educational levels, we examined effect estimates stratified by offspring education and the Wald test for an acculturation-education interaction term with a significance criterion of $P \leq 0.1$. Education level was dichotomized into ≤12 years and >12 years as done in similar populations and prior NLDS publications[104,205].

### Section 3.7.3 *Aim 2*: Examine whether neighborhood-level cultural segregation (Spanish language isolation and ethnic segregation) is associated with depressive symptoms in an older Mexican-origin population

To carry out Aim 2 we utilized SALSA participant data only (see section 3.4.3). Figure 9 depicts the simplified DAG for this aim. Based on the confounding pathways identified by our DAG, all final models adjusted for the individual factors of age, sex, nativity, and education, as these are potentially key confounders of the relationship between neighborhood cultural segregation and depressive symptoms.

To quantify the association between the two neighborhood-level segregation factors (Spanish language use ICE and Hispanic composition ICE) and CES-D scores, for each ICE variable separately we fit a two-level general linear mixed model with a random intercept for each census tract utilizing PROC MIXED in SAS 9.4 (SAS Institute, Inc., Cary, NC). The random intercept accounted for any residual within-tract correlation in outcomes. Level 1 represented within-neighborhood variation in CES-D scores, and level 2 represented between-neighborhood variation in CES-D scores due to neighborhood cultural segregation. As

previously stated (see section 3.4.3), the data structure of SALSA comprised 1,766 individuals (level 1) nested within 249 neighborhoods (level 2) within the 6 counties targeted by SALSA. We additionally calculated Intraclass Correlations (ICC) to examine the proportion of the total variance in CES-D scores that was accounted for by neighborhood clustering.

As noted in section 3.4.3, neither of the ICE variables had previously been examined in the SALSA data; consequently, we examined multiple functional forms of both variables in order to determine the most appropriate forms as they relate to depressive symptoms. The functional form choices included continuous linear (centered around the grand mean)[213–217], continuous quadratic (centered around the grand mean), quartiles[218], deciles[175], and dichotomization at the 60th percentile[213,219–222]. We compared Akaike Information Criterion (AIC) from each of these models and examined graphical analyses via Loess plots to determine the most appropriate functional form to employ for the final model. This functional form assessment indicated that the continuous, linear functional form was appropriate for both neighborhood variables.

#### *3.7.3.a Aim 2a: Assess whether individual-level language preference modifies the association between neighborhood language isolation and depressive symptoms*

As discussed in section 2.10.2, the associations between neighborhood cultural segregation and depressive symptoms may differ by individual-level cultural characteristics such as language preference[175]. We therefore performed a secondary analysis examining the cross-level interaction between individual-level language preference and neighborhood Spanish language isolation. To assess individual-level language use, SALSA participants indicated their primary language preference of either English or Spanish. Cross-tabulations of neighborhood Spanish language ICE quartiles and individual primary language indicated that we should have sufficient variability of individual language preference within neighborhoods to conduct the modification analysis (Table 4). To determine if the association between neighborhood language

isolation and depressive symptoms differed by individual language preference, we examined the Wald test for an interaction term between individual-level language use and neighborhood Spanish language ICE with a significance criterion of $P \leq 0.1$. We further examined effect estimates stratified by individual-level language use.

## Section 3.8 Tables

### Table 1. Baseline descriptive characteristics of the NLDS and SALSA populations

| Variables | NLDS total (N=670) | NLDS linked to a parent (N=638) | SALSA total (N=1786) | SALSA linked to an offspring (N=476) |
|---|---|---|---|---|
| Aim | | 1b | 1a, 2 | 1b |
| Age [Mean (SD)] | 52.8 (12.2) | 53.0 (11.8) | 70.6 (7.1) | 70.5 (6.9) |
| Male [n (%)] | 252 (37.6) | 244 (38.2) | 741 (41.7) | 192 (40.6) |
| Birth country [n (%)] | | | | |
| United States | 505 (75.4) | 482 (75.5) | 871 (49.0) | 225 (47.6) |
| Mexico | 146 (21.8) | 137 (21.5) | 809 (45.5) | 222 (46.9) |
| Other | 19 (2.8) | 19 (3.0) | 99 (5.6) | 26 (5.5) |
| Education years [n (%)] | | | | |
| <12 | 87 (13.4) | 82 (13.3) | 1260 (70.8) | 326 (68.9) |
| 12 | 152 (23.4) | 144 (23.3) | 225 (12.7) | 63 (13.3) |
| 13-16 | 331 (50.9) | 316 (51.1) | 227 (12.8) | 66 (14.0) |
| >16 | 80 (12.3) | 77 (12.4) | 67 (3.8) | 18 (3.8) |
| Educational mobility [n (%)] (Aim 1a exposure) | | | | |
| Stable-low | - | - | 745 (41.7) | - |
| Upwardly mobile | - | - | 228 (12.8) | - |
| Stable-high | - | - | 292 (16.4) | - |
| Downwardly mobile | - | - | 521 (29.2) | - |
| Language acculturation trajectory [n (%)] (Aim 1b exposure) | | | | |
| Stable-high Spanish use | - | 160 (25.4) | - | - |
| Decreased Spanish use | - | 30 (4.8) | - | - |
| Stable-low Spanish use | - | 192 (30.4) | - | - |
| Increased Spanish use | - | 224 (35.5) | - | - |
| Stable-equal English/Spanish | - | 25 (4.0) | - | - |
| Overall acculturation trajectory [n (%)] (Aim 1b exposure) | | | | |
| Stable-high Latino | - | 189 (29.6) | - | - |
| Increased US | - | 199 (31.2) | - | - |
| Stable-high US | - | 237 (37.2) | - | - |
| Increased Latino | - | 13 (2.0) | - | - |
| Socialization acculturation trajectory [n (%)] (Aim 1b exposure) | | | | |
| Stable-high Latino | - | 154 (241) | - | - |
| Increased US | - | 243 (38.1) | - | - |
| Stable-high US | - | 206 (32.3) | - | - |
| Increased Latino | - | 35 (5.5) | - | - |
| % Spanish language use [mean±SD, range] | - | - | 20.1 (11.5), 1.4-50.0 | - |
| % Hispanic [mean (SD), range] | - | - | 28.2 (13.2), 2.9-57.0 | - |
| Spanish language use ICE [mean (SD), range] (Aim 2 exposure) | - | - | 0.42 (0.23), -0.03-0.90 | - |
| Hispanic composition ICE [mean (SD), range] (Aim 2 exposure) | - | - | 0.16 (0.30), -0.32-0.85 | - |
| High depressive symptoms [n (%)] | 193 (29.2) | 178 (28.3) | 439 (25.5) | 114 (24.7) |

**Table 2. Effect estimates for high depressive symptoms in NLDS participants**

| Education mobility category | Prevalence Ratio (95%CI)[1] |
|---|---|
| Stable-low (n=170) | 1 (referent) |
| Upwardly mobile (n=209) | 0.55 (0.39, 0.78) |
| Stable-high (n=178) | 0.62 (0.44, 0.87) |
| Downwardly mobile (n=52) | 0.65 (0.38, 1.11) |

[1]Adjusted for age, sex, child nativity, parent nativity, and clustering at family level

**Table 3. Exposure Variable Summary**

| Variable | Functional Form | Aim | Data Source |
|---|---|---|---|
| Intergenerational educational mobility | Categorical:<br>Stable high<br>Upwardly mobile<br>Stable low<br>Downwardly mobile | 1a | SALSA |
| Language acculturation trajectory | Categorical:<br>Stable high Spanish use<br>Stable low Spanish use<br>Stable bilingual<br>Increased Spanish use<br>Decreased Spanish use | 1b | NLDS |
| Overall acculturation trajectory | Categorical:<br>Stable-high Latino<br>Increased US<br>Stable-high US<br>Increased Latino | 1b | SALSA and NLDS |
| Socialization acculturation trajectory | Categorical:<br>Stable-high Latino<br>Increased US<br>Stable-high US<br>Increased Latino | 1b | SALSA and NLDS |
| Spanish language use ICE | Continuous | 2 | SALSA and 2000 US Census |
| Hispanic composition ICE | Continuous | 2 | SALSA and 2000 US Census |

**Table 4. Quartiles of neighborhood Spanish use ICE by individual primary language among SALSA participants**

| N(%) | Individual primary language | | |
|---|---|---|---|
| Neighborhood Spanish use ICE | English | Spanish | Total |
| Quartile 1 (0.20) | 144 (19.3) | 293 (29.0) | 441 |
| Quartile 2 (0.40) | 152 (20.4) | 269 (26.6) | 425 |
| Quartile 3 (0.61) | 189 (25.4) | 265 (26.2) | 455 |
| Quartile 4 (>0.61) | 260 (34.9) | 184 (18.2) | 445 |
| Total | 745 | 1011 | 1756 |

## Section 3.9 Figures

**Figure 1. Dissertation aims and data sources**

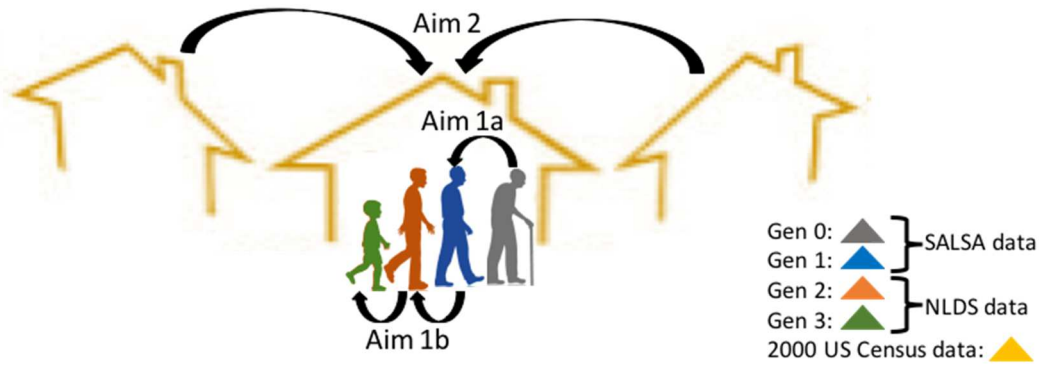


**Figure 2. Timeline and example familial structure in the SALSA and NLDS population**

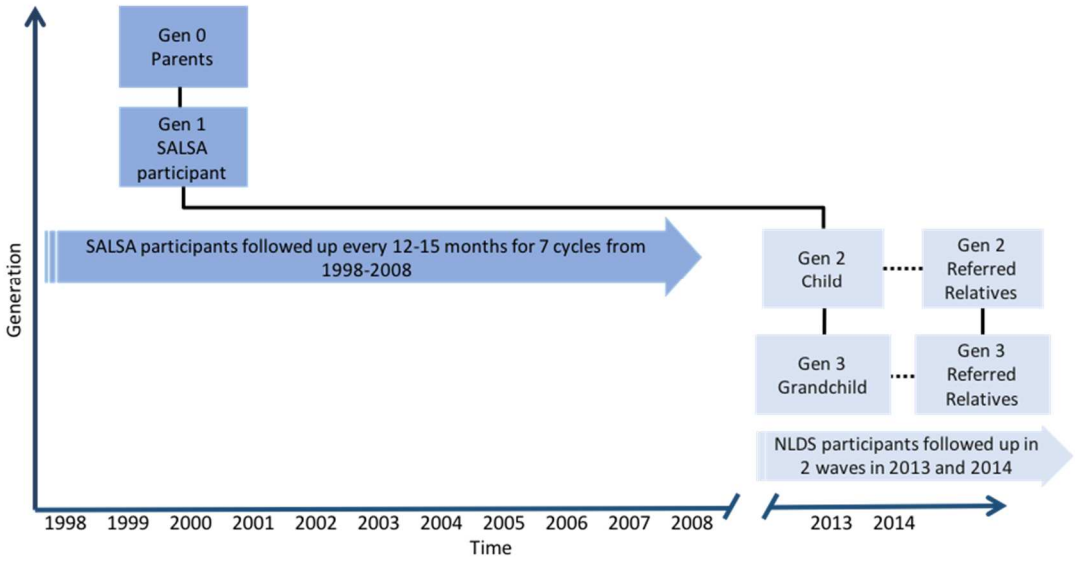


**Figure 3. Baseline geographic distribution of SALSA and NLDS participants**

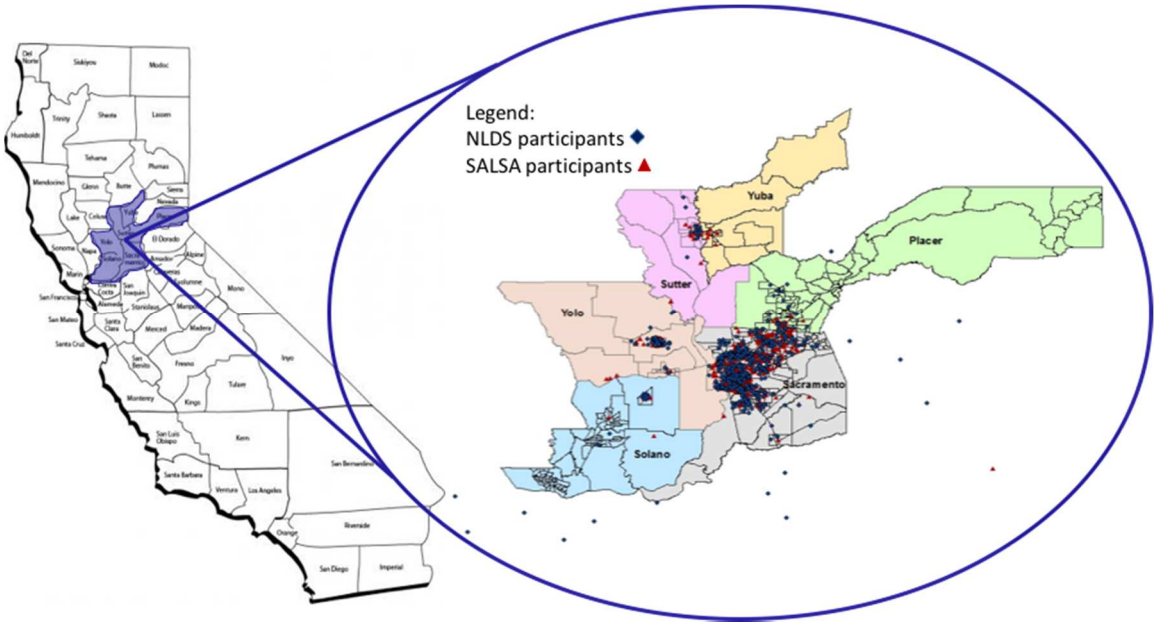


**Figure 4. Baseline geographical distribution of participants in the Sacramento Area Latino Study on Aging (1998-2008)**

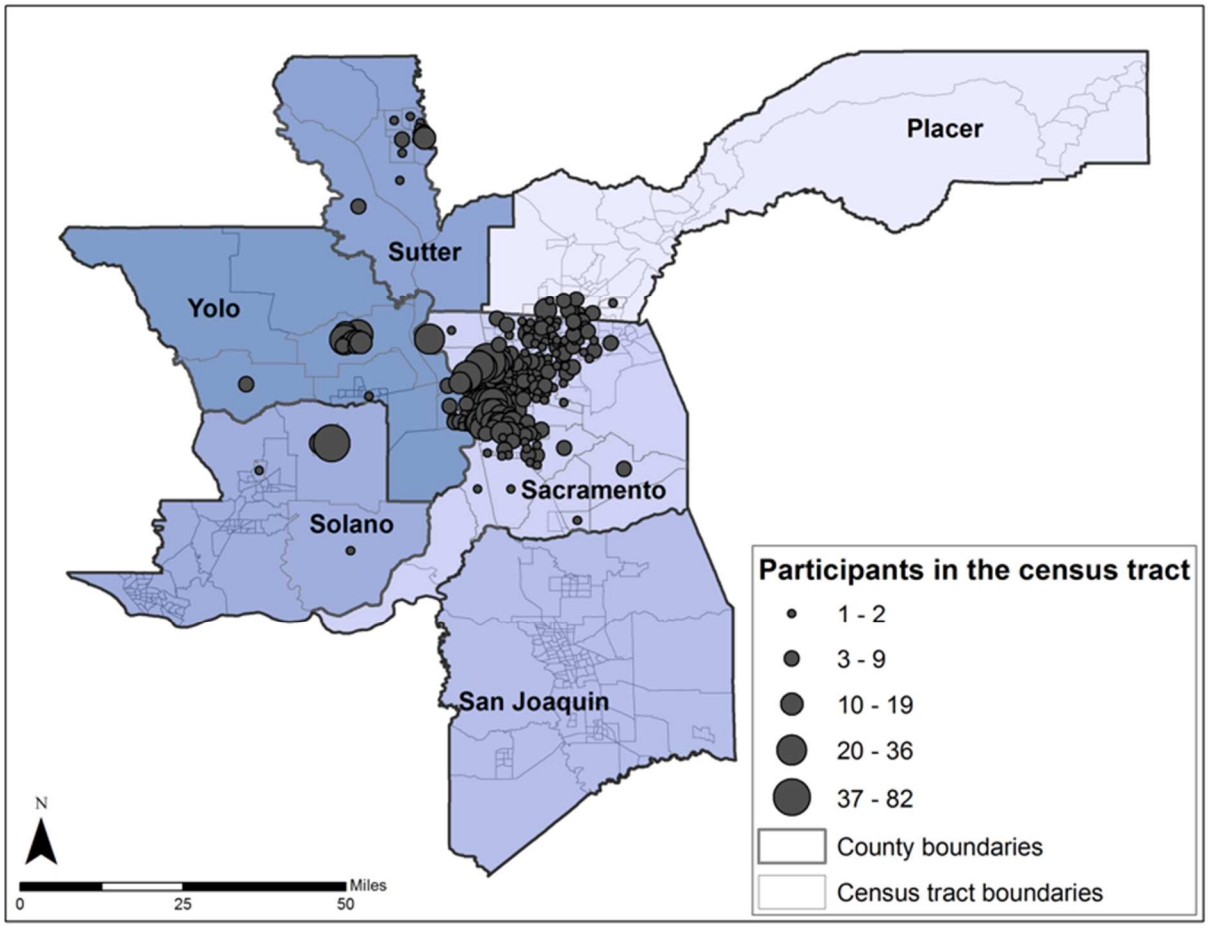


**Figure 5. Spanish language use by census tract in the Sacramento Area Latino Study on Aging (U.S. 2000 Census)**

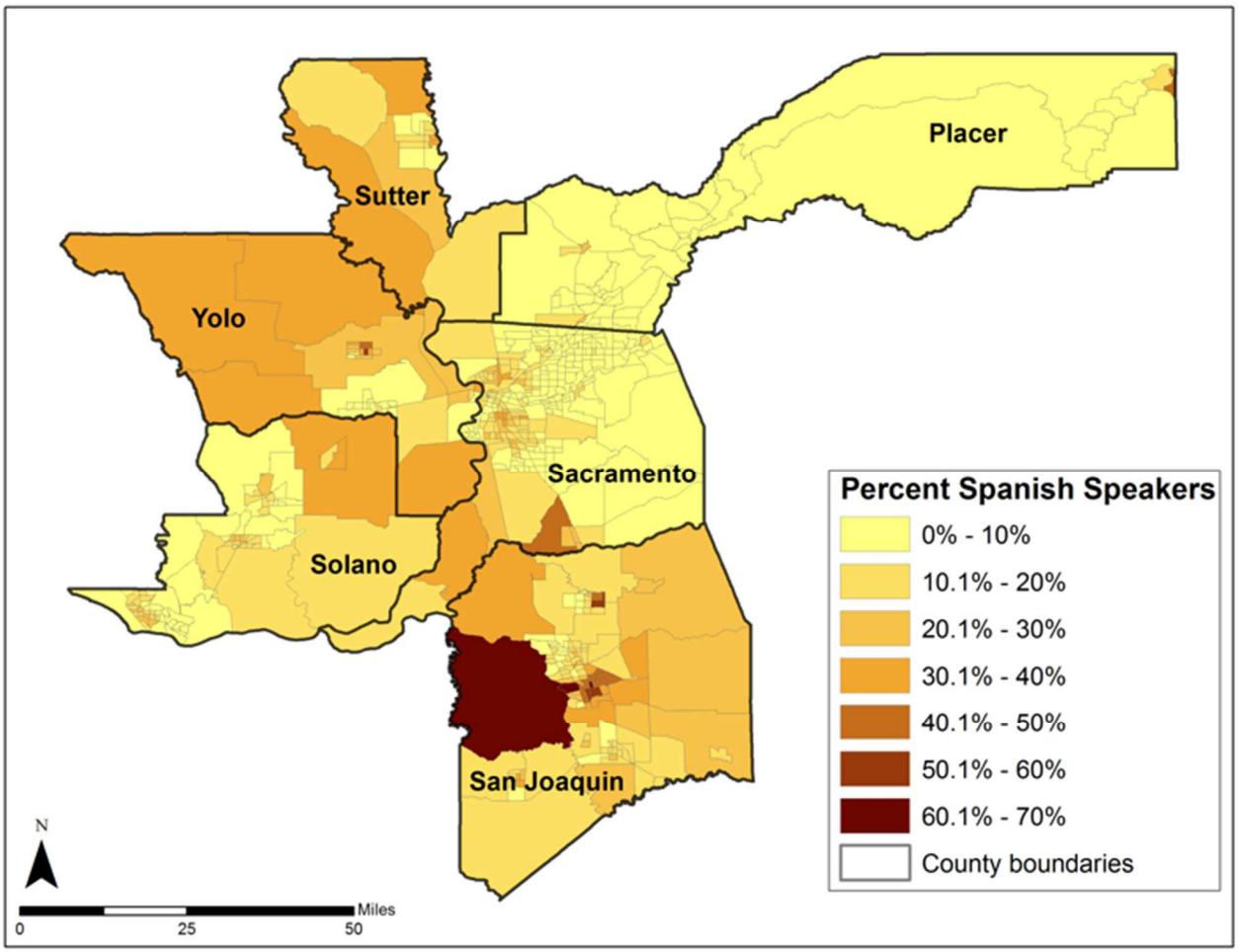


**Figure 6. Hispanic composition by census tract in the Sacramento Area Latino Study on Aging (U.S. 2000 Census)**

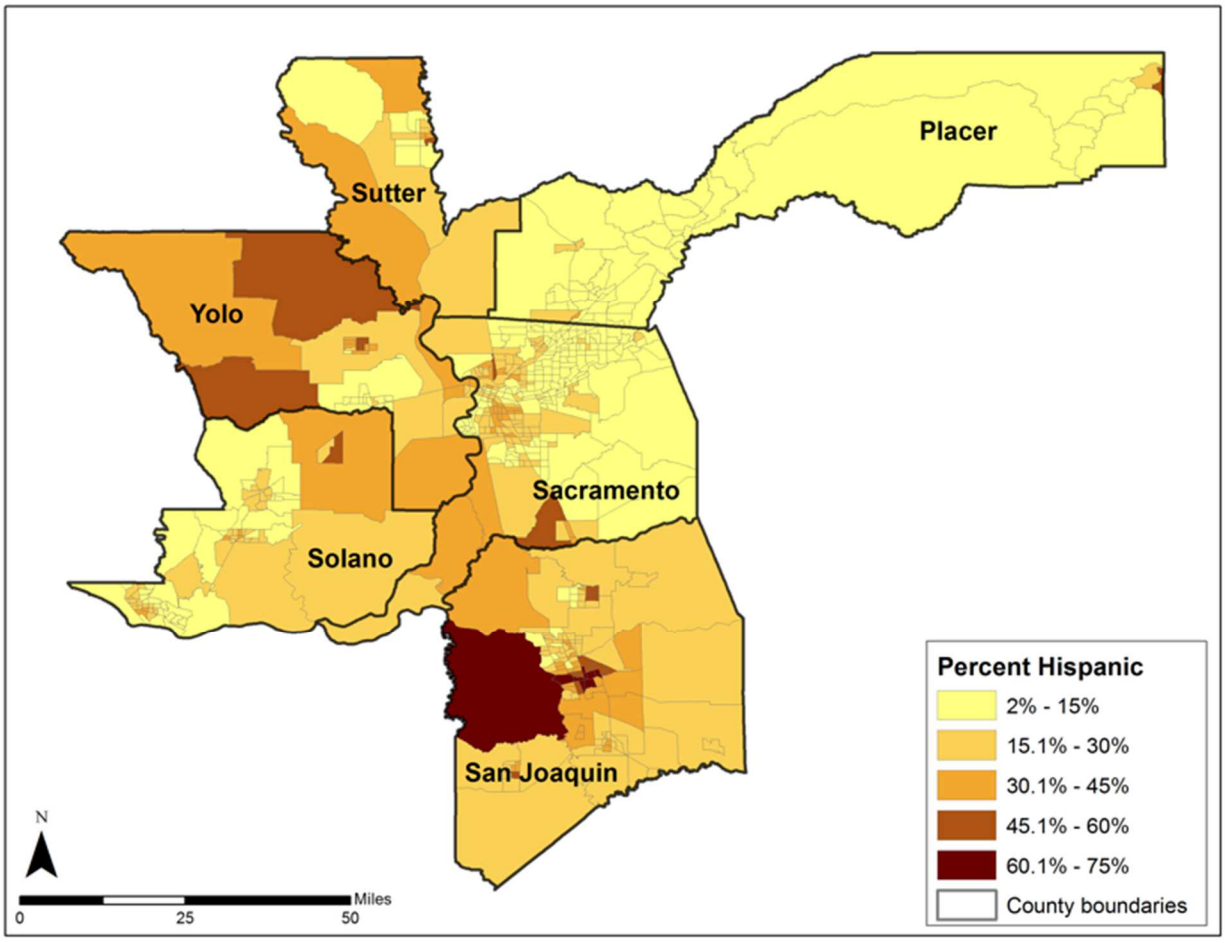


**Figure 7. Simplified DAG for effect of educational mobility on offspring depressive symptoms**

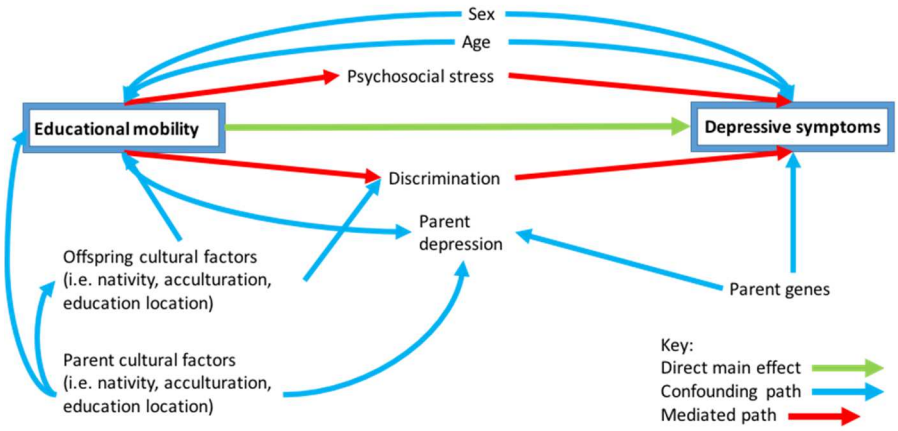


**Figure 8. Simplified DAG for effect of Spanish language use changes across generations on offspring depressive symptoms**

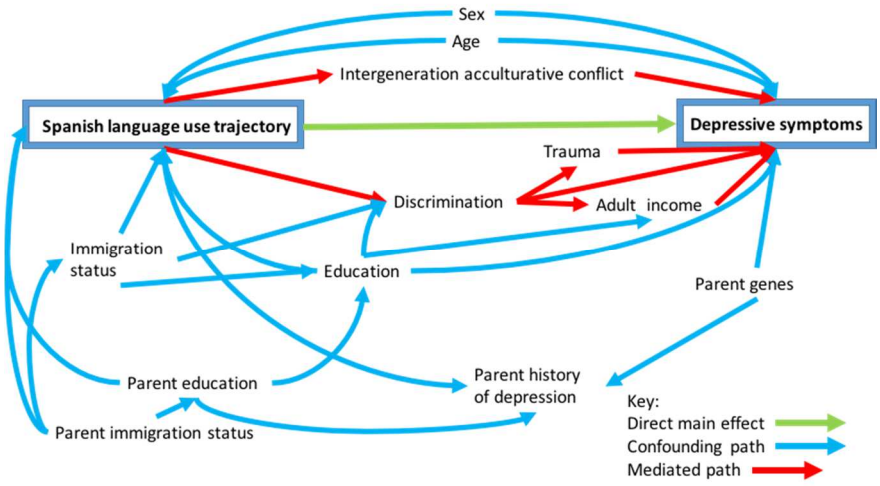
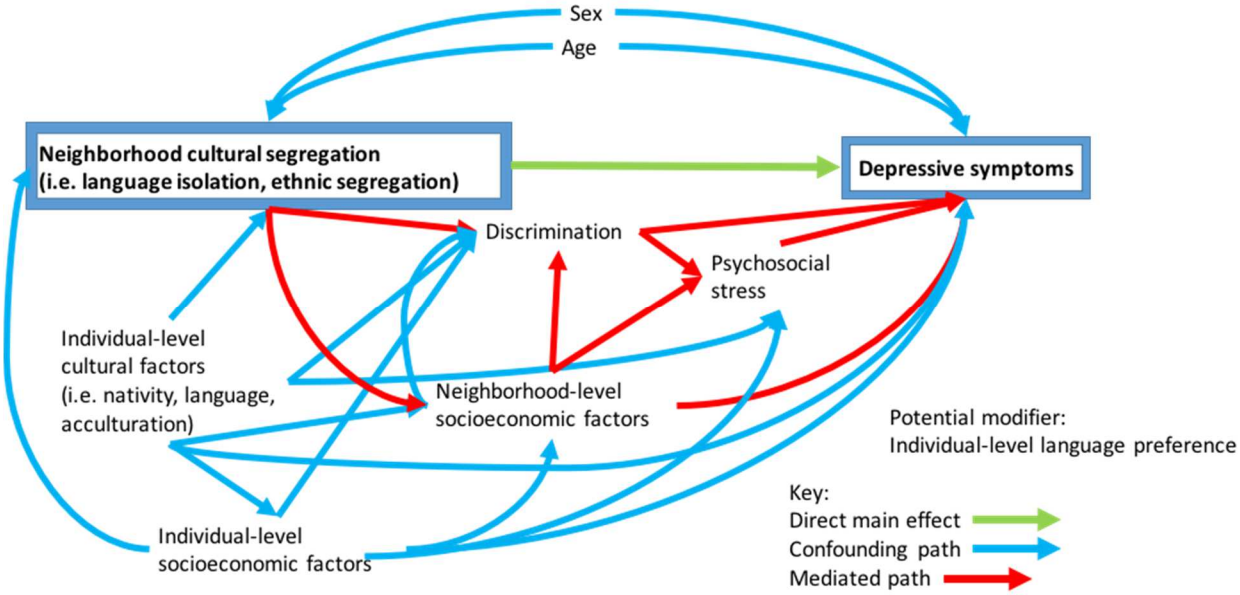


**Figure 9. Simplified DAG for effect of neighborhood cultural segregation on depressive symptoms**



# CHAPTER 4: EDUCATIONAL MOBILITY ACROSS GENERATIONS AND DEPRESSIVE SYMPTOMS OVER 10 YEARS AMONG US LATINOS

## Section 4.1 Introduction

Depression in late life is widespread and may worsen outcomes of other illnesses and increase suicide risk among the elderly[73]. In the United States (US), elderly Latinos in particular suffer a disproportionate burden of depression; indeed, elderly Latinos are up to twice as likely as elderly non-Latino Whites to suffer from elevated depressive symptoms[10–16,68,69].

Socioeconomic disadvantage has long been associated with increased depression prevalence[22,27,79,80]. Individuals of lower socioeconomic position (SEP) may lack access to the personal and financial resources that protect against depression[22,27]. Certain populations, however, such as the US Latino population, may be more highly exposed to these socioeconomic risk factors[33–35]. Latinos face immense socioeconomic disparities in the US, with lower overall educational attainment and high school graduation rates than those identifying as White, Black, or Asian[18]. Consequently, Latinos may be at greater risk of the adverse impacts of low educational attainment on long-term mental health.

The trajectory of educational attainment across multiple generations may affect health outcomes of future generations. Examination of poverty cycles across generations indicates that parental education impacts the educational attainment of offspring, especially among US Latinos[42,47]. Latinos are susceptible to intergenerational transmission of socioeconomic risk factors due to obstructed opportunities for upward social mobility across generations[48,49].

Socioeconomic disadvantage, both within and across generations, may influence depression by acting as a chronic stressor, disrupting components of the body's stress system that have been linked to mental health and depression specifically[52–54]. The propensity of these stressors to accumulate over generations among Latinos may lead to long-term sustained disruption of the stress system, resulting in poorer mental health. Additionally, elderly Latinos with low SEP may be especially vulnerable to depression given that stress induced by socioeconomic disadvantage may have accumulated both over multiple generations and also throughout the life course.

The socioeconomic measures used in most previous studies have lacked an intergenerational perspective. These previous studies examined the independent socioeconomic effect of one generation, either that of the parent[33,38] or the offspring[33–35], on offspring depression. These studies do not consider the interdependence of parental and offspring education when assessing offspring mental health. Thus, despite the potential importance of measures of socioeconomic mobility, such as educational mobility, across generations for Latino mental health, studies examining such effects among this population are virtually non-existent. Further, no prior research on this topic has collected longitudinal data to examine how socioeconomic factors impact depressive symptoms over time.

This study utilized data from the longitudinal Sacramento Area Latino Study on Aging (SALSA) to examine the association between educational mobility across two generations of Latinos and depressive symptoms over a 10-year period. We hypothesized that participants with stable-low educational attainment across two generations would have higher depressive symptom prevalence over a 10-year period, compared to those classified as stable-high, upwardly mobile, or downwardly mobile across generations.

## Section 4.2 Methods

Study population

Participants in this analysis were members of the SALSA cohort, which had seven waves of follow-up occurring 12-15 months apart from 1998 to 2008[190]. SALSA is a longitudinal study of 1,789 elderly Latinos, predominantly of Mexican origin. SALSA's study design has been described previously[32,190,191]. Briefly, eligible participants were self-identified Latinos aged 60+ years at baseline and residing in California's Sacramento Valley[32,190]. The sample was representative of older Latinos residing in the target area. During home visits, participants reported health conditions, lifestyle, and sociodemographic factors; trained bilingual interviewers collected clinical data. Informed consent was obtained from all participants, and study procedures were approved by institutional review boards at participating institutions.

Measures

*Depressive symptoms*

Depressive symptoms were measured by Center for Epidemiological Studies Depression Scale (CES-D) scores[224]. This scale was administered at baseline and each follow-up visit. The CES-D is a 20-item 4-point Likert-type scale assessing the extent to which individuals experienced depressive symptoms during the prior week[224]. This scale has been validated in Spanish-speaking populations[234–236] and utilized with older Latinos[229,230]. While not designed for clinical diagnoses, the CES-D is based on clinical depression symptoms and correlates well with other depression scales[224]. The total score ranges from 0-60 and was dichotomized using a standard cutoff of ≥16 to classify individuals with high depressive symptoms[224].

Depression-free days (DFD) were utilized as an additional outcome measure to create an aggregate assessment of depression-free time over the 10-year follow-up period. This valid,

clinically relevant depression measure integrates both occurrence and duration of time free of depressive symptoms[242]. DFDs reflect symptom change over time by estimating the time spent in various stages of depression remission and the cycling between remission and relapse that commonly occurs with depression[246].

To calculate DFDs, we converted CES-D scores into Patient Health Questionnaire-9 (PHQ-9) scores[252]. PHQ-9 scores are preferable for estimating DFDs because PHQ-9 cut points distinguish between fully symptomatic, partially symptomatic, and asymptomatic depressive states[253]. The PHQ-9 also maps directly onto the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, making it a more clinically relevant measure for depressive disorders[253]. We classified PHQ-9 scores <5 as asymptomatic and scores >14 as fully symptomatic[254]. Asymptomatic and fully symptomatic days received respective scores of 1 and 0, and linear interpolation was used to convert scores between the upper and lower cut points into proportions between 0 and 1[242]. To determine total DFDs over the study period, the scores for two consecutive assessments were averaged and multiplied by the average number of days between assessments; the values for all intervals were then totaled[247,255]. Finally, we transformed DFDs into "percent of follow-up time spent depression-free" to account for the differing follow-up periods between participants.

*Educational attainment across generations*

Intergenerational educational mobility was the exposure of interest. For parents of SALSA participants, "high" educational attainment was defined as completing ≥6 years of education (i.e., completed elementary school) and "low" as completing <6 years[197]. As done in prior literature, where SALSA participants reported education for both parents, the education of the more highly educated parent was utilized[97,197,198]. For SALSA participants, "high"

educational attainment was defined as completing ≥12 years (i.e., completed high school) and "low" as completing <12 years[197]. As done in previous SALSA studies, we utilized a lower education cut point for parents than participants to account for age- and location-related differences in educational norms between the two generations[197]. Finally, we classified participants into one of four educational mobility categories: (1) stable-low (low parent and low participant education), (2) upwardly mobile (low parent and high participant education), (3) stable-high (high parent and high participant education), and (4) downwardly mobile (high parent and low participant education).

*Time*

A recent review of longitudinal depression trajectories indicated that most elderly individuals have relatively stable depressive symptoms over time[272]. In US studies, 82-100% of elderly participants belonged to categories characterized by stable depression over periods ranging 8-20 years[272]. While the studies described in this review pertained largely to non-Hispanic populations[273–275], a growing body of Latent Class Analysis literature indicates that most elderly Latinos also belong in classes characterized by stable depressive symptoms over time[276,277]. Additionally, longitudinal studies suggest a negligible effect of time on depressive symptoms among elderly Latinos[278,279]. For thoroughness, we examined the impact of study time on CES-D scores in our sample. These preliminary analyses indicated that CES-D scores remained largely stable over follow-up (Figure 10); thus, our final models did not include a main effect for time.

Statistical analysis

Sociodemographic and depressive characteristics by generation were first summarized with descriptive and graphical analyses. We created and examined a directed acyclic graph to

identify potential confounders and adjusted our final models for baseline age, sex, and offspring and parent nativity (US-born or foreign-born). Nativity and location of education were highly correlated (r=0.9), and cross-tabulations of these variables revealed sparse data in several cells. For this reason, our final model included nativity and excluded location of education.

To quantify the association between intergenerational educational mobility and continuous CES-D scores over the follow-up period, we fit a marginal model using generalized estimating equations with PROC GENMOD in SAS 9.4 to estimate the CES-D score differences among the four education mobility categories[270]. We utilized stable-low education as the referent group. While our models did not include a main effect for time, we employed generalized estimating equations to account for the correlation of repeated CES-D measurements collected from the same individual and correct standard errors[270]. We specified an autoregressive correlation matrix because we believed that the correlation between two consecutive CES-D measurements would be greater than that between measurements occurring farther apart in time. As done in previous SALSA analyses, time was operationalized as visit number[191].

We replicated the above analysis utilizing dichotomous high depressive symptoms, defined as CES-D scores ≥16, as the outcome. We used log-binomial and linear-binomial models to estimate the prevalence ratios and prevalence differences, respectively, of high depressive symptoms, comparing levels of educational mobility[271]. As a final step, we examined the association between educational mobility and DFDs over the study period. We utilized linear regression to estimate the difference in percent time spent depression-free between educational mobility categories.

*Multiple Imputation*

The average annual attrition rate in the SALSA study was 5%. Approximately half of this

loss was due to death (49.5%) and the other half due to dropout. We addressed the issue of missing data due to dropout or response refusal through the multiple imputation approach described in detail by previous SALSA analyses[191,196,197]. A statistical team utilized a sequential regression multivariate imputation approach for the entire SALSA dataset using the Imputation and Variance Estimation Software. This approach conditioned on all dataset variables as predictors in a sequence of multiple regressions[281,282]. All available variables were utilized to improve statistical efficiency and to provide unbiased estimates compared to other analytical approaches such as complete-case analysis[282,283]. Five imputed datasets that included all study variables were produced for the SALSA study and used for our analysis.

Finally, we assessed potential survivor bias with a sensitivity analysis examining whether average CES-D scores changed over time due to attrition from mortality and if these changes differed by educational mobility category.

**Section 4.3 Results**

Table 5 displays participant and parent baseline characteristics. Participants had an average age of 70.6 years, and 58.5% were female. Additionally, 48.9% of participants were US-born compared to 15.0% of their parents. Participants were more highly educated than their parents; 70.9% of participants completed <12 years of education compared to 95.4% of their parents. In terms of intergenerational education, 41.7% of participants had stable-low educational mobility, 16.4% classified as stable-high, 12.8% were upwardly mobile, and 29.2% were downwardly mobile. The average baseline CES-D score was 10.0, and participants with baseline CES-D scores ≥16 comprised 24.8% of the sample.

Table 6 displays the beta estimates and 95% confidence intervals (CI) for the association between educational mobility and CES-D scores over the follow-up period. The crude model

includes only the educational mobility variable, and model 1 is age- and sex-adjusted. Model 2, our final model, further adjusts for parent and offspring nativity. Compared to SALSA participants with stable-low education, stable-high education and upward educational mobility were associated with lower CES-D scores (β=-2.75 and -2.18, respectively). Downwardly mobile participants had slightly lower CES-D scores compared to stable-low participants (β=-0.77), although the CI included the null. A sensitivity analysis examining modification by offspring nativity showed no evidence that the association varied by nativity status.

Tables 7 and 8 show prevalence ratios and differences, respectively, for high depressive symptoms (CES-D score ≥16) by educational mobility among SALSA participants over the follow-up period. These results demonstrated a similar pattern to those using continuous CES-D scores. In the fully-adjusted model, prevalence of high depressive symptoms was lower among those with stable-high education and the upwardly mobile than among those with stable-low education, with respective prevalence ratios of 0.66 and 0.68 and respective prevalence differences of -0.068 and -0.067. Downward mobility also appeared to protect against high depressive symptoms compared to stable-low education (prevalence ratio=0.89; prevalence difference=-0.023), but these CIs included the null.

Table 9 shows the differences in percent follow-up time spent free of depressive symptoms among educational mobility categories. In the fully-adjusted model, stable-high education was associated with a 5.10% (95% CI: 2.49, 7.70) increase in average depression-free time over the follow-up period compared to stable-low education. Upward mobility was similarly beneficial for depression-free time (β: 4.14; 95% CI: 1.13, 7.15) compared to stable-low education. Downwardly mobile participants also had a higher percentage of DFDs compared to stable-low participants (β: 1.80; 95% CI: -1.12, 7.15), although the CI included the null.

Regarding potential survivor bias, we found higher mortality among those with higher CES-D scores. These individuals disproportionately belonged to the stable-low and downwardly mobile categories, resulting in slight overall decreases in CES-D scores over time in these categories (Figure 10). The average baseline CES-D scores for those who died and those who remained alive were 11.6 and 9.5, respectively. Further, the 10-year mortality risk was >26% for the stable-low and downwardly mobile categories and <20% for the stable-high and upwardly mobile categories. Thus, two cells, the stable-low and downwardly mobile participants with high depressive symptoms, were more rapidly depleted than other cells. As a result, average CES-D scores of the stable-low and downwardly mobile categories decreased over time, causing the different educational mobility categories to look more similar over time.

**Section 4.4 Discussion**

This study assessed the impact of intergenerational educational mobility on depressive symptoms over a 10-year period among a sample of elderly Latinos, predominantly of Mexican origin. High depressive symptom prevalence, defined as CES-D scores ≥16, was 24.8% in our population; this is comparable to larger, representative samples of US Latino adults, where high depressive symptom prevalence has been shown to be 27%[11]. Our study supports an association between intergenerational educational mobility and depressive symptoms among elderly Mexican-origin individuals, whereby stable-high education and upward educational mobility were similarly protective against depressive symptoms. Additionally, high parental education appeared to somewhat counteract the adverse impact of low educational attainment in offspring.

Our findings add support to the extant literature demonstrating higher depression prevalence among those with low education[27,52], especially within Latino communities[33–35], while providing a novel intergenerational perspective. Socioeconomic factors may influence

Latino mental health through a number of mechanisms. Exposure to chronic stressors, such as socioeconomic disadvantage, can disrupt the body's biological stress system and affect mental health[81–83]. Stress exposure leads to hyperactivity of the amygdala and the hypothalamic-pituitary-adrenal axis and increases secretion of cortisol and corticotrophin-releasing hormone, all of which are components of the physiological stress system that have been individually associated with depression[53,82,84]. Further, low-SEP individuals may lack access to the social and economic resources that buffer the impacts of chronic stress on depression[22,27]. The Latino community may be especially vulnerable to the adverse mental-health influences of low SEP given that this population experiences lower overall educational attainment, high school graduation rates, and individual income than all other US racial/ethnic groups[18].

Recent immigrants comprise a large proportion of the Latino community[18]; thus, many Latinos may be raised in socioeconomic and cultural contexts that greatly differ from those of their parents and grandparents. Considering how these contexts change across generations is necessary in order to understand the pathways that shape mental health. Nevertheless, measures used in most previous studies have been limited to a single generation. To our knowledge, only one study has examined the association between intergenerational socioeconomic trajectories and depressive symptoms among a population of US Latinos. Consistent with our results, this study found that participants with stable-high education and upward mobility had fewer depressive symptoms than stable-low participants[198]. However, unlike our study, this study was limited by its cross-sectional nature and relatively small sample size.

Our study advances the results of previous single-generation studies by examining how the educational attainment of both the parent and offspring may interact to influence offspring depressive symptoms. In our analysis, the impact of parental education on depressive symptoms

appeared to depend upon offspring education, as indicated by our finding that stable-high education and upward mobility were similarly protective against depressive symptoms compared to stable-low educational attainment. Further, at every follow-up wave we observed fewer depressive symptoms among downwardly mobile participants compared to stable-low participants. While these findings were only marginally significant, they suggest that the negative impact of low offspring education may be somewhat offset by high parental education. Thus, the mental health effect of offspring education may depend on parental education. Our results therefore provide some support for the "accumulation of risk" hypothesis whereby multiple generations of low educational attainment cumulatively impact depression and any break in generational cycles of socioeconomic disadvantage may have benefit the mental health of subsequent generations[284–286].

An intergenerational framework provides novel insight into the importance and sustained power of inheritance of social stressors on mental health. Maternal psychosocial stress during pregnancy has been shown to alter offspring cortisol excretion and hypothalamic-pituitary-adrenal activity[92,93], both of which have been associated with depression[53,82,84]. Continued low-SEP exposure in subsequent generations may then result in persistent disruption of the body's physiological stress response and thereby impact depression[81–83]. Studies further show that accumulated strain from coping with daily life challenges while lacking adequate resources, over time, leads to more physiological damage than does a single dramatically stressful event[85]. Accordingly, downstream mental health effects may be particularly pronounced when the chronic stress associated with poor socioeconomic conditions has accumulated over multiple generations.

Our study had a number of strengths including use of intergenerational and longitudinal data collected from a population-based sample representative of Latinos residing in Sacramento, California. Our study was the first to examine educational mobility's impact on depressive symptoms over time in Mexican-origin individuals. We utilized trained bilingual interviewers and validated surveys to collect sociodemographic and depression data. Further, while most previous studies report odds ratios of socioeconomic effects, our study estimated prevalence ratios and differences of high depressive symptoms and absolute differences in CES-D scores. Given the high prevalence of depressive symptoms in our population, odds ratios could have greatly overstated the effect. Additionally, prevalence ratios and differences are more directly interpretable than odds ratios and allow for better estimation of public health burden[269]. Our study was also the first to employ DFDs in relation to educational mobility.

Our study also had limitations. Firstly, given the advanced baseline age of SALSA participants and the established literature documenting the association between depression and mortality[5,287–290], survivor bias may have impacted our results by influencing who survived to be eligible to participate in SALSA. However, sensitivity analyses indicated that selective attrition due to death caused the populations in the different educational mobility categories to look more similar over time, suggesting that educational mobility may actually have a larger impact than observed. Despite this limitation, we still detected sizeable differences in CES-D scores and depression-free time between educational mobility groups.

Secondly, study participants were predominantly elderly Mexican-origin individuals living in California's Sacramento Valley. Consequently, we cannot draw conclusions regarding depressive symptom prevalence among all US Latinos across all ages given that our findings may not apply to other Latino subpopulations or age groups. However, Mexican Americans are

the largest and fastest growing Latino subgroup in the US[18], and elderly Latinos carry an especially disproportionate burden of depression[69]; therefore, examining factors associated with depression in these groups holds particular importance.

Finally, education is a limited measure of SEP. SALSA did collect participant income data; however, income and education were highly correlated in our dataset. Moreover, education is often preferred since it predicts occupation and wages and is less influenced by age-related changes in these characteristics[79,206]. The elderly SALSA participants may be retired and therefore not have incomes representative of their earlier occupations. Further, use of educational attainment, a key measure of SEP, is consistent with other studies examining socioeconomic effects among Latino populations[197,205]. Nevertheless, our findings may be unique to educational mobility; education may impact depression through pathways that do not hold for other SEP measures, such as through its more direct influence on cognitive reserve and health or through stress related epigenetic alterations[262,263,291,292].

In conclusion, we observed a strong association between educational mobility and depressive symptoms among elderly Latinos, predominantly of Mexican origin. Our study suggests that parental and offspring educational attainment may have joint effects on mental health over and above the independent effect of either generation alone. Over the follow-up period, we consistently found the highest depressive symptoms among those with stable-low educational mobility, indicating that the health impacts of socioeconomic disadvantage may accumulate over time and impact subsequent generations. Our study contributes to a more comprehensive and contextual understanding of depression etiology and the dynamic socioeconomic pathways that shape Latino mental health. The accumulation of socioeconomic risk factors within Latino families has been influenced by years of discrimination, segregation,

exclusionary policies, and unequal allocation of resources. If our findings are causal, improving educational opportunities in under-resourced communities may counteract the adverse impacts of low parental education on the mental health of individuals residing in these communities and that of their future offspring. Future work should aim to identify the key social and environmental stressors and mediating biological pathways by which accumulation of low educational attainment may influence mental health among Latinos and other at-risk populations.

## Section 4.5 Tables

**Table 5. Baseline descriptive characteristics of the SALSA population overall and stratified by nativity, Sacramento, California, 1998-2008.[a]**

| | | Full Sample ($n$ = 1,786) | |
|---|---|---|---|
| | | Mean (SD) | % |
| Covariates | Age | 70.6 (7.1) | |
| | Female | | 58.5 |
| | Nativity | | |
| | US-born | | 48.9 |
| | Foreign-born | | 51.1 |
| | Parent nativity | | |
| | US-born | | 15.0 |
| | Foreign-born | | 85.1 |
| | Location of education | | |
| | United States | | 52.4 |
| | Mexico | | 45.6 |
| | Both/uncertain | | 2.0 |
| Socioeconomic Position | Education, years | 7.2 (5.3) | |
| | <12 | | 70.9 |
| | 12 | | 12.7 |
| | 13-16 | | 12.7 |
| | >16 | | 3.8 |
| | Parent education, years | 5.1 (4.4) | |
| | <6 | | 53.6 |
| | 6-12 | | 41.8 |
| | 13-16 | | 3.7 |
| | >16 | | 0.9 |
| | Intergenerational education mobility | | |
| | Stable-low | | 41.7 |
| | Upwardly mobile | | 12.8 |
| | Stable-high | | 16.4 |
| | Downwardly mobile | | 29.2 |
| Depression | CES-D score | 10.0 (10.5) | |
| | High depressive symptoms[b] | | 24.8 |
| | Percent time spent depression free[c] | | |

Abbreviations: CES-D, Center for Epidemiological Studies Depression Scale; SALSA, Sacramento Area Latino Study on Aging; SD, standard deviation; US, United States

[a] Conducted with imputed data to account for missingness

[b] Defined as CES-D score ≥16

[c] Created from the depression-free day measure

**Table 6. Estimates from generalized estimating equations predicting differences in CES-D scores over a 10-year period by educational mobility among SALSA participants, Sacramento, California, 1998-2008.[a]**

| | Crude[b] | | Model 1[c] | | Model 2[d] | |
|---|---|---|---|---|---|---|
| Education mobility category | β | 95% CI | β | 95% CI | β | 95% CI |
| Stable-low | 0 | Referent | 0 | Referent | 0 | Referent |
| Upwardly mobile | -2.73 | -3.39, -2.06 | -2.50 | -3.13, -1.87 | -2.18 | -2.81, -1.54 |
| Stable-high | -3.41 | -3.94, -2.87 | -3.06 | -3.60, -2.52 | -2.75 | -3.29, -2.20 |
| Downwardly mobile | -0.80 | -1.68, 0.07 | -0.80 | -1.64, 0.04 | -0.77 | -1.61, 0.06 |

Abbreviations: CES-D: Center for Epidemiological Studies Depression Scale; CI: Confidence Interval; SALSA: Sacramento Area Latino Study on Aging

[a] Accounting for missingness with multiple imputation.

[b] Crude model. Score statistic *P* value for education mobility was <0.0001.

[c] Adjusted for age and sex. Score statistic *P* value for education mobility was <0.0001.

[d] Adjusted for age, sex, child nativity, and parent nativity. Score statistic *P* value for education mobility was <0.0001.

**Table 7. Prevalence ratios from generalized estimating equations for high depressive symptoms over a 10-Year period by educational mobility among SALSA participants, Sacramento, California, 1998-2008.[a]**

| | Crude[b] | | Model 1[c] | | Model 2[d] | |
|---|---|---|---|---|---|---|
| Education mobility category | PR | 95% CI | PR | 95% CI | PR | 95% CI |
| Stable-low | 1 | Referent | 1 | Referent | 1 | Referent |
| Upwardly mobile | 0.61 | 0.50, 0.74 | 0.64 | 0.53, 0.77 | 0.68 | 0.56, 0.81 |
| Stable-high | 0.58 | 0.50, 0.67 | 0.62 | 0.54, 0.73 | 0.66 | 0.57, 0.77 |
| Downwardly mobile | 0.89 | 0.74, 1.06 | 0.89 | 0.75, 1.05 | 0.89 | 0.75, 1.06 |

Abbreviations: CI, confidence interval; PR, prevalence ratio; SALSA, Sacramento Area Latino Study on Aging

[a] Accounting for missingness with multiple imputation.

[b] Crude model. Score statistic *P* value for education mobility was <0.0001.

[c] Adjusted for age and sex. Score statistic *P* value for education mobility was <0.0001.

[d] Adjusted for age, sex, child nativity, and parent nativity. Score statistic *P* value for education mobility was <0.0001.

**Table 8. Prevalence differences from generalized estimating equations for high depressive symptoms over a 10-Year period by educational mobility among SALSA participants, Sacramento, California, 1998-2008.[a]**

| | Crude[b] | | Model 1[c] | | Model 2[d] | |
|---|---|---|---|---|---|---|
| Education mobility category | PD | 95% CI | PD | 95% CI | PD | 95% CI |
| Stable-low | 0 | Referent | 0 | Referent | 0 | Referent |
| Upwardly mobile | -0.089 | -0.121, -0.056 | -0.076 | -0.107, -0.046 | -0.067 | -0.097, -0.037 |
| Stable-high | -0.094 | -0.118, -0.071 | -0.076 | -0.102, -0.051 | -0.068 | -0.094, -0.042 |
| Downwardly mobile | -0.026 | -0.063, 0.012 | -0.025 | -0.062, 0.013 | -0.023 | -0.060, 0.014 |

Abbreviations: CI, confidence interval; PD, prevalence difference; SALSA, Sacramento Area Latino Study on Aging

[a] Accounting for missingness with multiple imputation.

[b] Crude model. Score statistic *P* value for education mobility was <0.0001.

[c] Adjusted for age and sex. Score statistic *P* value for education mobility was <0.0001.

[d] Adjusted for age, sex, child nativity, and parent nativity. Score statistic *P* value for education mobility was <0.0001.

**Table 9. Change in percent of follow-up time spent depression-free by educational mobility among SALSA participants, Sacramento, California, 1998-2008.[a]**

| | Crude[b] | | Model 1[c] | | Model 2[d] | |
|---|---|---|---|---|---|---|
| Education mobility category | β | 95% CI | β | 95% CI | β | 95% CI |
| Stable-low | 0 | Referent | 0 | Referent | 0 | Referent |
| Upwardly mobile | 5.25 | 2.35, 8.14 | 4.91 | 1.99, 7.84 | 4.14 | 1.13, 7.15 |
| Stable-high | 6.56 | 4.02, 9.11 | 5.82 | 3.31, 8.34 | 5.10 | 2.49, 7.70 |
| Downwardly mobile | 1.76 | -1.15, 4.67 | 1.77 | -1.15, 4.69 | 1.80 | -1.12, 7.15 |

Abbreviations: CI, confidence interval; SALSA, Sacramento Area Latino Study on Aging

[a] Accounting for missingness with multiple imputation.

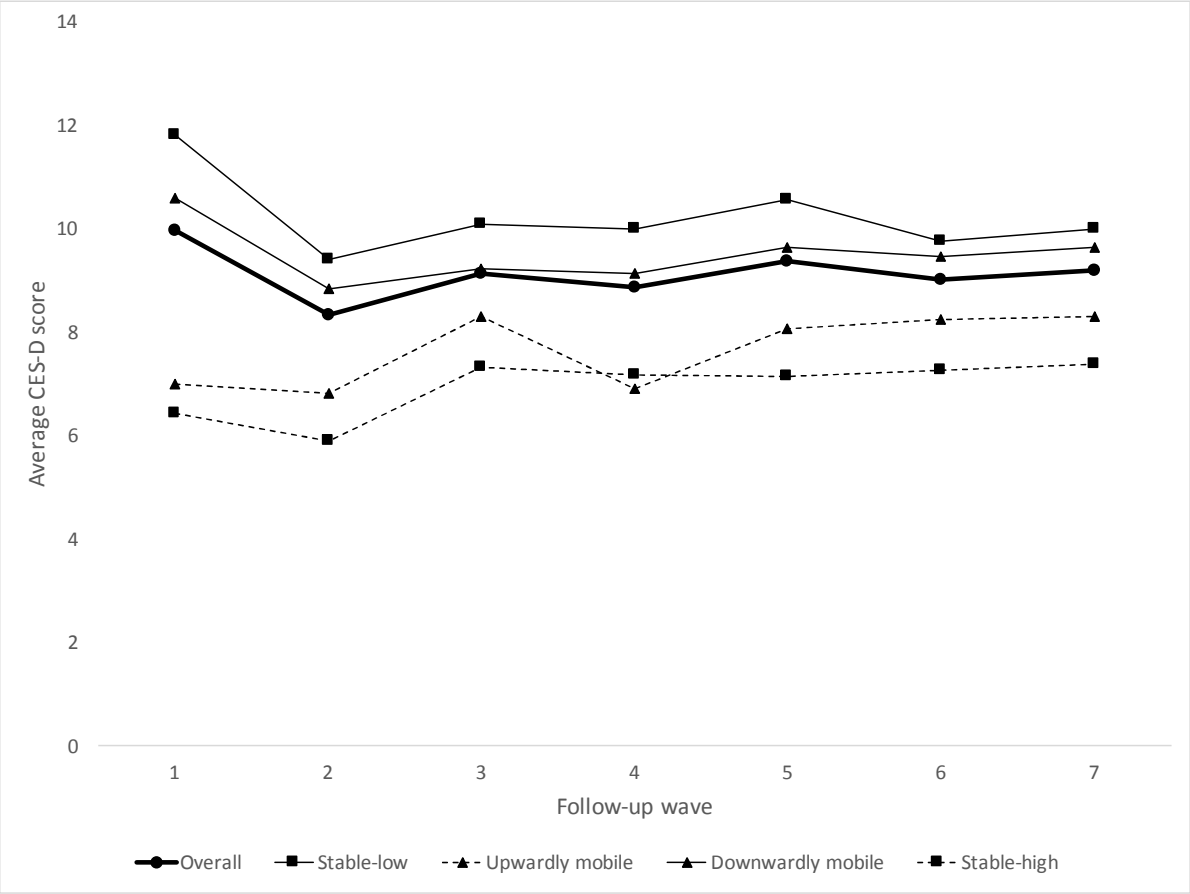
[b] Crude model. Likelihood ratio test *P* value for education mobility was <0.0001.

[c] Adjusted for age and sex. Likelihood ratio test *P* value for education mobility was <0.0001.

[d] Adjusted for age, sex, child nativity, and parent nativity. Likelihood ratio test *P* value for education mobility was <0.001.

## Section 4.6 Figures

**Figure 10. Average CES-D scores, overall and stratified by educational mobility category, over the follow-up period, Sacramento Area Latino Study on Aging, Sacramento, CA, 1998-2008.**



# CHAPTER 5: CULTURAL ORIENTATION ACROSS GENERATIONS AND DEPRESSIVE SYMPTOMS AMONG US LATINOS

## Section 5.1 Introduction

In the United States (US), the Latino community suffers a disproportionate burden of poor mental health outcomes, with Latinos often more likely to suffer from depression compared to non-Latino Whites[16,69]. Cultural behaviors and ethnic identity are particularly salient for Latino mental health[32,102]. Acculturation refers to the process by which attitudes and behaviors of individuals from one culture are altered or retained upon contact with a different culture[22,28,29]. Immigrants to the US may experience culture shock and isolation upon encountering the new environment, and this may lead to a sense of displacement, stress, and anxiety[100]. Therefore, this type of chronic stressor has the potential to greatly influence mental health among Latino immigrants and their offspring. In fact, qualitative studies indicate that many Latinos do not perceive depression as an illness, but rather as a result of the disruption caused by the immigration process and the hardships Latinos confront while trying to survive in the US[101].

Studies examining the association between an individual's degree of acculturation and depression have mixed results. Some studies indicate that orientation to the dominant culture is positively associated with depression[23,61,102], while others suggest that difficulty integrating into mainstream US culture and having a lower degree of acculturation predict higher depression prevalence[22,32].

These inconsistent results may have several explanations. First, acculturation is an inherently relational concept given its dependence upon contact with and interactions between multiple individuals from varying contexts[22,28,29]. Consequently, the effects of an individual's acculturation level should be examined in concert with the cultural orientation of that individual's family members. Indeed, theories related to the acculturative process suggest that acculturation conflict between individuals within families and changing degrees of acculturation over time actually drive the association between cultural orientation and mental health outcomes [43–45]. Several studies have found that familial conflict and changing structure of Latino families across generations are associated with emotional distress and other health risk behaviors[10,107,108]. Yet few acculturation studies have gathered intergenerational data to account for cultural changes between generations.

Secondly, prior studies have not measured acculturation consistently. Past work has often utilized proxy measures of acculturation, including birth country, generational status, immigration history, and time in the US[111]. These measures are limited in that they do not capture the multiple factors that comprise an individual's cultural orientation[111]. These prior studies are an initial step to establishing an understanding of the association between acculturation and mental health. However, the literature lacks studies utilizing and comparing multiple acculturation measures to more comprehensively assess the impact of the acculturative process along the key dimensions important for mental health.

Significant interdisciplinary support exists for the role of language use in mental health. For example, numerous studies have demonstrated the social-emotional and socio-cognitive advantages afforded bilingual individuals compared to monolingual English-speakers[120,149]. Additionally, language use may impact mental health through its influence on acquisition of

resources, creation of social ties, maintenance of familial values, and a sense of belonging to one's community[30,31]. Moreover, studies demonstrate that language use accounts for the majority of the variability in acculturation scales[116]. For these reasons, a focus on the cultural factor of language use may be appropriate when unpacking the effects of the acculturation construct on Latino mental health.

Finally, the existing acculturation and mental health literature is limited in that studies either adjust away possible socioeconomic effects[44] or ignore socioeconomic position entirely[43,105]. However, acculturation is undeniably linked with socioeconomic factors, such as educational attainment; and the impact of acculturation on Latino mental health may actually vary by educational level[103]. In general, higher education is associated with increased access to resources and social connections and thereby improved health[79]; however, in Latino immigrant communities, higher education's beneficial effects may have a complex relationship with the acculturative process, which may involve exposure to discrimination and other social stressors that negatively influence mental health[100]. In fact, our recent work suggests that the negative impact of perceived discrimination on Latino mental health may be stronger among the more highly educated[104]. Consequently, acculturation may have differential mental health impacts across levels of educational attainment.

To address the limitations of the existing literature, this study utilized data from multiple generations of Latinos participating in the Niños Lifestyle & Diabetes Study and the Sacramento Area Latino Study on Aging. These combined studies include 638 parent-offspring pairs, allowing us to examine the influence of multiple measures of acculturation across two generations of Latinos on offspring depressive symptoms. We further examined if offspring education modified these associations.

**Section 5.2 Methods**

Study population

Offspring participants in this analysis were members of the Niños Lifestyle & Diabetes Study (NLDS). The NLDS cohort comprises adult biological offspring, grandchildren, and other referred relatives of participants in the Sacramento Area Latino Study on Aging (SALSA), which took place from 1998 to 2008[190]. Any living English- or Spanish-speaking biological relatives of the original 1,789 SALSA participants aged 18+ years at baseline were eligible to participate in the NLDS. For the purposes of this study, we utilized participants from the NLDS who could be linked to a biological parent in either SALSA or NLDS.

This analysis utilized data collected by trained interviewers from the baseline NLDS phone interview (March-November 2013) and linked participants' data with baseline cultural, socioeconomic, and demographic data from their parents. Of the 670 NLDS participants contributing baseline phone interviews, 638 were linked to a SALSA or NLDS parent with acculturation data. Participants who did not report acculturation, education, age, sex, or nativity were excluded, leaving a total study sample of 603 offspring-parent pairs. Written or verbal informed consent was obtained from all participants, and study procedures were approved by institutional review boards at participating institutions.

NLDS participants had an average age of 53.0±11.8 years at baseline, and 38.2% were male. Additionally, 75.6% of NLDS participants were US-born compared to 52.2% of their parents. Similarly, 81.6% of participants completed their entire education in the US compared to 58.6% of their parents. Foreign-born participants were predominantly of Mexican origin (~88%). NLDS participants were more highly educated than their parents; 13.3% of participants

completed <12 years of education compared to 62.9% of their parents. NLDS participants with a CESD-10 score ≥10 comprised 28.3% of the sample.

Measures

*Assessment of high depressive symptoms*

The outcome of interest was Center for Epidemiological Studies Depression Scale-10 (CESD-10) scores among offspring. The CESD-10 is a 4-point Likert-type scale assessing the extent to which individuals experienced depressive symptoms during the prior week. The CESD-10 was derived from the 20-item CES-D, a widely-used self-report survey designed to measure depressive symptomology in the general population[224]. The shorter 10-item scale was developed to alleviate participant burden in older adults[225]. The CESD-10 corresponds closely to the full-length version and has high internal consistency and test-retest reliability[231,232]. Both the CES-D and CESD-10 have been validated in Spanish-speaking populations[233,236]. As suggested by CESD-10 validation studies, participants scoring ≥10 were considered to have high depressive symptoms[231,237].

*Intergenerational acculturation trajectory categories*

We created three intergenerational acculturation measures regarding: 1) Spanish language use, 2) "overall" US orientation combining the domains of language use, socialization, and communication, and 3) "socialization" US orientation regarding socialization and communication/media use.

We constructed the intergenerational Spanish language use variable utilizing two questions from the NLDS survey. Participants were asked, "When you were growing up, how often did your parents speak to you in Spanish?", and "In your current adult life, how often do you speak Spanish?", with five possible responses ranging from "never" to "always." We

collapsed the top two and bottom two categories to create three individual Spanish language use categories for each parent and each offspring of: (1) high Spanish use, (2) equal English/Spanish use, and (3) low Spanish use. Utilizing these parental and offspring categories, we created five mutually exclusive cross-generational language categories: (1) stable-high Spanish use, (2) stable-low Spanish use, (3) stable-equal English/Spanish, (4) increased Spanish use, and (5) decreased Spanish use.

To create the "overall" acculturation trajectory variable, we first assessed parent and offspring acculturation levels, separately. Both NLDS and SALSA employed versions of the Acculturation Rating Scale for Mexican-Americans II (ARSMA-II), an established measure of cultural orientation that assesses the acculturative process along multiple dimensions[112]. The ARSMA-II is widely used to assess the degree of cultural adaptation of Mexican Americans into mainstream US culture, and the scale's reliability and validity have been demonstrated among numerous Mexican-American populations[112,208]. The ARSMA-II asks subjects about language preference, Spanish/English media preference, food preparation, holidays celebrated, and associations in adulthood and childhood with people of Mexican or Latino and non-Hispanic White backgrounds. The ARSMA-II questions are grouped into the Anglo Orientation Subscale (AOS) and the Mexican Orientation Subscale (MOS), both of which have good internal reliabilities (Cronbach's Alpha=0.86 and 0.88 for the AOS and MOS, respectively)[112]. As recommended by Cuellar et al., the mean MOS was subtracted from the mean AOS to create an overall continuous acculturation score for each parent and offspring, with lower scores indicating higher Latino cultural orientation and a score of 0 indicating equal US- and Latino-orientation[112].

We defined high Latino orientation as an acculturation score $<0$ and high US orientation as a score $\geq 0$. If both parents of an NLDS participant participated in SALSA, the more highly

US-oriented parent was linked to the NLDS participant. We then created the "overall" cultural orientation trajectory variable, classifying each participant into one of four categories: (1) stable-high Latino orientation (Latino-oriented parent and offspring), (2) increased US orientation (Latino-oriented parent and US-oriented offspring), (3) stable-high US orientation (US-oriented parent and offspring), and (4) increased Latino orientation (US-oriented parent and Latino-oriented offspring).

We created the "socialization" acculturation trajectory variable in the same way as the "overall" acculturation trajectory, differing only in that the language specific questions were excluded when calculating the AOS and MOS. This variable allowed us to separate the acculturative influence of language from the other aspects of acculturation.

*Other covariates*

Nativity was based on self-report of birth country. Participants were classified as either US-born or foreign-born. Education level was dichotomized into ≤12 years and >12 years as done in similar populations and prior NLDS publications[104,205]. Other covariates utilized in this analysis included age and sex of the NLDS participant.

Statistical Analysis

We conducted separate analyses utilizing all three acculturation variables: the language use trajectory, the "overall" acculturation trajectory, and the "socialization" acculturation trajectory. For all three analyses, we employed log-binomial models to estimate prevalence ratios (PR) and linear-binomial models to estimate prevalence differences (PD) of high depressive symptoms among offspring[271]. We created and examined directed acyclic graphs to identify potential confounders and adjusted all final models for age, sex, and offspring education. The language use analysis further adjusted for offspring nativity. Stable-high Latino orientation and

stable-high Spanish were utilized as referent categories. Given that one parent may be linked to multiple children, general estimating equations were used to account for within-family clustering[270].

We were also interested in potential modification of the association between each acculturation trajectory and depressive symptoms by offspring education. To determine if the association differed across educational levels, we examined effect estimates stratified by offspring education and the Wald test for an acculturation-education interaction term with a significance criterion of $P \leq 0.1$. All analyses were conducted in SAS 9.4 (SAS Institute, Inc., Cary, NC).

**Section 5.3 Methods**

Table 10 displays selected offspring and parent characteristics of the sample overall and stratified by education level. Regarding language use, 52.4% of offspring reported using Spanish language at least half the time in their current adult life, and 66.1% reported that their parents spoke to them in Spanish at least half the time while they were growing up. In terms of Spanish language use changes across generations, 30.4% of offspring classified as having stable-low Spanish use across two generations, 25.4% had stable-high Spanish use, 4.8% had increased Spanish use, 35.5% had decreased Spanish use, and 4.0% had stable-equal English/Spanish use.

Regarding overall cultural orientation, 31.7% of offspring were classified as having high Latino orientation, compared to 60.6% of their parents. In terms of intergenerational changes in overall acculturation, 37.2% had stable-high US orientation, 29.6% had stable-high Latino orientation, 31.2% had increased US orientation, and 2.0% had increased Latino orientation. When the "overall" acculturation trajectory variable was reclassified to create the "socialization" trajectory variable by removing responses to language use questions, participants mostly shifted

out of stable-high US and stable-high Latino categories and into the increasing and decreasing US categories. The correlations between the two acculturation trajectory variables were relatively high ($r$=0.9), yet neither of the acculturation trajectories were highly correlated with the language trajectory variable ($r$=-0.1).

Stratification by offspring educational attainment indicated that, compared to those with >12 years of education, participants with ≤12 years of education were slightly older and more likely to be female. They were also more likely to be foreign-born and foreign-educated, speak Spanish at least half the time, have stable-high cross-generational Spanish use, have high Latino orientation, have stable-high Latino orientation across generations, and have CESD-10 scores ≥10.

Table 11 shows PRs and PDs for high depressive symptoms by intergenerational language use changes among NLDS participants. Model 1 adjusts for age, sex, and family-level clustering, and model 2 further adjusts for offspring nativity and education. Compared to participants with stable-high Spanish use, those with decreased Spanish use had 0.60 (95%CI: 0.42, 0.85) times the prevalence of high depressive symptoms. Notably, stable-low Spanish use did not appear to confer a clear mental health benefit compared to stable-high Spanish use (PR:0.87; 95%CI: 0.60, 1.27). Additionally, stable-equal English/Spanish use appeared to protect against high depressive symptoms (PR:0.60; 95%CI: 0.27, 1.36). However, this estimate lacked precision due to the small sample size ($n$=25, confidence limit ratio: 5.04). Prevalence difference estimates showed a similar pattern.

Table 12 shows PRs and PDs for high depressive symptoms by "overall" acculturation changes across generations among NLDS participants. Model 1 adjusts for age, sex, and family-level clustering, and model 2 further adjusts for offspring education. Overall, for both PR and PD

analyses, we did not find a strong association between "overall" acculturation trajectories and offspring depressive symptoms (respective PR and PD p-values=0.3 and 0.2). Upon adjustment for all potential confounders, the four acculturation trajectory categories did not appear to greatly differ in terms of high depressive symptoms. The results did suggest that those with increased US or increased Latino orientation were less likely to have high depressive symptoms than those with stable-high Latino orientation; however, these estimates were not statistically significant. Sensitivity analyses further adjusting for nativity produced similar results.

Table 13 shows PRs and PDs for high depressive symptoms by "socialization" acculturation changes (excluding language changes) across generations among NLDS participants. The effect estimates showed a similar pattern to those utilizing the "overall" acculturation variable (Table 3), however, the effects were slightly stronger. This was especially true for the PDs on the additive scale (p-value=0.07). The results suggested that those with both increased US orientation and stable-high US orientation were less likely to have high depressive symptoms than those with stable-high Latino orientation.

Given the close link between cultural orientation and educational attainment, we additionally tested for modification of all three acculturation analyses by offspring education. For all three analyses, stratification of the association by offspring educational attainment, dichotomized at >12 years, indicated that the association did not differ across education levels, and Wald tests on both the multiplicative and additive scales produced non-significant results for an interaction between education and the acculturation variables (see Tables 14-16). Of note, the modification analysis examining the interaction between education and "socialization" acculturation trajectories indicated that increased Latino orientation was protective against depressive symptoms among those with <12 years of education and harmful among the more

highly educated. However, the small sample size of the increased Latino orientation category led to imprecise estimates and this interaction did not reach statistical significance on either the multiplicative or additive scales (respective interaction p-values=0.4 and 0.6).

**Section 5.4 Discussion**

This study assessed the impact of intergenerational acculturation trajectories on depressive symptoms among a sample of Latino adults, predominantly of Mexican origin. Depressive symptoms were highly prevalent in our study population, with 28.3% of offspring having CESD-10 scores ≥10. This is comparable to larger, representative samples of US Latino adults, where high depressive symptom prevalence has been shown to be 27%[11]. Our study supports an association between intergenerational Spanish language use and depressive symptoms among Mexican-origin individuals, suggesting a beneficial effect of exposure to multiple languages across generations. Further, we found that the mixing of acculturation domains into a single "overall" acculturation trajectory variable led to non-significant associations. However, we did find that the association between "socialization" acculturation trajectories and depressive symptoms was marginally significant, whereby increased and stable-high US orientation across generations appeared beneficial for mental health. Finally, we did not find evidence of an acculturation-education interaction, suggesting that these associations were not modified by educational attainment in our study population.

Several single-generation studies have suggested improved mental health among those with high US orientation, although these studies lacked intergenerational data[22,32]. High US orientation may positively impact mental health through upward social mobility and the resulting increased access to resources. Individuals who are more oriented toward US culture may have educational and employment opportunities that allow for increased socioeconomic mobility or

improved access to social and medical resources[32]. Those who are highly Latino oriented may lack access to the social resources that allow them to effectively navigate the US educational system and job market; this could in turn result in exclusion from advancement opportunities, further socioeconomic hardship, and thereby increased susceptibility to poor mental health[32].

Regarding language use, our study found that exposure to both English and Spanish, through either stable-equal English/Spanish use or decreased Spanish use across generations, was protective against depression; although the estimate for stable-equal English/Spanish use did not reach statistical significance. In our study, decreased Spanish use across generations was characterized by high exposure to the Spanish language as a child and increased English language use as an adult. Therefore, both the stable-equal English/Spanish and decreased Spanish use categories comprised individuals who experienced exposure to both languages across generations. In fact, bilingual offspring likely comprised both the stable-equal English/Spanish and decreased Spanish use categories. Of the 224 participants classified as having decreased Spanish use, 117 reported speaking Spanish half the time and their parents speaking Spanish all/most of the time. Thus, while these individuals had decreased Spanish use across generations, they would likely consider themselves bilingual. Our findings are therefore consistent with several studies that have shown the socio-cognitive and socio-emotional benefits of exposure to multiple languages throughout the lifetime, although these previous studies lacked an intergenerational component[120,149,150].

Decreased Spanish usage across generations may also be capturing upward social mobility and an increased ability to access health-promoting resources. While our analysis did control for education level, this variable may not fully capture the socioeconomic benefit of English proficiency. Improved resource access due to increased English use may result in a

higher sense of self-efficacy and less psychological distress[32]. Further, to be classified as having decreased Spanish language use, participants had to report higher exposure to parental Spanish language use as a child. This early-life exposure to one's cultural heritage may foster maintenance of cultural and familial ties that benefit mental health despite an increased use of English over the life course. Early-life exposure to parental Spanish use may therefore prevent the cutting of ties with heritage-cultural support networks and consequently prevent a sense of displacement or lack of belonging during adulthood[23].

In our study, cross-generational monolingualism in either English or Spanish appeared to have equally adverse impacts on mental health. Spanish monolingualism may have deleterious impacts on mental health because English-language proficiency has been shown to increase access to health information as well as to mental health services[117,118]. Additionally, among Latinos, English-language barriers could promote social isolation due to the inability to interact directly with mainstream English-speaking US culture[293].

At the same time, for US Latinos, English monolingualism could adversely impact mental health because maintaining Spanish language proficiency throughout the acculturation process may foster familial connectedness across generations and promote other social and cultural connections[109]. Understanding and using one's primary language facilitates access to important cultural information that is connected with cultural identity, self-concept, and social-emotional development[120]. Consequently, preservation of one's primary language in addition to developing a second language supports the maintenance of cultural and familial ties while also enabling improved access to resources in the new cultural context[48].

The measures used in these previous studies have been limited to a single generation. To our knowledge, no existing studies examine acculturation or language changes across two

generations in relation to offspring depression among Mexican-origin populations. Our study advances the results of previous single-generation studies by examining how intergenerational cultural factors, collected directly from multiple generations of Mexican-origin individuals, interact to impact depressive symptoms in subsequent generations. Our finding that decreased Spanish use was more protective against depressive symptoms than stable-low Spanish use indicates that the effect of offspring language use on depressive symptoms depends upon parental language use. Additionally, our finding of lower prevalence of high depressive symptoms among those with decreased Spanish use compared to those with stable-high Spanish use suggests that the effect of parental language use on depressive symptoms also depends on offspring language use. Thus, our overall findings demonstrate for the first time in a Latino population that the joint effects of language use across multiple generations, rather than the independent effects of a single generation's language use, may play a key role in mental health.

An intergenerational perspective is especially important when examining the mental health impacts of cultural factors. An individual's language use and acculturation level depend upon contact and interactions between multiple individuals from varying contexts[22,28,29]. Given the relational nature of these concepts, the effects of an individual's language preference and acculturation level should be examined concurrently with the cultural orientation of that individual's family members. Several studies suggest that increased intra-familial conflict due to changing cultural orientation across generations may adversely impact mental health and other health risk behaviors[10,107,108]. However, our study findings indicate that exposure to multiple languages and acculturation levels across generations, even if this results in intergenerational differences, may actually benefit mental health.

The differing strengths of our three cultural analyses is also noteworthy. We found that the "socialization" acculturation trajectory variable (which excluded language use) and the "Spanish language use" trajectory variable were both more strongly associated with depressive symptoms than the "overall" acculturation trajectory variable. We additionally found moderately low correlations between the language use trajectory variable and both acculturation trajectory variables. These findings suggest that language use and other socialization questions, which are often combined to assess the construct of acculturation, may actually function independently to impact depressive symptoms. Consequently, the combination of these two dimensions into a single index may create a mixing of effects that masks the true effect of either dimension on mental health. The strength of our language use analysis is further supported by factor analyses indicating that language use accounts for the majority of the variance in acculturation scales[116,294,295]. The primary difference observed in our study between the language and acculturation trajectory findings was that stable-low Spanish use was not protective against depression whereas the socialization acculturation equivalent of this category (stable-high US orientation) did appear to have a stronger protective effect. These findings are consistent with the literature indicating the mental health benefits of exposure to multiple languages but also the beneficial effect of access to resources indicated by stable-high US orientation and integration into the dominant culture. In summary, our results draw into question the validity of scales that combine diverse aspects of cultural orientation into a single index and emphasize the need for future research examining the various components of acculturation and how they differentially impact health.

Our study had a number of strengths including data collected directly from multiple generations of a representative sample of Latino families living in California's Sacramento

Valley and the use of trained bilingual interviewers and validated surveys to collect depressive symptoms and acculturation data. Our study was the first to examine multiple cultural factors across generations in relation to depressive symptoms in Mexican-origin individuals. Additionally, while most previous studies report odds ratios of acculturative effects, our study estimated prevalence ratios and differences to assess the associations of interest. Given the high prevalence of depressive symptoms in our population, odds ratios would have greatly overstated the effect. Prevalence ratios and differences also allow for a more interpretable estimation of relative and absolute between-population differences and of public health burden[269].

Our study also had limitations. Use of cross-sectional data prevented determination of the temporal direction of the acculturation-depressive symptom association. Reverse causality may have influenced our results; depressed individuals may struggle integrating into a new cultural environment and learning a new language as a result of their mental status while non-depressed individuals may be more capable of cultural adaptation. The cross-sectional design also precluded examination of causal interrelations between education, language, and acculturation, variables that are undeniably linked. Further, we lacked the power due to small sample size to detect a significant association among stable-equal English/Spanish individuals despite our results suggesting a protective effect of this dual language use. Given the overlap of bilingual individuals in both the stable-equal English/Spanish and decreased Spanish use categories, we conducted two sensitivity analyses: (1) separating into their own category the 117 individuals who reported speaking Spanish half the time and their parents speaking Spanish all/most of the time, and (2) combining these individuals with the stable-equal English/Spanish participants. Both analyses produced results nearly identical to those with the original categorizations in terms of direction and magnitude of the effects; although in the latter analysis, the stable-equal

English/Spanish category became more significant due to its increased sample size (p-value=0.08).

Additionally, study participants were predominantly Mexican-origin individuals living in California's Sacramento Valley. Consequently, we cannot draw conclusions regarding depressive symptom prevalence among all US Latinos given that our findings may not apply to other Latino subpopulations. However, Mexican Americans are the largest and fastest growing Latino subgroup in the US[18]; therefore, examining factors associated with depression in this group holds particular importance.

Furthermore, the dichotomization of the parent and offspring acculturation scores may appear simplistic and incapable of capturing the true nature of the underlying constructs. However, sensitivity analyses utilizing a continuous acculturation difference score between parents and offspring indicated that those who differed more from their parents had lower levels of depression. These findings support the results of our dichotomized analyses where offspring with increased US orientation had the fewest depressive symptoms. Consequently, our sensitivity analyses supported dichotomization and suggested that our results were robust to different functional forms of the acculturation variables. Also of note, the acculturation variables captured only two generations, and these associations may continue to change, and even change direction altogether, over time.

Finally, our modification analysis utilized education as a proxy for socioeconomic position. This measure is limited, and future analysis could include additional variables such as income, occupation, and wealth. While the NDLS did collect data on participant income, income and education were highly correlated in our dataset. Education is often the preferred measure since it predicts future occupation and wages and is less influenced by age-related changes in

these characteristics[79,206]. Furthermore, the use of educational attainment is consistent with other studies examining socioeconomic effects among Latino populations[197,205].

Our findings support an association between cultural changes across generations and depressive symptoms among Mexican-origin adults. Our study suggests that exposure to multiple languages across generations and increased and stable-high US orientation across generations may have protective properties against depression. These findings point to the health importance of access to resources through successful interactions with the US culture and the additional protective function of maintaining ties to one's culture of origin. If the observed associations are causal, encouraging bilingualism and exposure to more than one language in both the school and home settings may have a beneficial impact on Latino mental health. Over the last two decades, several states have instituted English-only instruction policies in public schools, such as Massachusetts's Question 2 in 2002, Arizona's Proposition 203 in 2000, and California's Proposition 227 in 1998, requiring English immersion rather than bilingual instruction. Our findings indicate that such policies may have adverse consequences for the affected students. Our study further suggests that improving access to mental health services in linguistically and culturally isolated communities may improve identification of depression and ultimately lead to increased treatment among underdiagnosed Latino populations.

## Section 5.5 Tables

**Table 10. Descriptive characteristics of the Niños Lifestyle & Diabetes Study (2013-2014) population, overall and stratified by education level**

| Offspring variables | | | Education level | |
|---|---|---|---|---|
| | | Overall (N=638) | ≤12 years (N=226) | >12 years (N=393) |
| Covariates | Age, mean (SD) | 53.0 (11.8) | 54.3 (12.3) | 51.9 (11.4) |
| | Male, n (%) | 244 (38.2) | 78 (34.5) | 159 (40.5) |
| | Offspring birth country, n (%) | | | |
| | United States | 482 (75.6) | 148 (65.5) | 327 (83.2) |
| | Mexico | 137 (21.5) | 71 (31.4) | 54 (13.7) |
| | Other | 19 (3.0) | 7 (3.1) | 12 (3.1) |
| | Offspring location of education, n (%) | | | |
| | United States | 504 (81.6) | 154 (70.3) | 343 (87.5) |
| | Mexico | 56 (9.1) | 47 (21.5) | 9 (2.3) |
| | Both/uncertain | 58 (9.4) | 18 (8.2) | 40 (10.2) |
| | Offspring education (years), n (%) | | | |
| | <12 | 82 (13.3) | | |
| | 12 | 144 (23.3) | | |
| | 13-16 | 316 (51.1) | | |
| | >16 | 77 (12.4) | | |
| Acculturation | Cultural orientation, n (%) | | | |
| | High Latino orientation | 202 (31.7) | 101 (44.7) | 88 (22.4) |
| | High US orientation | 436 (68.3) | 125 (55.3) | 305 (77.6) |
| | Spanish use, n (%) | | | |
| | More than half the time | 178 (27.9) | 91 (40.3) | 75 (19.1) |
| | Half the time | 156 (24.5) | 46 (20.4) | 108 (27.5) |
| | Less than half the time | 304 (47.7) | 89 (39.4) | 210 (53.4) |
| | Parent Spanish use, n (%) | | | |
| | More than half the time | 338 (53.6) | 134 (59.6) | 191 (48.9) |
| | Half the time | 79 (12.5) | 26 (11.6) | 52 (13.3) |
| | Less than half the time | 214 (33.9) | 65 (28.9) | 148 (37.9) |
| | Intergenerational language trajectory, n (%)[a] | | | |
| | Stable-high Spanish | 160 (25.4) | 85 (37.8) | 64 (16.4) |
| | Decreased Spanish | 224 (35.5) | 63 (28.0) | 158 (40.4) |
| | Stable-low Spanish | 192 (30.4) | 58 (25.8) | 133 (34.0) |
| | Increased Spanish | 30 (4.8) | 10 (4.4) | 20 (5.1) |
| | Stable-equal English/Spanish | 25 (4.0) | 9 (4.0) | 16 (4.1) |
| | Overall acculturation trajectory (Including language variables), n (%)[a] | | | |
| | Stable-high Latino | 189 (29.6) | 94 (41.6) | 82 (20.9) |
| | Increased US | 199 (31.2) | 61 (27.0) | 135 (34.4) |
| | Stable-high US | 237 (37.2) | 64 (28.3) | 170 (43.3) |
| | Increased Latino | 13 (2.0) | 7 (3.1) | 6 (1.5) |
| | Socialization acculturation trajectory (Excluding language variables), n (%)[a] | | | |
| | Stable-high Latino | 154 (24.1) | 83 (36.7) | 60 (15.3) |
| | Increased US | 243 (38.1) | 76 (33.6) | 162 (41.2) |
| | Stable-high US | 206 (32.3) | 53 (23.5) | 150 (38.2) |
| | Increased Latino | 35 (5.5) | 14 (6.2) | 21 (5.3) |
| Depression | ≥10 CESD-10 score, n (%) | 178 (28.3) | 81 (36.7) | 90 (23.0) |

**Table 10 cont. Descriptive characteristics of the Niños Lifestyle & Diabetes Study (2013-2014) population, overall and stratified by education level**

| Parent variables | | Overall (N=415) | <12 years (N=259) | ≥12 years (N=153) |
|---|---|---|---|---|
| Covariates | Age, mean (SD) | 69.2±8.1 | 66.3±8.3 | 70.9±7.5 |
| | Parent birth country, n (%) | | | |
| | United States | 216 (52.2) | 96 (37.1) | 120 (78.4) |
| | Mexico | 177 (42.8) | 153 (59.1) | 22 (14.4) |
| | Other | 21 (5.1) | 10 (3.4) | 11 (7.2) |
| | Parent location of education, n (%) | | | |
| | United States | 232 (58.6) | 109 (44.3) | 123 (82.0) |
| | Mexico | 155 (39.1) | 136 (55.3) | 19 (12.7) |
| | Both/uncertain | 9 (2.3) | 1 (0.4) | 8 (5.3) |
| | Parent education (years), n (%) | | | |
| | <12 | 259 (62.9) | | |
| | 12 | 60 (14.6) | | |
| | 13-16 | 74 (18.0) | | |
| | >16 | 19 (4.6) | | |
| Acculturation | Cultural orientation, n (%) | | | |
| | High Latino orientation | 251 (60.6) | 198 (76.5) | 51 (33.3) |
| | High US orientation | 163 (39.4) | 61 (23.6) | 102 (66.7) |

[a] Mobility from Gen1 parents to Gen2 offspring or from Gen2 parents to Gen3 offspring

**Table 11. Prevalence ratios and differences for high depressive symptoms by language trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014)**

| | Prevalence Ratio (95% CI) | | | Prevalence Difference (95% CI) | | |
|---|---|---|---|---|---|---|
| Language use trajectory category[a] | Crude[b] | Model 1[c] | Model 2[d] | Crude | Model 1 | Model 2 |
| Stable-high Spanish | 1 | 1 | 1 | 0 | 0 | 0 |
| Decreased Spanish | 0.52 (0.38, 0.72) | 0.53 (0.39, 0.72) | 0.60 (0.42, 0.85) | -0.19 (-0.28, -0.10) | -0.19 (-0.28, -0.10) | -0.15 (-0.25, -0.05) |
| Stable-low Spanish | 0.72 (0.54, 0.97) | 0.73 (0.54, 0.99) | 0.87 (0.60, 1.27) | -0.11 (-0.21, -0.01) | -0.11 (-0.21, -0.01) | -0.06 (-0.18, 0.05) |
| Increased Spanish | 0.84 (0.49, 1.45) | 0.84 (0.47, 1.49) | 1.01 (0.56, 1.81) | -0.06 (-0.25, 0.12) | -0.06 (-0.25, 0.14) | -0.02 (-0.22, -0.17) |
| Stable-equal English/Spanish | 0.50 (0.23, 1.13) | 0.52 (0.24, 1.13) | 0.60 (0.27, 1.36) | -0.20 (-0.37, -0.02) | -0.20 (-0.35, -0.04) | -0.15 (-0.32, 0.02) |

[a] Stable-high Spanish (n=160), decreased Spanish (n=224), stable-low Spanish (n=192), increased Spanish (n=30), stable-equal English/Spanish (n=25)

[b] Overall PR p-value = 0.002, overall PD p-value = 0.002

[c] Adjusted for age, sex, and clustering at family level (overall PR p-value = 0.003, overall PD p-value = 0.002)

[d] Adjusted for age, sex, nativity, education, and clustering at family level (overall PR p-value = 0.03, overall PD p-value = 0.03)

**Table 12. Prevalence ratios and differences for high depressive symptoms by overall acculturation trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014)**

| Overall acculturation trajectory category[a] | Prevalence Ratio (95% CI) | | | Prevalence Difference (95% CI) | | |
|---|---|---|---|---|---|---|
| | Crude[b] | Model 1[c] | Model 2[d] | Crude | Model 1 | Model 2 |
| Stable-high Latino | 1 | 1 | 1 | 0 | 0 | 0 |
| Increased US | 0.67 (0.48, 0.92) | 0.69 (0.50, 0.95) | 0.72 (0.52, 1.01) | -0.12 (-0.21, -0.03) | -0.10 (-0.19, -0.01) | -0.10 (-0.19, 0.00) |
| Stable-high US | 0.78 (0.59, 1.04) | 0.81 (0.61, 1.09) | 0.89 (0.66, 1.22) | -0.08 (-0.16, 0.01) | -0.06 (-0.15, 0.02) | -0.04 (-0.13, 0.06) |
| Increased Latino | 0.66 (0.24, 1.82) | 0.67 (0.22, 2.05) | 0.61 (0.18, 2.08) | -0.12 (-0.36, 0.12) | -0.11 (-0.37, 0.15) | -0.12 (-0.37, 0.13) |

[a] Stable high Latino (n=189), stable high US (n=237), increased US (n=199), increased Latino (n=13)

[b] Overall PR p-value = 0.09, overall PD p-value = 0.09

[c] Adjusted for age, sex, and clustering at family level (overall PR p-value = 0.2, overall PD p-value = 0.2)

[d] Adjusted for age, sex, education, and clustering at family level (overall PR p-value = 0.3, overall PD p-value = 0.2)

**Table 13. Prevalence ratios and differences for high depressive symptoms by socialization acculturation trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014)**

| Socialization acculturation trajectory category[a] | Prevalence Ratio (95% CI) | | | Prevalence Difference (95% CI) | | |
|---|---|---|---|---|---|---|
| | Crude[b] | Model 1[c] | Model 2[d] | Crude | Model 1 | Model 2 |
| Stable-high Latino | 1 | 1 | 1 | 0 | 0 | 0 |
| Increased US | 0.66 (0.49, 0.90) | 0.66 (0.49, 0.91) | 0.69 (0.49, 0.96) | -0.12 (-0.22, -0.03) | -0.12 (-0.21, -0.03) | -0.12 (-0.22, -0.01) |
| Stable-high US | 0.68 (0.49, 0.93) | 0.69 (0.50, 0.96) | 0.76 (0.54, 1.07) | -0.12 (-0.22, -0.02) | -0.11 (-0.21, -0.01) | -0.08 (-0.19, 0.02) |
| Increased Latino | 1.09 (0.69, 1.72) | 1.10 (0.68, 1.77) | 1.10 (0.65, 1.86) | 0.03 (-0.15, 0.21) | 0.04 (-0.15, 0.22) | 0.05 (-0.15, 0.24) |

[a] Stable-high Latino (n=154), stable-high US (n=206), increased US (n=243), increased Latino (n=35)

[b] Overall PR p-value = 0.02, overall PD p-value = 0.02

[c] Adjusted for age, sex, and clustering at family level (overall PR p-value = 0.03, overall PD p-value = 0.03)

[d] Adjusted for age, sex, education, and clustering at family level (overall PR p-value = 0.1, overall PD p-value = 0.07)

**Table 14. Prevalence ratios (PR) and differences (PD) for high depressive symptoms by language trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014), stratified by education level**

| | Model 3[b] PR (95% CI) | | Model 3 PD (95% CI) | |
|---|---|---|---|---|
| Language trajectory category[a] | >12 years education[c] | ≤12 years education[d] | >12 years education | ≤12 years education |
| Stable-high Spanish | 1 | 1 | 0 | 0 |
| Decreased Spanish | 0.60 (0.36, 1.00) | 0.61 (0.37, 1.02) | -0.12 (-0.25, 0.01) | -0.19 (-0.35, -0.04) |
| Stable-low Spanish | 0.93 (0.56, 1.54) | 0.80 (0.48, 1.34) | -0.03 (-0.17, 0.12) | -0.13 (-0.30, 0.05) |
| Increased Spanish | 0.85 (0.37, 1.98) | 1.21 (0.59, 2.46) | -0.04 (-0.27, 0.18) | 0.05 (-0.29, 0.39) |
| Stable-equal English/Spanish | 0.63 (0.21, 1.91) | 0.57 (0.17, 1.95) | -0.10 (-0.32, 0.11) | -0.23 (-0.50, 0.04) |

[a] PR interaction p-value = 0.9, PD interaction p-value = 0.8

[b] Adjusted for age, sex, nativity, and clustering at family level. Stratified by education level of NLDS participants.

[c] Stable-high Spanish (n=64), decreased Spanish (n=158), stable-low Spanish (n=133), increased Spanish (n=20), stable-equal English/Spanish (n=16)

[d] Stable-high Spanish (n=85), decreased Spanish (n=63), stable-low Spanish (n=58), increased Spanish (n=10), stable-equal English/Spanish (n=9)

**Table 15. Prevalence ratios (PR) and differences (PD) for high depressive symptoms by overall acculturation trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014), stratified by education level**

| Overall acculturation trajectory category[a] | Model 3[b] PR (95% CI) | | Model 3 PD (95% CI) | |
|---|---|---|---|---|
| | >12 years education[c] | ≤12 years education[d] | >12 years education | ≤12 years education |
| Stable-high Latino | 1 | 1 | 0 | 0 |
| Increased US | 0.60 (0.35, 1.02) | 0.87 (0.58, 1.31) | -0.11 (-0.23, 0.01) | -0.05 (-0.20, 0.10) |
| Stable-high US | 0.90 (0.58, 1.39) | 0.85 (0.54, 1.33) | -0.03 (-0.15, 0.09) | -0.06 (-0.22, 0.10) |
| Increased Latino | 0.56 (0.08, 4.16) | 0.64 (0.15, 2.67) | -0.12 (-0.42, 0.18) | -0.13 (-0.53, 0.27) |

[a] PR interaction p-value = 0.6, PD interaction p-value = 0.8

[b] Adjusted for age, sex, and clustering at family level. Stratified by education level of NLDS participants.

[c] Stable-high Latino (n=82), stable-high US (n=170), increased US (n=135), increased Latino (n=6)

[d] Stable-high Latino (n=94), stable-high US (n=64), increased US (n=61), increased Latino (n=7)

**Table 16. Prevalence ratios (PR) and differences (PD) for high depressive symptoms by socialization acculturation trajectory category among participants in the Niños Lifestyle & Diabetes Study (2013-2014), stratified by education level**

| Socialization acculturation trajectory category[a] | Model 3[b] PR (95% CI) | | Model 3 PD (95% CI) | |
|---|---|---|---|---|
| | >12 years education[c] | ≤12 years education[d] | >12 years education | ≤12 years education |
| Stable-high Latino | 1 | 1 | 0 | 0 |
| Increased US | 0.60 (0.34, 1.04) | 0.80 (0.55, 1.16) | -0.12 (-0.27, 0.02) | -0.08 (-0.22, 0.06) |
| Stable-high US | 0.76 (0.46, 1.26) | 0.74 (0.46, 1.21) | -0.08 (-0.22, 0.06) | -0.10 (-0.27, 0.07) |
| Increased Latino | 1.42 (0.77, 2.59) | 0.82 (0.36, 1.86) | 0.12 (-0.11, 0.34) | -0.07 (-0.36, 0.22) |

[a] PR interaction p-value = 0.4, PD interaction p-value = 0.6

[b] Adjusted for age, sex, and clustering at family level. Stratified by education level of NLDS participants.

[c] Stable-high Latino (n=60), stable-high US (n=150), increased US (n=162), increased Latino (n=21)

[d] Stable-high Latino (n=83), stable-high US (n=53), increased US (n=76), increased Latino (n=14)

# CHAPTER 6: NEIGHBORHOOD LANGUAGE ISOLATION, ETHNIC SEGREGATION, AND DEPRESSIVE SYMPTOMS AMONG US LATINOS

## Section 6.1 Introduction

Depression in late life is highly prevalent and may worsen outcomes of other illnesses and increase suicide risk among the elderly[73]. Older Latinos in particular have been found to be under-diagnosed and under-treated for depression[78]. Yet even without adjusting for this under-diagnosis, studies across the United States (US) suggest that older Latinos report the highest levels of depression compared to other populations[69].

Neighborhood characteristics may play an important role for the mental health of elderly US Latinos. Older individuals tend to spend more time at home and in the immediate outdoor environment than younger people[157] and have been shown to derive a strong sense of emotional attachment from their home and the surrounding community[158]. Neighborhood-level segregation may be an important lens through which to examine the impact of neighborhood characteristics on the mental health of historically marginalized populations, such as US Latinos. Over the last ten years, residential segregation of Latinos has increased in the US, with Latinos often residing in ethnic enclaves[51]. However, the majority of 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 health as a result of the fact that the existence of such ethnically homogenous (i.e. segregated) neighborhoods reflects structural discrimination that constrains where an individual can reside and reinforces racial hierarchy and

white privilege[164]. Institutional racism, which often results in highly segregated neighborhoods, can influence health by placing racial and ethnic minorities in impoverished neighborhoods with little potential for socioeconomic mobility across the life course and lead to the psychosocial distress and trauma that influence mental health[167,168].

The mechanisms driving segregation may differ for Hispanic communities compared to Black communities, however, and may therefore impact health differently. Hispanic residential 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[296]. However, like Black individuals, Hispanics 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 associated with segregation of Hispanic communities[297].

Nevertheless, the influence of segregation on mental health of US Latinos has not been well explored. Past studies of neighborhood cultural factors and depressive symptoms among US Latinos have utilized neighborhood racial/ethnic composition as a proxy for more direct cultural segregation measures. These studies have mixed results. Several studies have found non-significant associations between neighborhood racial/ethnic composition and depression measures[172,298–300]. However, some studies have also found that increased neighborhood Latino composition may protect against depression, even after adjusting for individual-level socioeconomic factors[174,175,184,301,302]. The protective effect of Latino composition in these studies is hypothesized to be due to a reinforced sense of social connection, cultural identity, and ethnic pride; fewer discrimination experiences; and thereby decreased stress levels that may occur for Latino individuals residing in predominantly Latino neighborhoods[302–304]. However, other

studies have found little evidence for the hypothesis that social ties and support contribute to improved health among Mexican immigrants compared to their US-born counterparts[304].

Neighborhood segregation in relation to cultural factors, such as language use and customs, 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[170]. However, the literature lacks studies assessing the mental health impact of formal segregation measures of more relevant cultural factors. A segregation measure related to neighborhood Spanish language isolation may provide a more direct metric of neighborhood-level cultural segregation than neighborhood-level ethnic or foreign-born composition, and thus may be of particular importance among Latino populations[177].

Language use may be an especially important cultural factor for Latino mental health[30,31,115]. Qualitative studies interviewing US Latinos indicate that lack of proficiency in the predominant language is viewed as a life stressor: "The language difference is traumatizing; it is more difficult when you are old," and "I felt lonely. I couldn't talk to anyone[65]." 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[30,31]. Proficiency in the English language has been shown to increase access to health information and mental health services[117,118]. At the same time, for US Latinos, maintaining Spanish language proficiency throughout the acculturation process may positively impact health by fostering familial connectedness across generations and promoting other social and cultural connections[109]. Additionally, studies demonstrate that among Latino populations language use

accounts for the majority of the variability in acculturation scales and is therefore considered a central component of the acculturation process[116,294,295]. Language use may further be a more accurate measure of cultural orientation because even if neighborhood Hispanic 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[178]. While a few studies have found an association between neighborhood-level language isolation and various physical health outcomes[177,178], studies assessing neighborhood language isolation in relation to mental health are virtually non-existent. Furthermore, the direction of the association between neighborhood cultural characteristics and depression may depend upon individual-level cultural orientation. 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[181,182]. 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[305,306]. However, the few neighborhood studies accounting for individual-level cultural factors adjust away these effects rather than assessing if they modify the association between neighborhood-level cultural factors and mental health[174,187].

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 sociocultural factors (residential segregation related to Spanish language use and ethnic composition) and individual depressive symptoms among an elderly Latino population. We further examined whether the influence of neighborhood-level language use varied by

individual-level language use.

**Section 6.2 Methods**

Study population

Participants in this analysis were members of the Sacramento Area Latino Study on Aging (SALSA), taking place from 1998 to 2008[190]. SALSA is a longitudinal study of 1,789 elderly Latinos, predominantly of Mexican origin. SALSA's study design has been described previously[32,190,191]. Briefly, eligible participants were self-identified Latinos aged 60+ years at baseline and residing within Sacramento, Yolo, Sutter, Solano, San Joaquin, and Placer Counties in California[32,190]. 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 also linked geocoded baseline SALSA data with language and race/ethnicity data from the 2000 US Census.

Measures

*Depressive symptoms*

Depressive symptoms were measured at baseline with the Center for Epidemiological Studies Depression Scale (CES-D)[224]. The CES-D is a 20-item 4-point Likert-type scale that assesses the extent to which an individual experienced depressive symptoms during the prior week[224]. This scale has been validated in Spanish-speaking populations[234–236] and utilized with older Latinos[229,230]. While not designed for clinical diagnoses, the CES-D is based on clinical depression symptoms and correlates well with other depression scales[224]. The continuous score ranges from 0 to 60 and can be dichotomized using a standard cutoff of ≥16 to classify individuals with high depressive symptoms[224].

*Neighborhood-level variables*

We utilized the Index of Concentrations at the Extremes (ICE) to measure neighborhood-level cultural segregation. This novel measure of segregation is not contingent on living near a metropolitan area[188]. The ICE was developed to demonstrate the extent to which an area's residents are concentrated at the extremes of deprivation and privilege[188,189]. The index ranges from -1 to 1, with a value of -1 indicating that 100% of the population is concentrated in the least privileged group and a value of 1 indicating that 100% of the population is concentrated in the most privileged group[188,189]. The ICE was originally developed to be used with economic measures but has more recently been utilized as a segregation marker to assess extreme concentrations of race and other cultural factors[188,189,209,210]. The ICE is preferable to other segregation measures, such as the Index of Dissimilarity, because it distinguishes which group is concentrated at the extreme. For example, neighborhoods that are 100% Hispanic would have the same Index of Dissimilarity as neighborhoods that are 100% White; the ICE, however, appropriately assigns these two neighborhoods distinct scores[188,189]. Additionally, unlike the Index of Dissimilarity or Isolation Index, the ICE can be meaningfully used outside of metropolitan centers and with smaller geographic units, such as census tracts[188,189,209,210].

To capture neighborhood-level segregation, we created two ICE variables with two sets of neighborhood-level cultural data: 1) Spanish language use, and 2) Hispanic composition. The first ICE variable measured Spanish language segregation, while the second measured ethnic segregation. Language use has been closely linked to mental health and is a more direct measure of a community's cultural orientation than other neighborhood-level measures such as ethnic composition[30,31]. However, segregation measures of ethnic composition have been used as markers of residential segregation in most previous studies[172,187,211–213]; therefore, our use of a

Hispanic composition ICE facilitated comparisons with past studies of neighborhood-level effects on depression.

We utilized census tract level language use and racial/ethnic composition data from the 2000 US Census to calculate the two ICE variables. The Spanish language ICE was calculated as the difference between the number of English-only speakers and Spanish speakers in a census tract divided by the total census tract population[188]. The numbers in the numerator were determined utilizing responses from two 2000 US Census questions: 1) "Does this person speak a language other than English at home?" and 2) "What was this language?" A Spanish language ICE value of -1 indicated an entirely Spanish-speaking census tract, a value of 1 indicated an entirely English-only speaking tract, and a value of 0 indicated an equally English- and Spanish-speaking tract. The Hispanic composition ICE was calculated as the difference between the number of non-Hispanic White residents and Hispanic residents in a census tract divided by the total census tract population[188]. A value of -1 indicated an entirely Hispanic census tract, a value of 1 indicated an entirely non-Hispanic White tract, and a value of 0 indicated a tract with equal non-Hispanic White and Hispanic populations.

*Other covariates*

Nativity was based on participant-report of birth country (US-born vs. foreign-born). Education level was defined as continuous years of education completed. Regarding individual-level language use, participants indicated at baseline their primary language preference of either English or Spanish. Other covariates included participant age and sex.

Statistical Analysis

We first summarized neighborhood- and individual-level characteristics with descriptive and graphical analyses. We created and examined directed acyclic graphs to identify potential

confounders and adjusted our final models for individual-level age, sex, nativity, and education, as these are potentially key confounders of the neighborhood segregation-depression association.

To quantify the association between neighborhood-level segregation and CES-D scores, for each ICE variable separately we fit a two-level general linear mixed model with a random intercept for each census tract utilizing PROC MIXED in SAS 9.4 (SAS Institute, Inc., Cary, NC). The random intercept accounted for any residual within-tract correlation in outcomes. Level 1 represented within-neighborhood variation in CES-D scores, and level 2 represented between-neighborhood variation in CES-D scores due to neighborhood cultural segregation. SALSA comprised 1,766 individuals (level 1) nested within 249 neighborhoods (level 2) within the six SALSA counties. We additionally calculated Intraclass Correlations (ICC) to examine the proportion of the total variance in CES-D scores accounted for by neighborhood clustering.

Neither of the ICE variables had previously been examined in SALSA data; consequently, we examined multiple functional forms of both variables to determine the most appropriate forms in relation to depressive symptoms. The functional form choices were informed by previous studies examining the health effects of neighborhood cultural variables and included: continuous linear (centered around the grand mean)[213–217]; continuous quadratic (centered around the grand mean); quartiles[218]; deciles[175]; and dichotomization at the 60th percentile[213,219–222]. Our functional form assessment involved comparing each model graphically with the Loess smoother and use of 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 for both neighborhood variables. Functional form assessments also informed our modeling of age and education as linear.

Given that the associations between neighborhood cultural segregation and depressive symptoms may differ by individual-level cultural characteristics such as primary language[175], we additionally assessed a cross-level interaction between individual-level language use and neighborhood Spanish language ICE. We examined the Wald test for an interaction term between the individual- and neighborhood-level language variables with a significance criterion of $P \leq 0.1$. We further examined effect estimates stratified by individual-level language use.

**Section 6.3 Results**

Table 17 displays selected baseline characteristics of the SALSA population, both overall and stratified by neighborhood-level Spanish language use ICE quartiles. Participants had an average age of 70.6 years, and 58.4% were female. Additionally, 51.0% of participants were foreign-born, and 57.8 identified Spanish as their primary language. The 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 SALSA participants living in neighborhoods most segregated toward Spanish use (the lowest Spanish language ICE quartile), those living in neighborhoods most segregated toward English-only use were more likely to be US-born and to consider English their primary language. Additionally, those living in neighborhoods most segregated toward English-only use (the highest quartile) had more years of education, had lived in their current neighborhoods for less time, and had lower CES-D scores.

SALSA participants resided in 249 of the 586 census tracts comprising the six counties targeted for the study. Figure 4 depicts the distribution of SALSA participants over the six counties. Overall, the census tracts had a mean±SD of 7.1±9.2 participants per tract (range: 1-82). Participants lived in their homes for an average of 22.3 years (range: 0-74 years). Among

the 249 census tracts, Spanish speakers made up 12.3%±9.7% of each census tract (range: 1-50%). Additionally, the average Hispanic composition of each census tract was 18.4%±11.1% (range: 3-57%). Figures 5 and 6 display the percent Spanish-speaking and Hispanic, respectively, by census tract over SALSA's six counties. Regarding measures of neighborhood cultural segregation, the Spanish language ICE ranged from -0.03 to 0.90 with a mean±SD of 0.58±0.20, and the Hispanic composition ICE ranged from -0.32 to 0.85 with a mean±SD of 0.39±0.29.

Tables 18 and 19 display the results from analyses examining the association between the two ICE variables and CES-D scores. The ICCs of all models indicated that between-neighborhood variance accounted for a small, although non-negligible, proportion of the variance in CES-D scores in our study population, even after accounting for neighborhood ICE variables. These ICCs were similar in magnitude to other neighborhood studies of depression conducted in the US, United Kingdom, Canada, and the Netherlands[172]. In both tables, Model 1 represents the crude, unadjusted model; Model 2 is age- and sex-adjusted, and Model 3 further adjusts for nativity. Model 4 further adjusts for education and represents our fully-adjusted model. Table 2 also shows a naïve model in which no variables were included. Additionally in Table 2, Models 5 and 6 introduce individual-level language preference and then an interaction term between individual-level language preference and neighborhood-level Spanish language ICE.

Regarding Spanish language use (Table 18), after adjusting for age, sex, and nativity (Model 3), residing in a neighborhood more segregated toward English-only use (a higher ICE score) was associated with lower CES-D scores (β:-4.410; 95% CI: -6.851, -1.970). 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. However, this

association attenuated toward the null upon adjustment for years of education (β:-2.119; 95% CI: -4.650, 0.413). Further, the association did not appear to be modified by an individual's primary language (interaction p-value: 0.9613).

Table 19 displays results from analyses examining the association between Hispanic composition ICE and CES-D scores. Residing in a more highly segregated non-Hispanic White neighborhood (a neighborhood with a higher ICE score) was associated with lower CES-D scores; however, this association was attenuated toward the null upon adjustment for years of education (β:-0.953; 95% CI: -2.859, 0.953). While these results followed a similar pattern to the Spanish language ICE analysis, the magnitude of the Hispanic composition ICE effect was much smaller than that of the Spanish language ICE in every model.

Some studies suggest that the association between segregation and mental health may also vary by participant nativity[184]; however, sensitivity analyses examining modification by nativity showed no evidence of this among our study population. Further sensitivity analyses indicated that adjusting for time spent in the US and time lived in the neighborhood did not impact the results.

**Section 6.4 Discussion**

This study assessed the impact of neighborhood-level cultural segregation on depressive symptoms among a sample of Latino adults, 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, where high depressive symptom prevalence is estimated to be 27%[11]. We found a strong unadjusted association between neighborhood cultural segregation and depressive symptoms that remained significant upon adjustment for age, sex, and nativity; in our study population, individuals residing in highly

segregated, Hispanic, and Spanish-speaking neighborhoods had more depressive symptoms than individuals residing in highly segregated, non-Hispanic White, and English-only speaking neighborhoods. However, these associations attenuated toward the null upon adjustment for the confounding effects of individual-level education. Further, we did not find evidence of a cross-level interaction between neighborhood-level language isolation and individual-level language preference, suggesting that the association between neighborhood language segregation and depressive symptoms did not differ for those whose primary language was English compared to Spanish.

Past studies of neighborhood cultural factors and depressive symptoms among US Latinos have utilized neighborhood racial/ethnic composition as a proxy for more direct cultural segregation measures. Several studies have found that, in contrast with our crude results, increased Latino composition of the neighborhood may protect against depression, even after adjusting for individual-level socioeconomic factors[174,175,184,301,302]. However, utilization of Latino composition as a proxy for segregation in these previous studies, rather than more direct segregation measures, may account for the differing direction of the associations when comparing prior results to our findings. Differences in results may also be due to differing study populations. Newer immigrants tend to have fewer depressive symptoms compared to immigrants who have spent more time in the US, especially those experiencing blocked upward social mobility[306,307]. Previous studies were conducted largely among younger populations or more recent immigrants, while our study population had spent relatively more time in the US and may be more likely to have experienced blocked socioeconomic mobility.

Few studies have assessed the impacts of more formal, direct measures of residential segregation on depressive symptoms among US Latinos. Consistent with our unadjusted results,

one previous study found a strong association between residential segregation, measured with the Isolation Index, and depressive symptoms among Mexican Americans in Chicago[187]. These findings may reflect the mental health influence of certain neighborhood features that have been shown to be concentrated in highly segregated minority neighborhoods, including lack of resources, increased disorder, high residential turnover, violence, inadequate housing, and lack of green spaces[308,309]. Such features may function as chronic stressors and likely characterize highly segregated neighborhoods as a result of historical and present-day discriminatory policies in housing that disproportionately sort certain racial/ethnic populations into socioeconomically disadvantaged and under-resourced neighborhoods; exposure to this structural discrimination and the resulting living conditions has also been shown to influence health[164].

Traditionally in the segregation literature, segregation appears to adversely influence health outcomes among Black communities but is often shown to be beneficial among Latino communities[297]. This pattern likely depends upon the nativity and time spent in the US of the Latino community; a growing body of literature demonstrates that, among Latino populations, increased time spent in the US is associated with worse health[307]. 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[305,306].

Segregation measures used in previous studies have focused almost exclusively on segregation in terms of racial composition. Our segregation measure, however, incorporated Spanish language use segregation, a more specific aspect of cultural segregation that may be

important for Latino health in particular[177,178]. 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[310]. Vega et al. found that neighborhood linguistic isolation protected against depressive symptoms. Their study hypothesized that linguistically isolated communities may serve as ethnic enclaves that allow immigrants to maintain their culture and language as a medium for the completion of everyday tasks and for social interaction and connection[310]. These enclaves may therefore create a cultural comfort zone in which to adjust to the new US context[310].

The protective effect of linguistic isolation found by Vega et al. directly opposes our unadjusted results. This is possibly again a result of differences in study population. Vega's study participants were younger and more likely to be foreign-born than SALSA participants and therefore possibly more likely to benefit from the resources provided by an ethnic enclave. On the other hand, our Spanish language segregation measure may be reflecting the adverse mental health impact of blocked upward social mobility, the institutional racism that often leads to highly segregated neighborhoods, and the resulting inadequate access to goods, services, and other socioeconomic opportunities faced by many minority populations[165,166].

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"[311]. 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[312,313], and individuals who speak Chinese, Korean, or Vietnamese at home are more likely to classify as linguistically isolated than Spanish-speaking individuals[313]. 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.

Our finding of differing strengths of the two ICE variables is also noteworthy. While both variables attenuated toward the null upon adjustment for education, the language use ICE remained relatively robust in contrast to the Hispanic composition ICE. These findings may reflect the importance of language segregation relative to ethnic segregation for Latino mental health[117,118]. Residents of linguistically isolated communities may lack access to physical and mental health services and the social resources that allow for effective navigation of the US educational system and job market; this could in turn result in exclusion from advancement opportunities, further socioeconomic hardship, and thereby increased susceptibility to poor mental health[32].

Neighborhood language use may be especially important for elderly Latinos because elderly individuals from visible ethnic minorities, and elderly Latinos in particular, are reported to seek formal health care later than those from non-minority groups[70]. 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[70,179]. Latino patients are more likely to seek health care from Latino physicians than

other physicians[314], and many Latino patients consider a physician's Spanish-speaking ability when choosing a physician[315,316]. However, the educational differential between US Latinos and non-Latino Whites makes interacting with a Latino or Spanish-speaking clinician a rare experience. In fact, fewer than 2% of American Psychological Association members identify as Latino[72]. Consequently, linguistic barriers to accessing neighborhood services may be a more salient consideration for Latino mental health compared to ethnic composition. 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.

To further assess the importance of language segregation compared to ethnic segregation, we conducted a sensitivity analysis combining Spanish language use and Hispanic composition into a single ICE variable also ranging from -1 to 1, comprised of Latino individuals speaking Spanish at home on one extreme and non-Latino English-only speaking Whites at the other extreme. These results were similarly patterned to those of both the Spanish language segregation and ethnic segregation analyses; however, the magnitude and strength of the combined effect fell in between the separate effects of Spanish language segregation and ethnic segregation. This provides further support that language segregation on its own may be a more important factor for mental health of elderly Latinos compared to ethnic segregation or the two segregation measures combined. The importance of language segregation was additionally confirmed by sensitivity analyses in which models were run including each ICE variable as a separate coefficient in the same model. While both remained non-significant in the fully adjusted model, the magnitude of the language use coefficient was substantially stronger.

In contrast to both the findings of Lee et al. and Vega et al., our results were attenuated toward the null upon adjustment for individual-level education. These findings suggest that observed crude associations between segregation and depressive symptoms were partially a result of lower educational attainment being disproportionately present among individuals living in highly segregated Latino and Spanish-speaking neighborhoods. The participants' education levels likely placed constraints, both financial and social, on where they were able and wanting to live. Thus, our results that individual-level educational attainment partially accounted for the observed segregation-depressive symptom association indicate that living in highly Spanish-speaking or Latino communities is not in and of itself depression-promoting, but rather the mental health of these individuals is impacted by the discriminatory sorting mechanism that disproportionately places them into segregated and isolated neighborhoods where they have little access to educational resources that protect mental health. Our results of a non-significant interaction between individual-level primary language and neighborhood-level language also support 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, but rather something else characterizes these census tracts, such as fewer educational resources and opportunities for upward social mobility, that lead to the association.

We conceptualized individual-level education as a confounder of the association between neighborhood segregation and depressive symptoms, although education has been considered a mediator along the causal pathway between segregation and health in other populations[212]. Given that SALSA was comprised of elderly individuals, many of whom were immigrants, participants likely completed their education prior to settling into their baseline neighborhoods. Indeed, 93%

of immigrant participants completed their education in their birth country. However, the age of the population does not entirely rule out education as a mediator if we assume that determinants of an individual's current neighborhood were associated with past residential history, including the contexts in which they received their educations, whether in the US or abroad. Nevertheless, for our study population, we conceptualized education as a common cause of the participants' neighborhood selection and depressive symptoms rather than a mediator between these two variables. Thus, the attenuation of the neighborhood segregation and depressive symptom association upon adjustment for individual-level education indicates that the observed unadjusted association may have been partially a product of the unequal distribution of educational attainment between those residing in predominantly Latino Spanish-speaking neighborhoods and those residing in predominantly non-Hispanic White English-only speaking neighborhoods.

Our study had a number of strengths including use of geocoded data collected from a population-based sample representative of elderly Latinos residing in Sacramento, California. We also 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 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 in terms of cultural factors such as language isolation or ethnic segregation, on mental health. More frequently utilized segregation measures, such as the Isolation Index, have been shown to be less reliable with smaller populations outside of metropolitan areas[317], while the ICE does not suffer from this limitation. Additionally, our study was the first to implement the ICE in terms of Spanish language use; this cultural factor has

greater face validity as a measure of cultural orientation as compared to ethnic composition and has not been sufficiently examined at the neighborhood level[178].

Our study also had limitations. Firstly, cultural segregation, socioeconomic position, and depression are dynamic constructs that may change over time for both neighborhoods and individuals residing within them. However, the cross-sectional nature of SALSA baseline data did not allow us to determine the temporal direction of the associations of interest. Any observed results may be a consequence of reverse causality. For example, the mental health status of individuals may cause them to self-select into neighborhoods of a certain composition rather than the neighborhood causing their mental health status. However, given that participants in the SALSA cohort were residentially stable, with an average neighborhood residence of 22.3 years, our neighborhood measures are likely capturing effects acting earlier in life[194,204]. Additionally, due to the residential stability of the cohort, we anticipate little selection bias due to repatriation to country of origin.

Further, we utilized education as a measure of participant socioeconomic position, which may not fully capture this construct. SALSA did collect participant income data; however, education is often preferred since it predicts occupation and wages and is less influenced by age-related changes in these characteristics[79,206]. The elderly SALSA participants may be retired and therefore not have incomes representative of their earlier occupations. Further, use of educational attainment is consistent with other studies examining socioeconomic effects among Latino populations[197,205].

Additionally, many factors may influence an individual's experience living within a given neighborhood, including immigration history and discrimination. These influences are difficult to capture using census data because individual's perceptions of their neighborhoods

often do not match census-based administrative data sources[318]. Our findings warrant further work related to neighborhood construct validity among Hispanic communities.

Finally, it is worth noting that study participants were predominantly Mexican-origin individuals living in California's Sacramento Valley. Consequently, our findings may not apply to other Latino subpopulations, and we cannot draw broad conclusions regarding depressive symptom prevalence among all US Latinos. However, given that Mexican Americans are the largest and fastest growing Latino subgroup in the US[18], examining factors associated with depression in this group holds particular importance.

In conclusion, our study found higher depressive symptoms among elderly Latinos residing in highly segregated Latino and Spanish-speaking neighborhoods compared to those residing in predominantly non-Hispanic White and English-only speaking neighborhoods. However, this association may be partially accounted for by individual-level educational attainment. These findings suggest that lack of access to educational resources in communities that are highly segregated may play a key role in the mental health of US Latinos. Our study contributes to a more comprehensive and contextual understanding of depression etiology and the dynamic community and socioeconomic pathways that shape Latino mental health. The accumulation of sociocultural risk factors within Latino neighborhoods is a complex issue influenced by years of discrimination, exclusionary policies, and unequal allocation of resources. Despite this formidable complexity, depression in Latino communities is a major public health issue that may greatly benefit from intervention at the community level. 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 under-resourced communities also deserves high priority if we are 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 individuals residing in these communities.

## Section 6.5 Tables

**Table 17. Baseline descriptive characteristics of the SALSA population (1998-2008), 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 Position | Education (years), mean (SD) | 7.2 (5.3) | 5.7 (4.8) | 6.0 (4.9) | 7.6 (5.2) | 9.7 (5.4) |
| | 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) |
| | % Hispanic quartile[c] | | | | | |
| | 1: Most Spanish | 412 (23.3) | 307 (69.6) | 105 (22.4) | 0 (0.0) | 0 (0.0) |
| | 2 | 486 (27.5) | 103 (23.4) | 214 (50.4) | 169 (37.1) | 0 (0.0) |
| | 3 | 426 (24.1) | 31 (7.0) | 90 (21.2) | 221 (46.4) | 94 (21.1) |
| | 4: Least Spanish | 442 (25.0) | 0 (0.0) | 16 (3.8) | 75 (16.5) | 351 (78.9) |
| | Hispanic composition ICE quartile[d] | | | | | |
| | 1: Most Hispanic | 423 (24.0) | 330 (74.8) | 93 (21.9) | 0 (0.0) | 0 (0.0) |
| | 2 | 491 (27.8) | 89 (20.2) | 263 (61.9) | 139 (30.6) | 0 (0.0) |
| | 3 | 431 (24.4) | 22 (5.0) | 69 (16.2) | 252 (55.4) | 88 (19.8) |
| | 4: Least Hispanic | 421 (23.8) | 0 (0.0) | 0 (0.0) | 64 (14.1) | 357 (80.2) |
| 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) |
| | ≥16 CES-D score, n (%) | 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] Quartiles of % Hispanic: >40.6%, 26.8-40.6%, 17.0-26.7%, and 0-16.9%

[d] Quartiles of Hispanic composition ICE score: -1- -0.10, -0.09-0.10, 0.11-0.39, and >0.39

**Table 18. Estimates from two-level generalized linear models predicting differences in CES-D scores by neighborhood-level Spanish language use ICE, SALSA (1998-2008)**

| | Naïve Model<br>$\beta$ (95% CI) | Model 1<br>$\beta$ (95% CI) | Model 2<br>$\beta$ (95% CI) | Model 3<br>$\beta$ (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; 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 18 cont. Estimates from two-level generalized linear models predicting differences in CES-D scores by neighborhood-level Spanish language use ICE, SALSA (1998-2008)**

| | Model 4<br>$\beta$ (95% CI) | Model 5<br>$\beta$ (95% CI) | Model 6<br>$\beta$ (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; 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 19. Estimates from two-level generalized linear models predicting differences in CES-D scores by neighborhood-level Hispanic composition ICE, SALSA (1998-2008)**

| | Model 1<br>$\beta$ (95% CI) | Model 2<br>$\beta$ (95% CI) | Model 3<br>$\beta$ (95% CI) | Model 4<br>$\beta$ (95% CI) |
|---|---|---|---|---|
| Intercept | 9.978 (9.397, 10.558)*** | 7.492 (6.671, 8.313)*** | 6.273 (5.328, 7.218)*** | 9.891 (8.498, 11.284)*** |
| Individual-level variables | | | | |
| Age[a] | -- | 0.060 (-0.012, 0.133) | 0.048 (-0.024, 0.120) | 0.007 (-0.065, 0.079) |
| Sex (Ref = male) | -- | 4.304 (3.310, 5.299)*** | 4.201 (3.213, 5.190)*** | 3.989 (3.013, 4.966)*** |
| Nativity (Ref = US-born) | -- | -- | 2.525 (1.534, 3.516)*** | 1.014 (-0.054, 2.082)* |
| Education (years) | -- | -- | -- | -0.372 (-0.478, -0.266)*** |
| Neighborhood-level ICE variables | | | | |
| Hispanic composition[b] | -3.261 (-5.146, -1.376)*** | -3.200 (-5.072, -1.328)*** | -2.619 (-4.488, -0.750)*** | -0.953 (-2.859, 0.953) |
| Random Variance components | | | | |
| Level-1 (within neighborhood) | 109.56*** | 104.68*** | 103.20*** | 100.37*** |
| Level-2 (between neighborhood) | 2.3690* | 2.6416** | 2.5567** | 2.5180** |
| ICC[c] | 0.0212 | 0.0246 | 0.0242 | 0.0245 |
| Goodness of fit components | | | | |
| AIC | 12863.1 | 12794 | 12771.2 | 12726.4 |
| -2*Log Likelihood | 12855.1 | 12782 | 12757.2 | 12710.40 |

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] Hispanic composition ICE centered at 0.16; higher ICE score indicated more segregated toward non-Hispanic White composition

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

# CHAPTER 7: DISCUSSION

The Latino community is the largest and fastest growing minority population in the US[18], and this population is consistently shown to suffer from a disproportionate burden of depression[14–16,67,68]. Even with the high prevalence of depression among US Latinos, depression remains greatly under-diagnosed in this population[17]. A growing body of research suggests that acculturative and socioeconomic factors may play a key role in Latino mental health. These risk factors have additionally been shown to accumulate and transmit within neighborhoods and across generations, and this has been especially true among the Latino population in the US. However, previous studies of the mental health effects of sociocultural factors are limited to individual-level variables within a single generation. Accordingly, an intergenerational and community-level approach is essential for a more comprehensive understanding of depression etiology among US Latinos and the mechanisms that drive ethnic disparities in mental health outcomes in general.

To address this critical gap in knowledge, this dissertation examined the effect of socioeconomic and acculturative exposures across generations and within neighborhoods on depressive symptoms in US Latinos. We utilized data derived from two large biologically-related longitudinal cohort studies, the Sacramento Area Latino Study of Aging and the Niños Lifestyle and Diabetes Study, in order to examine two primary aims. We first examined whether changes in (a) socioeconomic position and (b) acculturation over two generations of a Mexican-origin population were associated with depressive symptoms in the offspring (Aims 1a and 1b). We

also examined whether neighborhood-level cultural segregation (Spanish language isolation and ethnic segregation) was associated with depressive symptoms an older Mexican-origin population (Aim 2).

## Section 7.1 Aim 1a

### Section 7.1.1 *Major Findings*

Chapter 4 assessed the impact of intergenerational educational mobility on depressive symptoms over a 10-year period among a sample of elderly Latinos, predominantly of Mexican origin. High depressive symptom prevalence in this population was 24.8%; this is comparable to larger, representative samples of US Latino adults[11]. The findings from the study described in Chapter 4 supported an association between intergenerational educational mobility and depressive symptoms among elderly Mexican-origin individuals, whereby stable-high education and upward educational mobility were nearly equally protective against depressive symptoms. Additionally, high parental education appeared to somewhat counteract the adverse effects of low educational attainment in offspring.

This chapter advances the results of previous single-generation studies by examining how the educational attainment of both the parent and offspring may interact to impact offspring depressive symptoms. In our analysis, the effect of parental education on depressive symptoms appeared to depend upon offspring education, as indicated by our finding that stable-high and upwardly mobile educational attainments equally protected against depressive symptoms compared to stable-low educational attainment. We further found fewer depressive symptoms among downwardly mobile participants at every follow-up wave compared to stable-low participants. While these findings were only marginally significant, they suggested that the negative impact of low offspring education may be somewhat buffered by high parental

education, indicating that the mental health effect of offspring education may depend on parental education. Our results may therefore support for the "accumulation of risk" hypothesis whereby multiple generations of low educational attainment cumulatively impact depression and any break in generational cycles of socioeconomic disadvantage may have a beneficial effect on the mental health of subsequent generations[284–286].

### Section 7.1.2 *Strengths*

There are many strengths of the study carried out in Chapter 4 that aid in the understanding of the influence of intergenerational socioeconomic effects on depressive symptoms among US Latinos.

Firstly, we utilized intergenerational data collected from a population-based sample representative of Latinos residing in Sacramento, California. Additionally, our study was the first to utilize longitudinal data in order to examine educational mobility's impact on depressive symptoms over time in Mexican-origin individuals. Capitalizing upon this longitudinal data, we also implemented the novel "depression-free day" measure. Further sociodemographic and depression data were collected by trained bilingual interviewers and with validated surveys. Finally, while most previous studies report odds ratios of socioeconomic effects, our study estimated prevalence ratios and differences of high depressive symptoms and absolute differences in CES-D scores. Odds ratios would have greatly overstated the effect given the high prevalence of depressive symptoms in our population. Prevalence ratios and differences are also more directly interpretable than odds ratios and allow for better estimation of public health burden[269].

### Section 7.1.3 *Limitations*

There are several limitations from Chapter 4 that may influence the interpretation and generalizability of our results.

Firstly, as a result of the advanced baseline age of SALSA participants and the established literature documenting the association between depression and mortality[5,287–290], survivor bias may have impacted our results by influencing who survived to be eligible to participate in SALSA. We conducted a sensitivity analysis to examine the potential impact of this bias, assessing whether average CES-D scores changed over time due to attrition from mortality and if these changes were differential by educational mobility category. We first assessed the impact of time and its interaction with educational mobility on depressive symptoms over the follow-up period. We found slight overall decreases in CES-D scores among the stable-low and downwardly mobile categories; this was largely due to higher mortality among those with higher CES-D scores who disproportionately belonged to these categories. Thus, two cells, the stable-low and downwardly mobile participants with high depressive symptoms, were more rapidly depleted than the other cells. As a result, over time the average CES-D scores of the stable-low and downwardly mobile categories decreased. Consequently, selective attrition due to death caused the populations in the different educational mobility categories to look more similar over time, indicating that educational mobility may actually have a larger effect than we observed. Despite this limitation, we still detected sizeable differences in CES-D scores and depression-free time between educational mobility groups.

A second limitation of the study described in Chapter 4 was that study participants were predominantly elderly Mexican-origin individuals living in California's Sacramento Valley. Consequently, we cannot draw broad conclusions regarding depressive symptom prevalence

among all US Latinos across all ages. However, Mexican Americans are the largest and fastest growing Latino subgroup in the US[18], and elderly Latinos have been shown to carry an especially disproportionate burden of depression[69]; therefore, examining factors associated with depression in these groups holds particular importance.

Finally, education is a limited measure of SEP. However, education may be preferable to other wealth measures, such as income, since it predicts occupation and wages and is less influenced by age-related changes in these characteristics[79,206]. The elderly SALSA participants may be retired and therefore not have incomes representative of their earlier occupations. Income and education were also highly correlated in our dataset. Further, use of educational attainment is consistent with other studies examining socioeconomic effects among Latino populations[197,205]. Nevertheless, education may impact depression through pathways that do not hold for other SEP measures, such as through its influence on cognition[262,263].

**Section 7.1.4** ***Public health implications and future directions***

Our study contributes to a more comprehensive and contextual understanding of depression etiology and the cross-generational socioeconomic pathways that shape Latino mental health. If our findings are causal, improving educational opportunities in under-resourced communities may counteract the adverse impacts of low parental education on the mental health of individuals residing in these communities and that of their future offspring. Future studies could add to the understanding of the socioeconomic drivers of Latino depression prevalence by utilizing other more comprehensive measures of socioeconomic position in order to determine if our findings are unique to educational mobility. Future research could also assess these associations in younger populations and other Latino subpopulations to see if the associations hold across these subgroups. Further, the longitudinal depression trajectories may be more salient

in younger Latino populations that are more likely to show emerging depressive symptoms over time. Finally, future work should aim to identify key social and environmental stressors and mediating biological pathways by which accumulation of low educational attainment may influence mental health among Latinos and other at-risk populations.

## Section 7.2 Aim 1b

### Section 7.2.1 *Major Findings*

Chapter 5 assessed the impact of three intergenerational acculturation trajectories on depressive symptoms among a sample of Latino adults, predominantly of Mexican origin. Depressive symptoms were highly prevalent in the NLDS study population, with 28.3% of offspring having CESD-10 scores ≥10. Like the high depressive symptom prevalence found in Chapter 4, this is comparable to larger, representative samples of US Latino adults, where high depressive symptom prevalence has been shown to be 27%[11]. The findings from Chapter 5 primarily supported an association between intergenerational Spanish language use and depressive symptoms among Mexican-origin individuals participating in the NLDS, suggesting a beneficial effect of exposure to multiple languages across generations. Regarding language use, our study found that exposure to both English and Spanish, through either stable-equal English/Spanish use or decreased Spanish use across generations, was protective against depression; although the estimate for stable-equal English/Spanish use did not reach statistical significance.

In the study described in Chapter 5, decreased Spanish use across generations was characterized by high exposure to the Spanish language as a child and increased English language use as an adult. Therefore, both the stable-equal English/Spanish and decreased Spanish use categories comprise individuals who have experienced exposure to both languages

across generations. The findings in Chapter 5 are therefore consistent with and add an intergenerational perspective to several studies that have shown the socio-cognitive and socio-emotional benefits of exposure to multiple languages throughout the lifetime[120,149,150].

Further, we found that the mixing of acculturation domains into a single "overall" acculturation trajectory variable led to non-significant associations. However, we did find that the association between "socialization" acculturation trajectories and depressive symptoms was marginally significant, whereby increased and stable-high US orientation across generations appeared beneficial for mental health. We additionally found moderately low correlations between the language use trajectory variable and both acculturation trajectory variables. These findings suggest that language use and other socialization questions, which are often combined to assess the construct of acculturation, may actually function independently to impact depressive symptoms. Consequently, the combination of these two dimensions into a single index may create a mixing of effects that masks the true effect of either dimension on mental health. Finally, we did not find evidence of an acculturation-education interaction, suggesting that these associations were not modified by educational attainment in our study population.

### Section 7.2.2 *Strengths*

There are several noteworthy strengths of the study carried out in Chapter 5 that aid in the understanding of the impact of intergenerational acculturative factors on depressive symptoms among US Latinos.

Firstly, this study capitalized upon data collected directly from multiple generations of a representative sample of Latino families living in California's Sacramento Valley. This is one of the only intergenerational studies where data has been collected directly from multiple generations, rather than by retrospective recall by a single generation. Secondly, the NLDS used

trained bilingual interviewers and validated surveys to collect depressive symptoms and acculturation data. Additionally, the study described in Chapter 5 was the first to examine multiple cultural factors across generations in relation to depressive symptoms in order to evaluate and compare the results from multiple measures of cultural orientation. Finally, as with the study carried out in Chapter 4, our study estimated prevalence ratios and differences to assess the associations of interest in lieu of the odds ratios reported by most previous studies of acculturative effects. Once again, due to the high prevalence of depressive symptoms among NLDS participants, odds ratios would have greatly overstated the effect. Further, prevalence ratios and differences are the preferable measure in that they also allow for a more interpretable estimation of relative and absolute between-population differences and of public health burden[269].

### Section 7.2.3 *Limitations*

Several limitations from the study carried out in Chapter 5 may influence the interpretation and generalizability of our results.

Firstly, use of cross-sectional data prevented determination of the temporal direction of the acculturation-depressive symptom association. Consequently, reverse causality cannot be ruled out and may have influenced our results. For example, depressed individuals may struggle integrating into a new cultural environment and learning a new language as a result of their mental status while non-depressed individuals may be more capable of cultural adaptation. The cross-sectional design also precluded examination of causal interrelations between education, language, and acculturation, variables that are undeniably linked.

Secondly, we lacked the power due to small sample size to detect a significant association among stable-equal English/Spanish individuals despite our results suggesting a

protective effect of this dual language use. As previously stated, given the overlap of bilingual individuals in both the stable-equal English/Spanish and decreased Spanish use categories, we conducted two sensitivity analyses first separating into their own category the 117 individuals who reported speaking Spanish half the time and their parents speaking Spanish all/most of the time and then combining these individuals with the stable-equal English/Spanish participants. Both of these analyses produced results nearly identical to those with the original categorizations in terms of direction and magnitude of the effects.

Additionally, the dichotomization of the parent and offspring acculturation scores may appear simplistic and incapable of capturing the true nature of the underlying constructs. However, sensitivity analyses utilizing a continuous acculturation difference score between parents and offspring indicated that those who differed more from their parents had lower levels of depression. These findings support the results of our dichotomized analyses where offspring with increased US orientation had the fewest depressive symptoms. Consequently, our sensitivity analyses supported dichotomization and suggested that our results were robust to different functional forms of the acculturation variables.

Finally, selection bias may be of concern for the analyses carried out in Chapter 5. The NLDS interviewed only relatives of SALSA participants who had remained in the Sacramento area. Those who moved out of the area, possibly for job or educational opportunities, could have differed from those remaining in the region in terms of education level, degree of acculturation, and depressive symptoms. As a result, NLDS participants may not represent all Latinos whose parents lived in the study region. However, more than 80% of SALSA offspring lived in Sacramento County, abutting counties, or the San Francisco Bay Area, leaving only a small portion that moved out of the region. Moreover, there were no observed differences between

parents whose children moved out of Sacramento and those whose children remained in the area. Therefore, selection bias may be minimal.

### Section 7.2.4 *Public health implications and future directions*

The comprehensive approach utilized in Chapter 5 to examine cultural orientation across multiple generations may shed some light on the specific aspects of the acculturation construct that impact mental health. Future studies of these associations could take many directions. The acculturation variables used in Chapter 5 captured only two generations, and these associations may continue to change, and even change direction altogether, over time. The NLDS is currently planning for a third wave of follow-up, and as the investigators continue to follow these individuals, future studies could examine the mental health effects of changing cultural orientation over time. Further, our modification analysis utilized education as a proxy for socioeconomic position. This measure is limited, and future analysis could include additional variables such as income, occupation, and wealth. Finally, more comprehensive studies of other Latino subgroups may provide insight into whether our findings of the mental health effect of cross-generational cultural orientation are unique to individuals of Mexican origin.

The findings from Chapter 5 may also have important public health implications. Exposure to multiple languages across generations and increased and stable-high US orientation across generations may have protective properties against depression. Thus, the findings of Chapter 5 point to the health importance of access to resources through successful interactions with the dominant culture and the additional protective function of maintaining ties to one's culture of origin. If causal, the observed associations suggest that encouraging bilingualism and exposure to more than one language in both the school and home settings may have a beneficial impact on Latino mental health. Several states in the last two decades have instituted English-

only instruction policies in public schools, such as Massachusetts's Question 2 in 2002, Arizona's Proposition 203 in 2000, and California's Proposition 227 in 1998. These policies require English immersion rather than bilingual instruction. Chapter 5 indicates that such policies may have adverse consequences for the affected students. Finally, this study further suggests that improving access to mental health services in linguistically and culturally isolated communities may improve identification of depression and ultimately lead to increased treatment among underdiagnosed Latino populations.

## Section 7.3 Aim 2

### Section 7.3.1 *Major Findings*

The purpose of Chapter 6 was to assess the impact of neighborhood-level cultural segregation on depressive symptoms among a sample of Latino adults, predominantly of Mexican origin. The prevalence of high depressive symptoms in this population was nearly identical to that found in Chapter 4 given that the study samples were nearly identical; any differences were due to slight differences in sample size due to missingness and the use of imputed data in Chapter 4. High depressive symptom prevalence in our population was 25.5%, which is comparable to larger, representative samples of US Latino adults[11]. Our study found a strong unadjusted association between neighborhood cultural segregation and depressive symptoms that remained significant upon adjustment for age, sex, and nativity; in our study population, individuals residing in highly-segregated, Hispanic, and Spanish-speaking neighborhoods had more depressive symptoms than individuals residing in highly-segregated, non-Hispanic White, and English-only speaking neighborhoods. These findings may reflect the mental health influence of certain neighborhood features that are often concentrated in highly-segregated neighborhoods, such as lack of resources, increased disorder, high residential

turnover, violence, inadequate housing, and lack of green spaces[308,309]. These features may function as chronic stressors that influence the mental health of residents over and above their individual-level characteristics[308,309].

However, the associations found in Chapter 6 were attenuated toward the null upon adjustment for the confounding effects of individual-level education. These attenuated findings suggest that the observed crude association between neighborhood segregation and depressive symptoms was in part a result of confounding by individual-level education, whereby lower educational attainment was disproportionately present among individuals living in highly-segregated Latino and Spanish-speaking neighborhoods.

The differing strengths of the two ICE variables is also worthy of note. While both variables attenuated toward the null upon adjustment for education, the language use ICE remained relatively robust in contrast to the Hispanic composition ICE. These findings may reflect the importance of language segregation relative to ethnic segregation for Latino mental health. Social connections related to mental health for Latinos are closely tied to language capabilities, and the dominant language in the surrounding community may impact an individual's social ties and how these ties facilitate knowledge about and access to mental health care[117,118]. 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[70,179]. Linguistic barriers to accessing neighborhood services may be a more salient consideration for Latino mental health compared to ethnic composition. 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.

Finally, we did not find evidence of a cross-level interaction between neighborhood-level language isolation and individual-level language preference, suggesting that the association between neighborhood language segregation and depressive symptoms did not differ for those whose primary language was English compared to Spanish.

**Section 7.3.2 *Strengths***

Several strengths are worth highlighting regarding the study carried out in Chapter 6 that aid in the understanding of the impact of neighborhood-level cultural segregation on depressive symptoms among US Latinos.

Firstly, the study described in Chapter 6 took advantage of geocoded data collected from a population-based sample representative of elderly Latinos residing in Sacramento, California, and linked this data with US 2000 Census data. Further, data collection was carried out by trained bilingual interviewers who used validated surveys to collect sociodemographic and depression data. Of note, this study was the first to implement the novel ICE measure to examine two aspects of cultural segregation on depressive symptoms among a Latino population. No existing studies have examined the influence this more direct measure of spatial social polarization, especially in terms of language isolation or ethnic segregation on mental health. The more frequently utilized segregation measures, such as the isolation index, have been shown to be less reliable with smaller populations outside of metropolitan areas[317], while the ICE does not suffer from this limitation. Additionally, Chapter 6 was the first study to implement the ICE in terms of Spanish language use; this cultural factor has greater face validity as a measure of cultural orientation than ethnic composition but has not been sufficiently examined at the neighborhood level[178].

### Section 7.3.3 *Limitations*

Chapter 6 also suffered from several limitations that have the potential to influence the interpretation and generalizability of our results.

Firstly, as with Chapters 4 and 5, study participants were predominantly Mexican-origin individuals living in California's Sacramento Valley, and our findings may not apply to other Latino subpopulations or to Latinos residing in communities in other regions of the US. Nevertheless, Mexican Americans are the largest and fastest growing Latino subgroup in the US[18], and examining factors associated with depression in this subgroup may be of particular importance.

Additionally, the relationships between cultural segregation, socioeconomic position, and depression may change over time for both neighborhoods and the individuals that reside in them. However, the cross-sectional nature of the SALSA baseline data did not allow us to determine the temporal direction of the associations of interest in Chapter 6. Any observed results may be a consequence of reverse causality. For example, the mental health status of individuals may cause them to self-select into neighborhoods of a certain composition rather than the neighborhood causing their mental health status. Nevertheless, participants in the SALSA cohort were residentially stable, with an average neighborhood residence of 22.3 years; consequently, our neighborhood measures likely captured effects acting earlier in life [194,204].

Further, participant neighborhoods were operationalized as the census tracts in which they resided. This method is limited because: 1) census tracts vary in size, 2) an individual's residence may not reflect the area in which they spend the most time, and 3) administratively defined borders do not account for an individual's definition of their neighborhood. However, utilizing census tracts as proxies for neighborhoods has been successfully utilized in numerous

previous studies and is standard procedure when utilizing Census data[217,319,320]. Prior work has also indicated good agreement across individuals residing within the same tract in relation to neighborhood stressors[319].

Finally, as with previous chapters, the analyses carried out in Chapter 6 operationalized socioeconomic position as years of education, which may not fully capture this construct. SALSA did collect participant income data; however, education may be the most appropriate socioeconomic position proxy for elderly cohorts, such as SALSA, given that many participants may be retired and therefore not have incomes representative of their earlier occupations.

**Section 7.3.4** ***Public health implications and future directions***

The findings from Chapter 6 provide insight into how the inhibition of upward socioeconomic mobility among Latino populations may result in communities that are highly-segregated and thereby impact Latino mental health. Our study was carried out among a population predominantly of Mexican origin; future studies should examine these associations among other Latino subpopulations residing in other areas of the country in order to determine if cultural segregation differentially impacts the various Latino subgroups residing in areas of the country with varying racial and ethnic compositions. Additionally, given that cultural segregation, socioeconomic position, and depression are complex and dynamic constructs that change over time, future studies could also benefit from a longitudinal perspective by examining how changing linguistic and ethnic compositions of neighborhoods impact Latino mental health over time.

The findings in Chapter 6 carry important public health implications. Depression in Latino communities is a major public health issue that may greatly benefit from intervention at the community level. Our results indicate that living in highly Spanish-speaking or Latino

communities is not in and of itself depression-promoting, but rather it is the discriminatory sorting mechanism that disproportionately places these individuals into segregated and isolated neighborhoods where they have worse access to educational resources that negatively impacts mental health. Consequently, if these associations are causal, improving educational opportunities in under-resourced communities deserves high priority if we hope to dismantle the social structures that lead to inequalities in resource allocation and improve the long-term mental health of the individuals residing in these communities.

**Section 7.4 Overall Conclusions**

The Latino community in the US has been shown to carry a disproportionate burden of depressive disorders relative to other ethnic groups, even though depression remains greatly underdiagnosed in this population[10–17]. Previous mental health studies present only a snapshot of the influence of socioeconomic and cultural factors by restricting analyses to the individual level and ignoring intergenerational and neighborhood components. The primary unresolved questions that this dissertation addressed were: (1) what role does the socioeconomic experience of US Latinos across generations play in depression prevalence, (2) do acculturation and linguistic differences between generations impact offspring depression prevalence, and (3) does cultural segregation of a neighborhood or community influence Latino depression over and above individual-level factors? Our purpose in taking an intergenerational and neighborhood-level approach with this study was to take a step back from the individual lens through which health is so often assessed and to provide insight into how the contextual experience of the US Latino population impacts their mental health.

When taken as a comprehensive whole, the overarching theme of our results is that depressive symptoms are highly prevalent among US Latinos and that intergenerational and

community-level factors may play a role in this high prevalence. Chapters 4 and 6 both point to the importance of upward social mobility through education as a factor that can benefit Latino mental health. In Chapter 4 we see the importance of breaking intergenerational cycles of socioeconomic immobility and the adverse impacts of the accumulation of socioeconomic disadvantage over multiple generations. Chapter 6 demonstrates that much of the variability in depressive symptoms associated with neighborhood cultural segregation is explained by the differential distribution in educational attainment across these neighborhoods. Thus, the two studies imply that socioeconomic mobility, both across generations and within neighborhoods, may have an important function for Latino mental health. Chapter 5 adds an additional layer to the story by demonstrating the mental health benefit of exposure to both English and Spanish languages for Latino individuals across generations, which may represent exposure to and maintenance of cultural and familial ties while also enabling improved access to resources in a new cultural context.

When looked at together, these three studies add to the mental health literature by bringing to light some aspects of the Latino experience in the US that may be potential mechanisms for the high depressive symptom prevalence among elderly Latino populations. The accumulation of low educational attainment across generations, which likely results from obstructed opportunities for upward mobility due to discriminatory policies and practices at both the individual and structural levels, may play a key role in depression prevalence in this population. The lower educational attainment among Latino communities compared to other racial/ethnic groups signifies that the Latino population is more greatly exposed to this mental health damaging circumstance than other groups. Immigration policy may have a large role to play in the future socioeconomic mobility of US Latinos given that at present undocumented

individuals lack access to many educational resources, such as in-state tuition at state universities. These structural barriers to education may have great impacts on the mental health of the populations that face them. In addition to the importance of breaking generational cycles of socioeconomic disadvantage for mental health, our studies suggest that improving educational access does not need to, nor should it, occur at the expense of Latino culture and heritage maintenance. In fact, cultivation of both the English and Spanish languages and improving educational resources within highly Latino and highly Spanish-speaking communities may prove to have immense mental health benefits.

Our study admittedly suffers from limitations, described in previous sections, that may limit our ability to draw any definitive conclusions; and we would not claim that intergenerational and neighborhood socioeconomic and cultural factors entirely explain the high burden of depression among the US Latino population. Nevertheless, our study results do help to illuminate some of the story of the Latino experience in the US and how this experience may come to impact this population's mental health.

This dissertation is characterized by several novel components regarding the questions, approach, and study design. Firstly, we examined the socioeconomic experience and the process of acculturation across multiple generations in relation to depression. No existing studies have directly collected socioeconomic and cultural data from multiple generations of Latinos at multiple time points in order to investigate the effect of accumulation of these factors across generations to impact depression prevalence. Such data are novel not only for the Latino population, but also for non-Hispanic White and Black populations as well as many other ethnic and race groups. Additionally, this project was the first to investigate the mental health effects of multiple measures of cultural orientation, allowing us to disentangle the aspects of acculturation

that are most salient for Latino mental health. This project was further unique in that it examined the mental health effects of two measures of neighborhood-level cultural segregation, neighborhood language isolation and Hispanic segregation, among SALSA participants. Our use of the Index of Concentrations at the Extremes to capture these two aspects of neighborhood-level cultural segregation was unique in that no existing studies have examined the influence this more direct measure of spatial social polarization, especially in terms of cultural factors such as language isolation or ethnic segregation, on mental health.

The interplay of community-level variables with socioeconomic and cultural trajectories across multiple generations of Latinos is of great importance in elucidating how multiple dimensions of the US Latino experience impact this population's mental health. However, prior to this dissertation, investigation of this interplay was non-existent in the literature. Our study was the first to examine the dynamic relationships between individuals and changes in their social and cultural contexts in order to gain a more comprehensive understanding of how the Latino experience in the US shapes this community's mental health. Other studies could build on this work and examine similar questions in other populations.

Overall, our study contributes to a more comprehensive and contextual understanding of depression etiology and the dynamic community and intergenerational pathways that shape Latino mental health in the US. The US Latino community represents a heterogeneous mix of ancestry, socioeconomic position, and cultural orientation that is constantly changing[18,47]. By combining individual- and neighborhood-level data from multiple generations of Latinos, the results from our study provided the first evidence highlighting the importance of collecting and examining data regarding the way that socioeconomic and cultural contexts change across generations and accumulate within communities to impact depression in an under-diagnosed and

under-treated ethnic population. The accumulation of socioeconomic and cultural factors within Latino families and neighborhoods has been influenced by years of discrimination, exclusionary policies, and unequal allocation of resources. While this complexity is formidable, beginning to disentangle the dynamic socioeconomic and cultural mechanisms at play for Latino mental health is an essential step in dismantling the cultural and social structures that lead to social and economic inequality in the US and improve the long-term mental health of Latinos.

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