Life Course Socioeconomic Conditions and Mental Health Among Older Mexicans and Mexican Americans

by

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Dedication

To my parents.

Preface

A version of Chapter 2 has been accepted for publication in the Journal of Aging and Health. And a version of Chapter 3 has been accepted for publication in the American Journal of Epidemiology.

Table of contents

Dedication ii
Preface iii
List of figures vi
List of tables vii
Chapter 1 Introduction 1
1.1 Specific research questions 3
Chapter 2 Life Course Exposure to Early Socioeconomic Environment, Education in Relation to Late Life Cognitive Function Among Older Mexicans and Mexican Americans 5
2.1 Introduction 5
2.2 Materials and Methods 6
2.3 Statistical Analysis 9
2.4 Results 11
2.5 Discussion 14
Chapter 3 Life Course Socioeconomic Position and Incidence of Dementia and Cognitive Function Without Dementia in Older Mexican Americans: Results from the Sacramento Area Latino Study on Aging 26
3.1 Introduction 26
3.2 Materials and Methods 27
3.3 Statistical Analyses 30
3.4 Results 33
3.5 Discussion 35
Chapter 4 Life course Socioeconomic Position and Risk of Depressive Symptoms in Older Mexican Americans: Results from the Sacramento Area Latino Study on Aging 47
4.1 Introduction 47
4.2 Materials and Methods 48
4.3 Statistical Analyses 51
4.4 Results 54
4.5 Discussion 57
Chapter 5 Conclusion 73

5.1 Major findings 73
5.2 Public health significance 74
Bibliography 77

List of figures

Figure 2.1. Distribution of cognitive z-scores by migration status..... 20

Figure 3.1. Conceptual Framework of Socioeconomic Trajectories. H, High; L, Low; SEP, Socioeconomic Position. 40

Figure 3.2. Survival to dementia/CIND by SEP trajectory group, SALSA, 1998-2008. Results were adjusted for age at enrollment, alcohol consumption, type-2 diabetes, and stroke. CIND, Cognitive Impairment Without Dementia; SALSA, Sacramento Area Latino Study on Aging; SEP, socioeconomic position. 41

Figure 4.1. Conceptual Framework of Life Course Socioeconomic Trajectories. 65

Figure 4.2. Comparison of participants with elevated versus normal depressive symptoms on the baseline CESD score and percent ever using antidepressant medications, by SEP mobility groups, Sacramento Area Latino Study on Aging, 1998-2008. 66

Figure 4.3. The risk of elevated depressive symptoms across the study period, by SEP mobility groups compared to those who maintained low SEP, Sacramento Area Latino Study on Aging, 1998-2008. Results are based on the adjusted model (2) of table 3. 67

Figure 4.4. Associations between life course cumulative disadvantages and risk of elevated depressive symptoms, by nativity, Sacramento Area Latino Study on Aging, 1998-2008. 68

List of tables

Table 2.1. Baseline characteristics of the study population, by study and migration status 21

Table 2.2. Results from linear regression models for the Bivariate associations between parental education and the offspring's cognitive z-scores, by study and migration status23

Table 2.3. Multivariate Linear regression models for the association between mother's education and the offspring's cognitive z-scores..... 24

Table 2.4. Multivariate Linear Regression models for the association between father's education and the offspring's cognitive z-scores..... 25

Table 3.1. Incidence Rates (per 1000/y) of Dementia/CIND by SEP Trajectory Group, SALSA, 1998-2008..... 42

Table 3.2. Life Course Socioeconomic Characteristics of the Study Population Free of Dementia/CIND at Baseline (n=1634), by SEP Trajectory Group, SALSA, 1998-2008. 43

Table 3.3. Prevalence of Socio-Demographic and Health Conditions Among the Study Population Free of Dementia/CIND at Baseline (N=1634) and Their Bivariate Associations With the Risk of Dementia/CIND Over From Cox Proportional Hazard models, SALSA, 1998-2008. 44

Table 3.4. Bivariate Associations Between Life Course Socioeconomic Conditions and Risk of Dementia/CIND Over the Study Follow-up Time From Cox Proportional Hazard models, SALSA, 1998-2008. 45

Table 3.5. Associations Between Life Course SEP Trajectory and Risk of Dementia/CIND From a Series of Cox proportional Hazards Models, SALSA, 1998-2008..... 46

Table 4.1. Life Course Socioeconomic Characteristics of the Study Population at Baseline (n=1789), by SEP Mobility Category, SALSA, 1998-2008. 69

Table 4.2. Prevalence of Socio-Demographic and Health Conditions Among the Study Population at baseline and Their Unadjusted Associations With depressive symptoms Over the Study Follow-up Time From GEE Logistic Regression, SALSA, 1998-2008.. 70

Table 4.3. Multivariate GEE Logistic Regression Models for the Associations Between Life Course SEP Mobility and Elevated Depressive Symptoms, SALSA, 1998-2008.... 71

Table 4.4. Multivariate GEE Logistic Regression Models for the Associations Between Life Course Cumulative Deprivation and Elevated Depressive Symptoms, SALSA, 1998-2008..... 72

Chapter 1

Introduction

There is a wealth of literature that suggests that early and mid-life socioeconomic positions (SEP) are associated with various health conditions later in life such as impaired cognitive function (1-5), dementia (6-22) and depressive symptoms (23-40). These associations have been increasingly traced back to early life circumstances (41-45) whose effects on health continue until adulthood (41). Accordingly, the influence of SEP on health later in life is best described within a life course context. The life course approach uses an interdisciplinary framework to guide the study of the long-term effects of exposures experienced at different life stages (46). In the current work, we focus on the accumulation risk model whereby socioeconomic exposures accumulate over time. With the accumulation risk model, chains of risk in particular, one disadvantaged exposure may result in further disadvantages along the life course shaping a socioeconomic mobility or trajectory.

The proportion of older Hispanics in the U.S. population is growing quickly (47). Sixty-six percent of U.S. Hispanics are of Mexican descent. Compared to non-Hispanic Whites and African Americans, Mexican Americans are disproportionately burdened with various aging conditions including impaired cognitive function and dementia (15, 48-50), dementia risk factors such as hypertension and type-2 diabetes (51-53), and

depressive symptoms (54-59). In a prospective study of older adults randomly selected from New York City, Latinos showed significantly greater dementia prevalence and incidence rates compared to non-Latino Whites across all age strata (for prevalence rates at ages 65-74: 7.5% vs. 2.9%; ages 75-84: 27.9% vs. 10.9%; and ages 85+: 62.9% vs. 30.2%)(49). According to a recent review, the prevalence of type-2 diabetes, a major risk factor for cognitive function and dementia, was about twice greater among U.S. Hispanics compared non-Hispanic Whites (60). Moreover, results from a population-based study on U.S. Hispanics reported an overall prevalence of depressive symptoms of 25.4%. The latter prevalence was greater than reported prevalence among non-Hispanic Whites and African Americans (ranging from 9 to 16.9%) (54).

Importantly, migration, often associated with dramatic changes in the social and economic environments, has been suggested to influence socioeconomic trajectories of U.S. Hispanics (61-62) which in turn influence health later in life (62). U.S. Hispanics have also shown a greater risk profile of major health-risk factors such as type-2 diabetes compared to Mexicans residing in Mexico (63). Consequently, the complex experience of U.S. Hispanics provides us with a great opportunity to investigate the interplay of migration and life course socioeconomic circumstances in shaping bio-behavioral pathways. Furthermore, most, if not all, studies of migration and health are often complicated by selection on health such that migrants tend to be healthier, at least initially, than those who remained in the home country as well as healthier than their native counterparts in the receiving country.

Despite such evidence, there remains a great gap in the literature exploring socioeconomic-health gradients among U.S. Hispanic older adults. For example, a

majority of the work examining racial/ethnic differences in dementia in the U.S. has focused on non-Hispanic white and black populations (10, 50, 64-68) and less is known about dementia among older Mexican Americans (49, 69). Similarly, there has been to our knowledge no previous work to explore life course socioeconomic conditions and depressive symptoms among historically disadvantaged groups such as older Mexican Americans.

The purpose of the current dissertation was to investigate the associations between life course socioeconomic conditions and three main health conditions namely impaired cognitive function, dementia and cognitive impairment without dementia (CIND), and depressive symptoms among an older cohort of Mexican Americans that has been followed for over a decade as part of the Sacramento Area Latino Study on Aging (SALSA). When examining cognitive function as an outcome, we will attempt to clarify the health selection biases mentioned earlier by comparing participants form the 'home' country and the 'receiving' country whose ancestors migrated from the home country. This will be achieved by additionally using data from the Mexican Health and Aging Study (MHAS), a prospective panel study of Mexicans residing in Mexico. Specifically, the dissertation will examine the following research questions.

1.1 Specific research questions

Research question 1: Life course education and late life cognitive function among older Mexicans and Mexican Americans. Aim (1): Evaluate the influence of parental education on cognitive function later in life. Aim (2): Evaluate the influence of one's educational attainment on the associations between parental education and one's

cognitive function later in life. Aim (3): Evaluate whether migration history modifies the association between one's educational attainment and cognitive function later in life.

Research question 2: Life course Socioeconomic Position and Incidence of Dementia/CIND in Older Mexican Americans: Results from the Sacramento Area Latino Study on Aging. Aim (1): Examine the effect of cumulative SEP disadvantages across childhood, early adulthood, and mid-life on the risk of dementia/CIND later in life. Aim (2): Examine the effect of trajectories of SEP mobility over the life course on the risk of dementia/CIND later in life.

Research question 3: Life course Socioeconomic Position and Depressive Symptoms Later in Life: Results from the Sacramento Area Latino Study on Aging. Aim (1): Examine the effect of cumulative SEP disadvantages across childhood, early adulthood, and mid-life on the risk of depressive symptoms later in life. Aim (2): Examine the effect of trajectories of SEP mobility over the life course on the risk of depressive symptoms later in life.

Chapter 2

Life Course Exposure to Early Socioeconomic Environment, Education in Relation to Late Life Cognitive Function Among Older Mexicans and Mexican Americans

2.1 Introduction

There is a wealth of data that shows an association between adulthood socioeconomic status (SES), education in particular, and cognitive function in middle to late-life (1-5). Such associations have been increasingly traced to early life socioeconomic conditions (43, 45) whose effects on health status continue into adulthood. Previous evidence demonstrates the importance of childhood SES in predicting developmental outcomes. For example, children born to low SES backgrounds are more likely to have lower educational opportunities, and be less exposed to learning and stimulating environments (46, 70-71). The clustering of risks associated with early-life stressors affects cognitive development in children and cognitive achievement across the life course (72-76). Accordingly, the study of socioeconomic status using a life course approach is important for understanding its influence on cognitive function (25, 45, 77-79).

Recently, there has been increasing evidence that documents racial and ethnic disparities in cognitive function (80-81) as well as disparities in the lifecourse trajectories of important risk factors for health and cognitive decline in old age (82-83). Importantly,

such health trajectories may be affected by life experiences such as migration which is often associated with dramatic changes in the social, economic, cultural and physical environments. Indeed, changes associated with migration have been shown to impact SES trajectories of U.S. Hispanics (61-62) which in turn influence cognitive function later in life (62). U.S. Hispanics have also shown a greater prevalence of important health-risk factors such as type-2 diabetes compared to Mexicans residing in Mexico (63, 84). Consequently, the complex experience of U.S. Hispanics provides us with a great opportunity to investigate the interplay of migration and life course socioeconomic circumstances in shaping bio-behavioral pathways.

Most, if not all, studies of migration and health are often complicated by selection on health such that migrants tend to be healthier, at least initially, than those who remained in the home country as well as healthier than their native counterparts in the receiving country. Such biases might be clarified by comparisons of non-migrants in the home country to migrants from the home country and to those born in the 'receiving' country whose ancestors migrated from the home country. This work extends previous research and fills the gap by combining samples from the sending country (Mexico) and the receiving country (U.S.). We evaluate the hypotheses that (1) higher parental education predicts better cognitive function later in life, (2) participants' educational attainment mediates the associations between parental education and cognitive function, (3) migration status modifies the associations between participant's education and cognitive function.

2.2 Materials and Methods

Study population

This study is based on cross-sectional analysis of baseline data from the Sacramento Area Latino Study on Aging (SALSA) and the Mexican Health and Aging Study (MHAS). SALSA is a longitudinal cohort study of 1,789 community-dwelling older Mexican Americans residing in California's Sacramento Valley and aged 60-101 years at baseline in 1998-1999. The participants were re-assessed every 12-15 months through 2008. The study population and the recruitment of SALSA participants have been described elsewhere (69). SALSA was approved by the Institutional Review Board (IRB) at the University of California, San Francisco and Davis, and the University of Michigan. MHAS is a two-wave prospective panel study of Mexican residents aged 50 and above in 2001 based on the 2000 Mexican National Employment Survey. A total of 5,253 sampled participants aged 60 and above at baseline were included in the present analysis. A detailed description of MHAS study has been published elsewhere (85-86). MHAS was approved by the IRB of the Universities of Pennsylvania, Maryland, and Wisconsin.

Measures

Cognitive function: Within SALSA, cognitive function was assessed using the Spanish and English Verbal Learning Test (SEVLT). The SEVLT is a test of short-term verbal recall that has been validated in both English and Spanish. SEVLT consists of four 15-word memory trials, an interference trial, followed by a fifth trial. Scores range from 0 to 15 for each trial. The score from the fifth trial is used as the delayed verbal recall test. Within MHAS, the test consists of three 8-word memory trials, an interference exercise, followed by a fourth trial with scores ranging from 0 to 8 for each trial. The score from

the fourth trial is used as the delayed verbal recall test. The cognitive scores of each study population were separately standardized to a mean of 0 and a standard deviation of 1. The resulting cognitive z-scores from SALSA and MHAS were then combined into one variable and used in the analysis. A higher z-score is indicative of better cognitive performance. The short-term verbal recall test is the only cognitive test in common between SALSA and MHAS and henceforth will be referred to as cognitive function/ z-score throughout the paper.

Parental and participant's education: Within SALSA, participants reported the years of education that their mother and father completed. Within MHAS, participants reported the highest level of education that their mother and father completed. Those variables were coded as ordinal where 0 was coded as 'no education', 1 to 5 years of education as 'less than elementary', 6 years of education as 'completed elementary', and 7 years of education and above as 'more than elementary'. Mother and father's education were examined separately in support of previous literature suggesting that mothers and fathers contribute in different ways to the socioeconomic context-cognitive function association (45). Within SALSA and MHAS, participants also reported the years of education they have completed. Participant's education was used as a continuous variable.

Participant's household income and occupation: Within SALSA and MHAS, participants reported their monthly household income and/or pension. Tertiles of income were created as low, medium, or high. Within SALSA and MHAS, participant's occupation was dichotomized into manual and non-manual. Housewives and unemployed were placed in the manual category.

Health conditions: Within SALSA and MHAS, health conditions such as diabetes, hypertension, stroke, and heart attack were self-reported by asking the participants whether a doctor or other medical personnel ever told them that they have the appropriate medical diagnoses. Having medical insurance was self-reported and was coded as yes or no.

Migration status: Within SALSA, migration status was determined by asking participants about their country of birth. Nearly 50.8% of SALSA participants were immigrants. Within MHAS, migration status was determined by asking participants about their migration history. Participants were either non-migrant permanent residents of Mexico or migrants to the U.S. who returned back to Mexico. Approximately, 89% of MHAS participants in this analysis never migrated from Mexico.

2.3 Statistical Analysis

The sample included four comparison groups based on the participant's migration status: 1) Mexican residents (Mx); 2) Mexicans-return migrants (Mx-Rm); 3) permanent Immigrants to the U.S. (Mx-Img); and 4) Mexicans-U.S. born (Mx-U.S. born). Groups 1 and 2 were from MHAS and Group 3 and 4 were from SALSA. Mexican resident (Mx) was used as the reference group in regression models. Mother's and father's education were coded into indicator variables as none, some elementary, completed elementary, and more than elementary. 'None' was used as the reference category in regression models. The distribution of descriptive characteristics was examined across the comparison groups and group differences within SALSA and MHAS were tested using one-way ANOVA for continuous variables and chi-square tests for categorical variables.

Generalized linear regression models were used to evaluate the associations between parental education and the participant's cognitive z-score while adjusting for covariates. Those covariates were selected based on the literature and on their association with both parental education and the participant's cognitive z-score. Model 1 adjusted for age and gender; model 2 added adjustment for participant's education; model 3 added adjustment for migration status, household income, participant's occupation, health conditions, and medical insurance; model 4 added adjustment to model 2 for migration status and interactions between migration status and participant's education; and model 5 adjusted simultaneously for all covariates. Regression coefficients (Beta estimates) and standard errors were computed. The two datasets were combined and all models either included a study term referring to SALSA or MHAS or included the participant's migration status. All analyses were conducted using SAS v.9.2 (87).

Data Imputation

In an attempt to deal with any biasing effects of missing data, a multiple imputation approach was performed for the entire SALSA dataset. This approach conditioned on all observed variables as predictors in a sequential regression multivariate imputation (SRMI) (88-89). By using all available variables, the multiple imputation approach provides unbiased estimates and improves efficiency, compared to other alternative analytical approaches such as the list-wise deletion analysis. Moreover, while the list-wise deletion approach assumes that data are missing completely at random, which is rarely valid in epidemiologic studies (90), the SMRI approach used in this analysis imposes a less restrictive assumption on missing data. Five data sets were imputed for SALSA using the Imputation and Variance Estimation Software (91). In the

present analysis, we only used imputed data for mother and father's education. Five sets were run for all corresponding regression analyses and were summarized using the 'MIANALYZE' procedure in SAS v.9.2.

2.4 Results

Table 1 presents study-specific baseline characteristics by migration status within each study. Within MHAS, the majority of Mexicans-return migrants was men and more likely than non migrants to be former or current smokers and to have ever consumed alcohol. Return migrants were also more likely to have higher household income than non-migrants. Other baseline characteristics did not differ by migration status including years of educational achievement, major lifetime occupation, cognitive z-scores, medical conditions, and parental education.

Within SALSA, Immigrants to the U.S. were older and less educated than the U.S.-born. Compared to immigrants, the U.S.-born were less likely to have never smoked and more likely to have ever consumed alcohol. The U.S.-born had significantly higher cognitive z-scores than immigrants. The U.S.-born were more likely to suffer from diabetes, stroke, and hypertension and to have medical insurance. The U.S.-born were more likely to have a non-manual occupation and to report a higher household income compared to immigrants. While father's education did not differ by migration status; the U.S.-born were more likely to have mothers who achieved higher levels of education compared to immigrants.

Figure 1 illustrates the distribution of unadjusted cognitive z-scores of the participants by migration status. Overall, cognitive z-scores were higher among the U.S.-born (median= 0.22; mean ± SD=0.15±0.99) compared to U.S. immigrants (median=-

0.10; mean ± SD=-0.14±0.99), non-migrant residents of Mexico (median=0.17; mean ± SD=0.01±1.00), and return migrants (median=0.17; mean ± SD=-0.04±0.98).

Table 2 presents study-specific results from linear regression models for the bivariate associations between parental education and the participant's cognitive function, by study and migration status. Within MHAS, higher father's education was associated with better cognitive function among non-migrants. Return migrants whose fathers completed more than elementary showed better cognitive function than those whose fathers had no education. Higher mother's education was associated with better cognitive function among non migrants but not for return migrants whose mothers completed elementary education.

Within SALSA, no significant associations were observed between father's education and cognitive function. Immigrants to the U.S. whose mothers completed elementary showed better cognitive function than those whose mothers had no education. The U.S.-born whose mothers completed more than elementary education showed significantly better cognitive function compared to those whose mothers had no education.

Table 3 presents the results of a series of linear regression models for the associations between mother's education and participant's cognitive function. In model 1, participants whose mothers had any education were likely to show better cognitive function than those whose mothers had no education. For example, the cognitive z-score of participants whose mothers had more than elementary was 0.28 compared to participants whose mothers had no education. Adjusting for participant's education in model 2 reduced the associations between mother's education and participant's cognitive

function. For participants whose mother had more than elementary, adjustment for participant's education reduced the coefficient by 75%. Associations between mother's education and participant's cognitive z-scores remained unchanged after adding adjustment for migration status, health conditions, and household income in model 3. In models 2 and 3 the adjusted associations between mother's education and participant's cognitive function were non-significant. Model 4 added interaction terms between participant's education and migration status (ref=non-migrating resident of Mexico). The association between participant's education and cognitive function was significantly different by migration status for the U.S.-born (p-value <0.05). For every 5 year difference in education, the cognitive z-score of a U.S.-born increased by 0.3 points (or 6.3% on the raw cognitive score). The latter interaction remained significant in the fully adjusted model 5.

Table 4 presents the results of a series of linear regression models for the association between father's education and participant's cognitive function. In model 1, participants whose father had higher educational levels were likely to show better cognitive function than those whose father had no education. For example, the cognitive z-score of participants whose father had more than elementary was 0.23 compared to participants whose father had no education. Adjusting for participant's education in model 2 reduced the associations to non-significance between father's education and cognitive function. For participants whose fathers had more than elementary education, adjustment for participant's education reduced the coefficient by 86.9%. Associations between father's education and participant's cognitive z-scores remained unchanged after adding adjustment for migration status, health conditions, and household income in

model 3. Model 4 added interaction terms between participant's education and migration status (ref=non-migrating resident of Mexico). The association between participant's education and cognitive function was significantly different for the-U.S.-born (p-value <0.05). For every 5 year difference in education, the cognitive z-score of a U.S.-born increased by 0.3 points. The latter interaction remained significant in the fully adjusted model 5.

Further results from mediation analysis (data not shown) showed that participant's educational achievement mediated 71.4% of the total effect between mother's education and participant's cognitive function. Participant's education also mediated 81% of the total effect between father's education and participant's cognitive function. Both partially mediated effects were statistically significant based on the computed Sobel test (92).

2.5 Discussion

Using data from MHAS and SALSA, we evaluated the three hypotheses on the associations between lifecourse exposure to education and cognitive function later in life among a cohort of older Mexicans and Mexican Americans. Findings from this study showed significant associations between childhood SES, indicated by mother and father's education, and participant's cognitive function later in life. The latter associations were mediated by participants' educational achievement. The association between participant's education and cognitive function was significantly different for the U.S.-born compared to the permanent residents of Mexico.

This study suggests that mother and father's education do not exert direct effects on cognitive function later in life. Our results are different from earlier work showing

independent effects of childhood SES on late middle-age cognitive function (33, 45, 77, 93). In a population-based study of eastern Finnish men, lower childhood SES measured as parental education and occupation was associated with poorer late middle-age cognitive function. A residual effect of childhood SES was still observed after adjustment for educational attainment (45, 77). Results from the 1998 Health and Retirement Study (HRS) showed attenuation in the effect of childhood SES, measured as parental education and occupation and financial well-being, on cognitive functioning after adjustment for adulthood SES, education and household income in particular (33). Moreover, results from the Chicago Health and Aging Project found a positive association between childhood SEP and childhood cognitive milieu and cognitive function in old age, independent of one's educational attainment (93). Our results however are consistent with other published work reporting the absence of a direct effect between childhood SES and late-life cognitive function. A longitudinal cohort study of British civil servants suggested that the influence of childhood SES on cognitive function was mediated through adult measures of SES including occupation and income (4). Results from the British 1946 birth cohort reported that the effect of father's occupation on midlife cognitive function was mediated by educational attainment (94).

Although our study did not find independent effects for parental education on cognitive function after accounting for their offspring's own educational achievement, this does not undermine the importance of childhood circumstances in shaping cognitive function. Childhood SES is suggested to contribute to children's cognitive development through the quality and quantity of parent-child interactions and verbalization. For example, a positive environment with a stimulating learning exposure results in better

brain development due to increased neuronal branching, synaptic density and networking (95-96). Similarly, the literature emphasizes the importance of intrauterine and early childhood nutritional status on cognitive development especially in developing countries where such deprivations are common (71, 73-74). Our results further suggest that the influence of childhood SES on cognitive function later in life is largely mediated by educational attainment, a marker for adolescence and early adulthood SES. While this supports a growing body of literature describing the unique and protective effect of education on cognition (3, 6, 76, 97-98); this does not mean that parental education does not have an effect on cognitive function but rather suggests that it shares the same pathway by which one's educational achievement affects cognition. These findings support a life course explanation for the association between education and cognitive function in which it is possible that a better childhood SES environment triggers higher educational achievement and a motivation to more successful and stimulating opportunities throughout the life. These findings may also suggest that higher education may contribute in old age to 'brain reserve' or capacity through compensating strategies that help to maintain cognitive function later in life.

In the present study, higher participant's education was associated with better cognitive function. However, our findings showed that the association between participant's education and cognitive function was significantly different for the U.S.-born compared to permanent residents of Mexico. In other word, with increased education, the cognitive benefit was more pronounced (steeper positive slope) among the U.S. born compared to permanent residents of Mexico (the significant participant's education-migration status interactions). For the remaining migration groups (US

immigrants and return migrants), the cognitive benefit associated with increased education was less pronounced and showed similar slopes as the permanent residents of Mexico. Several interpretations present themselves. First, in addition to the differences in educational achievement between SALSA and MHAS participants, some of the cognitive differences observed between the four groups possibly may be attributed to the better quality of education in the U.S. compared to Mexico. When it comes to health outcomes such as cognitive aging, researchers in the field argue that years of education and quality of education are both important but different predictors, especially in cross-cultural research (99). Second, while immigrants to the U.S. are usually a select group compared to their U.S.-born counterparts in terms of health-related and psychosocial characteristics which are translated into better cognitive function later in life (99); in SALSA, the average time since migration was 40 years. We assume that this passage of several decades is likely to have reduced the effect of migration selection. Third, while migration has been linked to better cognitive aging--partly because of the intellectual and cognitive demands associated with adjustment to a new environment-- it is possible that such benefits may have been buffered by migration-associated stressors (99). Despite the predicted importance of education, migration history appears to be a more important predictor of cognition and the differences observed between the four groups were not fully explained by differences in education (parental or offspring). Existing literature exploring the association between education and cognitive function among Hispanics is very scarce. Results from the Asset and Health Dynamic among the oldest Old (AHEAD) study showed a ceiling effect of education on cognitive function after few years of schooling among Latinos (3). While the Latino participants of the AHEAD study were

either U.S. born or foreign-born, the study did not have enough power to compare the two groups. Hence, more research is needed to confirm our results and attempt to understand the mechanisms underlying migration and cognitive aging.

Our findings from the present study showed that Mexican Americans have a greater prevalence of type-2 diabetes and stroke compared to Mexicans living in Mexico. Such health conditions were also found to be associated with worse cognitive functioning. It is possible that migration to the U.S. results in a new cultural context that shapes risk factors for cognitive functioning through various pathways including behavioral or nutritional. Furthermore, while such risk factors may act in part as mediators on the pathway linking education and cognitive function, adjusting for them in the multivariate analyses only decreased the coefficient of participant's education by 25%. Thus, there remains a significant direct effect of education on cognitive function that is unexplained by these highly prevalent health conditions.

There are a few limitations to the conclusions of this study. First, the measures of parental education were reported by their offspring retrospectively possibly resulting in some recall bias. Second, SALSA and MHAS differ in their eligibility criteria and in their various assessments. In an attempt to address this concern, we included a study term referring to the dataset or included the migration status of the participant from each study and cognitive test scores were standardized. Third we were limited to using the delayed verbal recall test which is the only test in common between SALSA and MHAS and which consequently limited our ability to examine other cognitive domains. However, the delayed verbal recall test correlates highly with other tests of global cognitive function such as the Modified Mini Mental State Exam (3MSE) (100). In spite of these limitations,

this is the first population-based study to examine the influence of migration on the association between life course exposure to education and late-life cognitive function among older Mexicans and Mexican Americans. This study has also a major strength added by the large sample size offered by the two datasets, MHAS and SALSA.

Our results from this study showed an association between parental education and participant's cognitive function later in life and which was largely explained by participant's educational achievement. Participant's migration history was found to have a modifying role on the association between participant's education and their cognitive function. With the growing Hispanic composition of the immigrant population to the U.S. (47), further work exploring the interplay between lifetime exposure to education and migration on late-life cognitive function is warranted. Building on this work is important for understanding the underlying mechanisms of health disparities and for planning interventions targeted at reducing the associated health effects.

Figure 2.1. Distribution of cognitive z-scores by migration status

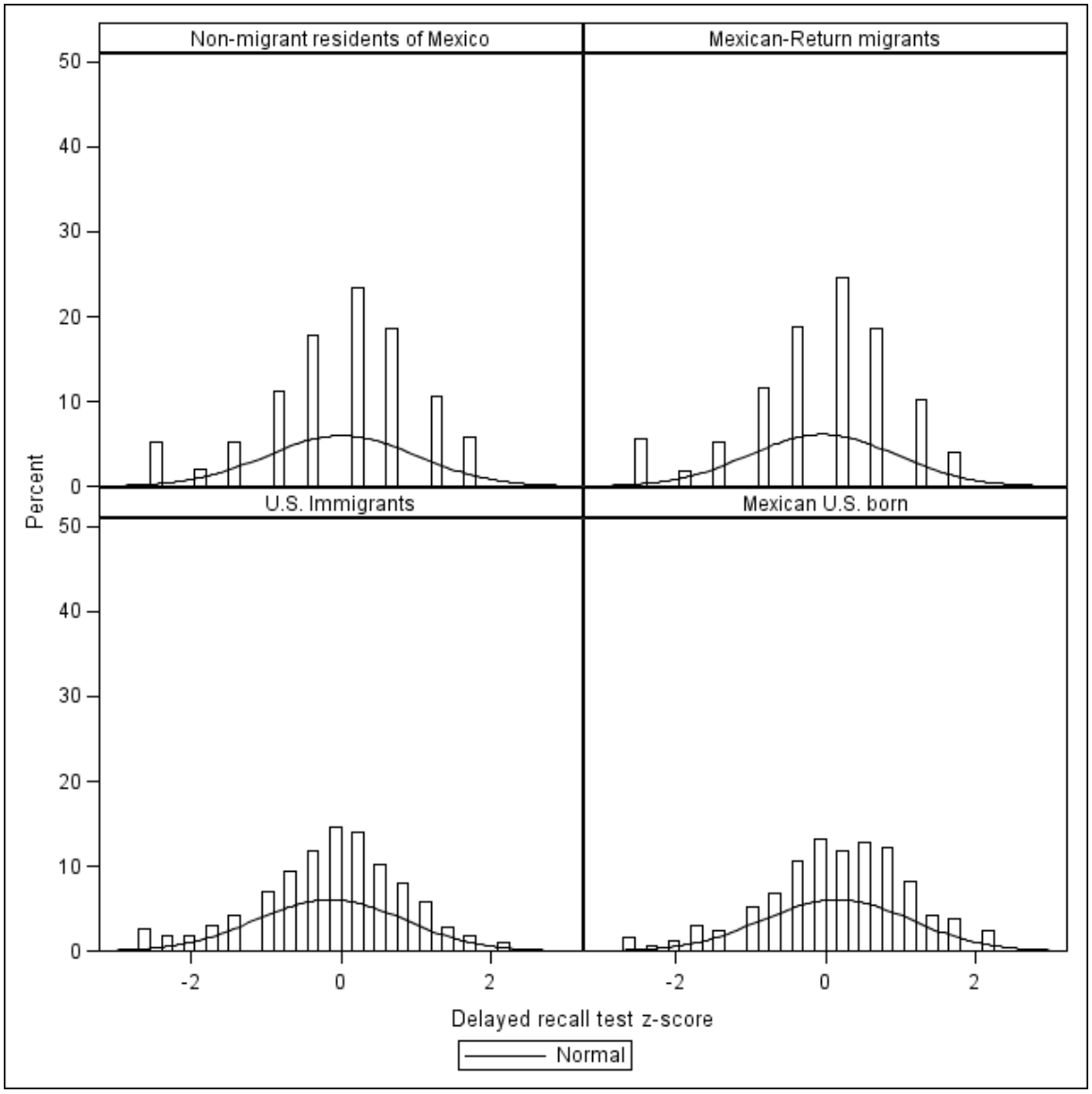


Table 2.1. Baseline characteristics of the study population, by study and migration status

		MHAS			SALSA		
		Overall	Mexican	Mexican-Return Migrant	P-value[a]	Mexican-Immigrant	Mexican-U.S.-born	P-Value[b]
	N	N=7042	n=4687	n=562		n=908	n=871	
Participant's characteristics								
Gender (%men)	2966	42.1	37.8	79.9	<0.01	39.7	43.4	0.11
Age in years	7042	70.6±7.7	70.5±8.0	71.3±7.7	0.04	71.2±7.7	70.1±6.4	<0.01
Education in years	7021	4.4±4.6	3.5±3.9	3.5±4.0	0.73	5.0±4.7	9.6±4.9	<0.01
Smoking (%)					<0.01			0.03
Never	3744	53.3	58.7	31.4		48.9	43.2	
Former	2289	32.6	27.5	43.7		39.6	45.5	
Current	990	14.1	13.8	25.0		11.5	11.4	
Alcohol (%ever)	3981	56.8	55.9	75.7	<0.01	48.8	57.8	<0.01
Cognitive z-score	6257	0.0±1.0	0.01±1.0	-0.04±0.98	0.32	-0.14±0.99	0.15±0.99	<0.01
Diabetes (%yes)	1393	20.2	17.6	15.2	0.17	24.6	32.7	<0.01
Stroke (%yes)	351	5.1	3.4	4.9	0.09	7.2	11.8	<0.01
Heart attack (%yes)	374	5.4	4.2	4.9	0.44	7.5	9.9	0.08
Hypertension (%yes)	3007	43.8	43.3	39.1	0.06	44.2	49.0	0.04
Medical insurance (%yes)	4815	68.6	61.8	55.2	<0.01	84.2	97.5	<0.01
Occupation (%Manual)	5479	78.3	77.9	79.7	0.36	88.3	68.9	<0.01
Household income (%)					0.02			<0.01
Low	3418	48.9	50.8	46.3		59.3	29.9	
Medium	1723	24.7	19.3	18.0		35.6	46.8	
High	1843	26.4	29.9	35.8		5.1	23.3	
Parents' characteristics								
Father's education					0.60			0.52
None	3159	53.3	55.5	57.4		49.4	50.4	
Some elementary	1604	27.1	30.0	27.0		27.6	25.2	
Completed elementary	504	8.5	8.4	9.3		8.8	8.2	
More than elementary	662	11.2	6.1	6.3		14.3	16.2	

Table 2.1. Continued

		MHAS				SALSA		
		Overall	Mexican	Mexican-Return Migrant	P-value[a]	Mexican-Immigrant	Mexican-U.S.-born	P-Value[b]
	N	N=7042	n=4687	n=562		n=908	n=871	
Mother's education					0.07			<0.01
None	3625	60.2	63.1	63.2		55.9	49.0	
Some elementary	1504	25.0	26.1	24.7		26.0	25.6	
Completed elementary	496	8.2	8.1	7.2		10.1	9.9	
More than elementary	399	6.6	2.7	4.9		8.0	15.5	

[a] *p*-value comparing within MHAS;
[b] *P*-value comparing within salsa;
*Data are presented as mean ± SD

Table 2.2. Results from linear regression models for the Bivariate associations between parental education and the offspring's cognitive z-scores, by study and migration status

	MHAS		SALSA	
	Mexican	Mexican-Return Migrant	Mexican-Immigrant	Mexican-U.S.-born
	n=4687	n=562	n=908	n=871
Father's education (REF=none)				
Some elementary	0.24 (0.04)*	0.002 (0.11)	0.10 (0.10)	0.13 (0.11)
Completed elementary	0.32 (0.06)*	0.19 (0.17)	0.21 (0.13)	0.17 (0.17)
More than elementary	0.43 (0.07)*	0.41 (0.20)*	0.05 (0.11)	0.14 (0.15)
Mother's education (REF=none)				
Some elementary	0.22 (0.04)*	0.27 (0.11)*	0.21 (0.11)	0.18 (0.13)
Completed elementary	0.34 (0.06)*	0.17 (0.18)	0.26 (0.11)*	0.32 (0.15)
More than elementary	0.41 (0.10)*	0.85 (0.22)*	0.02 (0.12)	0.34 (0.11)*

*p-value<0.05

**Data are presented as β (SE)

Table 2.3. Multivariate Linear regression models for the association between mother's education and the offspring's cognitive z-scores

	Model 1	Model 2	Model 3	Model 4	Model 5
	B (SE)	**B (SE)**	**B (SE)**	**B (SE)**	**B (SE)**
Independent variable					
Intercept	2.52 (0.12)*	2.14 (0.12)*	2.15 (0.13)*	2.14 (0.12)*	2.17 (0.13)*
Mother's education					
None (REF)					
Some elementary	0.15 (0.03)*	0.05 (0.04)	0.05 (0.04)	0.06 (0.04)	0.06 (0.04)
Completed elementary	0.26 (0.05)*	0.07 (0.05)	0.07 (0.05)	0.09 (0.05)	0.08 (0.05)
More than elementary	0.28 (0.06)*	0.07 (0.06)	0.06 (0.06)	0.07 (0.06)	0.06 (0.06)
Study (SALSA vs. MHAS)	0.01 (0.03)	-0.13 (0.03)*			
Age (in years)	-0.04 (0.002)*	-0.04 (0.002)*	-0.03 (0.002)*	-0.04 (0.002)*	-0.03 (0.002)*
Gender (females vs. males)	0.26 (0.03)*	0.29 (0.02)*	0.32 (0.03)*	0.30 (0.03)*	0.32 (0.03)*
Participant's education (in years)		0.04 (0.003)*	0.03 (0.004)*	0.04 (0.004)*	0.03 (0.005)*
Migration status					
Non-migrating resident of Mexico (REF)					
Mexican-Return migrant			0.13 (0.05)*	0.13 (0.07)*	0.13 (0.07)*
Mexican-Immigrant to the U.S.			-0.09 (0.04)*	-0.16 (0.05)*	-0.13 (0.05)*
Mexican-U.S. born			-0.01 (0.04)	-0.23 (0.07)*	-0.15 (0.08)*
Interaction terms					
Participant's education x Mx-RM				-0.003 (0.01)	0.0003 (0.01)
Participant's education x Mx-Img				0.01 (0.01)	0.01 (0.01)
Participant's education x Mx-U.S. born				0.02 (0.01)*	0.02 (0.01)*
Health variables					
Diabetes (yes vs. no)			-0.12 (0.03)*		-0.12 (0.03)*
Stroke (yes vs. no)			-0.30 (0.06)*		-0.29 (0.06)*
Heart attack (yes vs. no)			0.06 (0.06)		0.06 (0.06)
Hypertension (yes vs. no)			-0.04 (0.03)		-0.04 (0.03)
Medical insurance (yes vs. no)			0.06 (0.03)		0.07 (0.03)*
Occupation					
Manual			-0.05 (0.03)		-0.06 (0.03)
Non-manual (REF)					
Household income					
Low			-0.09 (0.03)*		-0.09 (0.03)*
Medium			-0.04 (0.04)		-0.05 (0.04)
High (REF)					

*p-value <0.05

Table 2.4. Multivariate Linear Regression models for the association between father's education and the offspring's cognitive z-scores

	Model 1	Model 2	Model 3	Model 4	Model 5
	B (SE)	**B (SE)**	**B (SE)**	**B (SE)**	**B (SE)**
Independent variable					
Intercept	2.61 (0.12)*	2.20 (0.12)*	2.22 (0.13)*	2.20 (0.13)*	2.23 (0.13)*
Father's education					
None (REF)					
Some elementary	0.13 (0.03)*	0.04 (0.03)	0.04 (0.03)	0.05 (0.03)	0.05 (0.03)
Completed elementary	0.21 (0.05)*	0.04 (0.05)	0.02 (0.05)	0.06 (0.05)	0.04 (0.05)
More than elementary	0.23 (0.05)*	0.03 (0.06)	0.04 (0.06)	0.05 (0.06)	0.05 (0.06)
Study (SALSA vs. MHAS)	0.02 (0.03)	-0.12 (0.03)*			
Age (in years)	-0.04 (0.002)*	-0.04 (0.002)*	-0.04 (0.002)*	-0.04 (0.002)*	-0.04 (0.002)*
Gender (females vs. males)	0.26 (0.03) *	0.29 (0.02)*	0.33 (0.03)*	0.30 (0.03)*	0.33 (0.03)*
Participant's education (in years)		0.04 (0.003)*	0.03 (0.004)*	0.04 (0.004)*	0.03 (0.005)*
Migration status					
Non-migrating resident of Mexico					
Mexican-Return migrant			0.13 (0.05)*	0.14 (0.07)*	0.14 (0.07)*
Mexican-Immigrant to the U.S.			-0.08 (0.04)*	-0.16 (0.05)*	-0.13 (0.05)*
Mexican-U.S. born			0.0004 (0.04)	-0.22 (0.07)*	-0.14 (0.08)
Interaction terms					
Participant's education x Mx-RM				-0.01 (0.01)	-0.003 (0.01)
Participant's education x Mx-Img				0.01 (0.01)	0.01 (0.01)
Participant's education x Mx-U.S. born				0.02 (0.01)*	0.02 (0.01)*
Health variables					
Diabetes (yes vs. no)			-0.13 (0.03)*		-0.13 (0.03)*
Stroke (yes vs. no)			-0.29 (0.06)*		-0.29 (0.06)*
Heart attack (yes vs. no)			0.06 (0.06)		0.06 (0.06)
Hypertension (yes vs. no)			-0.03 (0.03)		-0.03 (0.03)
Medical insurance (yes vs. no)			0.05 (0.03)		0.06 (0.03)
Occupation					
Manual			-0.06 (0.03)		-0.06 (0.03)
Non-manual (REF)					
Household income					
Low			-0.09 (0.04)*		-0.09 (0.04)*
Medium			-0.05 (0.04)		-0.05 (0.04)
High (REF)					

*p-value <0.05

Chapter 3

Life Course Socioeconomic Position and Incidence of Dementia and Cognitive Function Without Dementia in Older Mexican Americans: Results from the Sacramento Area Latino Study on Aging

3.1 Introduction

There is a wealth of literature that suggests that low socioeconomic position (SEP), assessed with a range of measures, including educational attainment (10-22) and occupation (6-9, 11, 16), is associated with late life dementia. These associations have been increasingly linked to early-life socioeconomic environment (41-44) which may influence brain and cognitive development (41, 70-72, 74, 76) and potentially increase risk of dementia later in life (41). Accordingly, the influence of SEP on dementia is best described within a lifecourse context.

The proportion of older U.S. Hispanics is growing quickly (47) with sixty-six percent of Mexican descent. Mexican Americans and some other minority groups are disproportionately burdened with dementia (15, 48-50) and dementia risk factors such as hypertension or type-2 diabetes (51-53) compared to non-Hispanic whites. The life course socioeconomic experience of U.S. Hispanics is complex, for example, beneficial changes in SEP trajectories from childhood to adulthood have been documented (61-62) to have protective effects on cognitive function (62). However, most of the work examining racial/ethnic differences in dementia in the U.S. has focused on non-Hispanic white and black populations (10, 50, 64-68) and less is known about dementia among U.S. Mexican Americans (49, 69).

To our knowledge, there have been no studies to date that examine the association between changes in SEP across the life course and dementia incidence among Mexican Americans. In the current analysis we examine the association of life course SEP trajectory with incident dementia and cognitive impairment without dementia (CIND) in a cohort of older Mexican Americans.

3.2 Materials and Methods

Study population

Participants in this analysis were from the Sacramento Area Latino Study on Aging (SALSA). SALSA is a longitudinal cohort study of 1,789 community-dwelling Mexican Americans residing in California's Sacramento Valley and aged 60-101 years at baseline in 1998-1999. The study population and the recruitment of participants have been described elsewhere (69). SALSA was approved by the Institutional Review Board (IRB) at the University of Michigan and the University of California, Davis. Clinical data were collected on participants in home visits every 12 to 15 months for a total of seven follow-up visits. Participants reported health conditions, lifestyle and socio-demographic risk factors. Baseline cases of dementia/CIND were excluded from this analysis (n=155) and the remaining (N=1634) participants were followed for an average of 6.3 years (SD=3.1). Mortality surveillance is still ongoing.

Measures

Dementia/CIND diagnosis: A multistage screening process was used. In the first stage, the Modified Mini Mental State Examination (3MSE), a 100 point global cognitive test, (101) and the Spanish and English Verbal Learning Test (SEVLT), a memory word list

recall test (102) were administered. If participants scored below the 20th percentile on either test, or if participants 3MSE or SEVLT scores declined by more than 8 points or 3 points from the previous exam, participants were referred for further neuropsychological testing. In the second stage, the neuropsychological test battery (Spanish English Neuropsychological Assessment Scales (SENAS)) (103) and the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) were used to determine the need for further neurological examination based on the following criteria: a score ≥3.40 on the IQCODE and below the 10th percentile on at least one of the SENAS tests, a score below the 10th percentile on at least 4 SENAS tests, or a score >4.0 on the IQCODE. In the third stage, neurologists and neuropsychologists diagnosed potential cases of dementia based on the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) (104) and National Institute of Neurologic and Communicative Disorders and Stroke-Alzheimer Disease and Related Disorders Association (NINCDS-ADRDA) (105) criteria. Participants were classified as normal, cognitively impaired but not demented (CIND) or demented. Demented cases were subject to further magnetic resonance imaging (MRI) and laboratory tests. In this analysis, dementia and CIND cases were combined into one outcome: dementia/CIND.

Life course SEP: We included measures from three life stages. Parental education and occupation, food deprivation while growing up, and childhood sibling mortality were measures of childhood SEP. As conceptualized here, participant's educational attainment and lifetime occupation were measures of early-adulthood and mid-life SEP, respectively. Both mother's and father's education were classified as low (< elementary) or high (≥elementary). Mother's occupation was classified as low (manual or housewives) or

high (non-manual) and father's occupation was classified as low (manual or unemployed) or high (non-manual). Participants reported how often they did not have enough to eat while growing up which was coded as low (ever lacked enough to eat) or high (never). Participants reported if any siblings died in childhood which was classified as present or absent. Participants with no siblings (1.93%) were classified as having no sibling mortality. All childhood SEP variables were assigned a score of 0 (high SEP) or 1 (low SEP) and then added together into a composite measure that estimates overall childhood SEP. Total childhood SEP score (0-6) was split at the median and re-coded into 0 (high SEP) or 1 (low SEP). Participant's education was obtained by asking them the years of education they completed and classified as low (<elementary) or high (≥elementary). Participants reported their major lifetime occupation which was classified as low (manual, unemployed, or housewives) or high (non-manual).

A four-level SEP trajectory measure was created with each level representing a distinct trajectory from childhood to early adulthood and mid-life (Figure 1): 1) low SEP at all stages (referent category): LLL; 2) downward SEP: HLL, LHL, or HHL; 3) upward SEP with low education: LLH or HLH; and 4) high SEP at all stages or upward SEP with high education: HHH or LHH (33, 77). Given the established importance of education in predicting dementia/CIND (6, 10-11, 13, 15, 19, 21, 98, 106-108), participants of upward SEP with high education were separated from those with low education. Furthermore, those with high education were merged with participants whose trajectory was always high since they had statistically similar hazards of dementia/CIND.

Cumulative SEP disadvantage: A variable measuring cumulative disadvantage (range 0-8) was constructed by summing dichotomous childhood, early adulthood, and mid-life SEP measures. A greater score represents greater disadvantage.

Other covariates: Nativity was constructed based on participants' report of their country of birth. Participants were either born in the U.S. or born in Mexico or another Latin American country but then migrated to the U.S. Nearly all immigrants were born in Mexico. Nativity was coded as US-born or Mexican-born. Participants reported their past-month household income which was split at the median and classified as low (income <$1,500) or high (income ≥$1,500). Glucose levels were measured from fasting blood and blood pressure was measured at each home visit. Diabetes was ascertained as a self-report of an MD diagnosis, use of diabetes medication, and/or a fasting glucose level ≥126 mg/dl (109). Hypertension was ascertained as a self-report of an MD diagnosis, use of medication, a systolic blood pressure >140 mm Hg, and/or a diastolic blood pressure >90 mm Hg (110). A stroke event was ascertained by self-report of an MD diagnosis including hospitalization for stroke. Anthropometric measures such as height (in cm) and weight (in Kg) were measured. Body mass index (in Kg/m^2) was derived and classified as normal (<25.0), overweight (25.0-29.9), and obese (≥30). Waist circumference (in cm) was measured and classified into sex-specific tertiles whose values were then combined for men and women. Participants reported whether they had health insurance, their baseline smoking status (ever/never) and alcohol consumption (never, <2drinks/week, ≥2 drinks/week).

3.3 Statistical Analyses

All statistical analyses were performed using SAS v.9.2 (87). Cox proportional hazards models were used with "PHREG" to examine the risk of dementia/CIND. Participants contributed observed time at risk beginning with their enrollment in the study (111). Time was considered as participants' age (112) and accordingly an entry point (age at enrollment) and an ending point (age at dementia/CIND diagnosis or censoring) were modeled in an attempt to address left truncation, the time at which participants contributed unobserved time at risk. Ties were handled using the 'discrete' option which assumes no underlying ordering for two events occurring at the same time. Participants without a dementia/CIND diagnosis by the end of study period were right censored at the age of their last available contact. A total of 27 deaths with dementia listed as a cause were identified from mortality surveillance, occurred during the study period, and were censored at their age of death.

Cox proportional hazards models were used to examine bivariate associations between covariates, selected based on the literature, and the risk of dementia/CIND. A series of Cox proportional hazards models were also used to evaluate the associations between life course SEP measures and the risk of dementia/CIND, adjusting for age, income, alcohol consumption, diabetes, and stroke. Inclusion of covariates at the multivariate level was based on their association with dementia/CIND at the bivariate level and their association with life course SEP. Hazard ratios (HR), 95% confidence intervals (CI) and two-sided P values were computed. Interactions between nativity, age at enrollment and life course SEP measures were tested separately. These interactions were not significant and were not included in the final models. Monthly household income often declines with retirement and is not an accurate measure of past income. It

was not included in the SEP trajectory but was adjusted for as a covariate in the multivariate analyses. We differentiated between diabetic participants who were treated and those untreated. Indicator variables for treated, untreated, and not diabetic (reference) were used. Incidence rates of dementia/CIND (per 1000 person-years) by SEP trajectory were calculated by dividing the number of dementia/CIND cases in each SEP trajectory by the number of person-years at risk contributed by participants within that trajectory.

Data Imputation

Prior to imputation, one fourth of the participants had missing data at any point during the study follow up time. Most of this was due to mortality (n=522). We performed sensitivity analyses using the non-imputed SALSA dataset. Similar conclusions were found with unchanged statistical significance compared to the analysis using multiple imputations. A multiple imputation approach was performed for the entire SALSA dataset to accommodate incomplete data points. It is a sequential regression multivariate imputation (SRMI) approach that conditions on all observed variables as predictors (88-89). The different imputations are run in a cyclic manner that overwrites previously drawn values and build interdependence between the imputed values. By using all available variables, the multiple imputation approach provides less biased estimates while improving efficiency compared to other alternative analytical approaches such as the list-wise deletion analysis. While such alternative approaches assume that data are missing completely at random, an assumption that is rarely valid in epidemiologic studies (90), the SMRI approach used in this analysis imposes a less restrictive assumption. The efficiency of the estimates levels-off after the production of a few imputed datasets (88), hence five imputations were produced for the SALSA dataset

using the Imputation and Variance Estimation Software (91). Baseline and six follow-up examinations were used in this analysis.

3.4 Results

Incidence rates of dementia/CIND are presented in Table 1 by SEP trajectory. A total of 234 participants developed dementia/CIND over the study period for an overall incidence rate of 23.0/1000 person-years at risk. While dementia/CIND incidence rates were lowest among participants with high SEP, incidence rates were highest among those with low SEP, followed by upward SEP with low education, and those with downward SEP.

Figure 2 illustrates the adjusted 'survival' curves to dementia/CIND diagnosis by SEP trajectory based on age at diagnosis. Participants of high SEP showed better survival curves than those of low SEP. Participants with upward SEP with low education or downward SEP had similar curves as participants of low SEP.

Baseline life course socioeconomic characteristics of the study population are presented in Table 2, overall and by SEP trajectory. Most of the participants had a manual occupation and a past-month income <$2,500. The majority of the participants had mothers and fathers with less than elementary education and most fathers had a manual occupation. Nearly all mothers worked at home. Over 21% of the participants experienced food deprivation when growing up and 49.3% reported childhood sibling mortality. Overall, participants experienced a mean cumulative SEP disadvantage of 5.4 (SD=1.5). SEP variables differed significantly across the four SEP trajectory groups. Participants with more disadvantaged SEP trajectories were more likely to have parents

with low education and manual occupations, to have experienced food deprivation when growing up, and to have experienced childhood sibling mortality.

Baseline characteristics of the study population and their bivariate associations with dementia/CIND from Cox proportional hazards models are presented in Table 3. Participants had a mean age of 70.1 years at enrollment (SD=6.7). The majority of participants were women and about half of the participants were born in Mexico (45%) or another Latin American country (5.5%). At baseline, nearly all participants reported having health insurance. The majority of the participants smoked and consumed alcohol. Higher alcohol consumption was associated with a lower hazard of dementia/CIND compared to no alcohol consumption. Over two-thirds of the participants were either overweight or obese. About a third of the participants had diabetes at baseline, over two-thirds had hypertension, and 7.7% reported a baseline stroke. Being treated for diabetes was associated with a greater hazard of dementia/CIND compared to non-diabetics. Baseline stroke was associated with a greater hazard of dementia/CIND. We further examined the associations between individual SEP factors and risk of dementia/CIND. Participants of lower SEP showed increased hazards of dementia/CIND compared to those of higher SEP, with statistical significance only for early adulthood SEP (Table 1-Appendix).

Table 4 presents the results of multivariate Cox proportional hazards models for the association of SEP trajectories with dementia/CIND. In age-adjusted model 1, participants who maintained high SEP or upward SEP with high education had lower hazards of dementia/CIND compared to participants with low SEP. Though not significant, participants with downward trajectory had lower hazards of dementia/CIND

compared to those with low SEP. In the fully-adjusted model 2, the hazard of dementia/CIND among participants with high SEP or upward SEP with high education increased slightly (0.43 to 0.49) but remained significant compared to participants with low SEP. The hazards of dementia/CIND for participants in other SEP trajectories remained non-significant. The hazard of dementia/CIND was lower among participants who consumed alcohol compared to those who never consumed alcohol. The hazard of dementia/CIND was greater among diabetics being treated compared to non-diabetics and among participants with reported stroke compared to those with no stroke.

For the measure of cumulative SEP disadvantage, the hazard of dementia/CIND increased by 16% with every increase in one unit of SEP disadvantage in age-adjusted model 1 (HR=1.16, 95% CI= 1.01, 1.33; *P*=0.04). In the fully-adjusted model 2, the association between cumulative SEP disadvantage and dementia/CIND was attenuated (HR= 1.12; 95% CI= 0.97, 1.30; *P*= 0.12).

3.5 Discussion

In this study of a population-based sample of older Mexican Americans, we provide evidence of an association between life course SEP and risk of dementia/CIND. In comparison with participants with low SEP, those who maintained high SEP or had an upward trajectory with high education had a 51% lower risk of dementia/CIND. Participants with low education who experienced an upward trajectory and participants with downward trajectory had a risk of dementia/CIND similar to that of participants who maintained low SEP. Increased cumulative socioeconomic disadvantage was associated with increased risk of dementia/CIND in age-adjusted models. Adjustment for alcohol

consumption and cardiometabolic risk factors attenuated the associations between trajectories of SEP and risk of dementia/CIND.

Our results from the SEP trajectory analyses support the well-established literature that childhood experience is not the only determinant of late life cognitive health with life course socioeconomic experiences also playing a role (4, 21, 33, 77, 113-114). The late life effects of a participant's disadvantaged childhood on dementia/CIND may be buffered by upward mobility in later stages. High educational attainment in particular, may provide a buffer as marked by the lower hazard compared to those with low SEP. The protective effects of an advantaged childhood or early adulthood may be diluted by downward mobility in later stages, as marked by the similar hazard compared to those with low SEP.

These findings are in agreement with previous studies examining cognitive outcomes, one of which examined Alzheimer's disease (AD). In a community-based longitudinal study of Swedish participants aged 75 and above, Karp et al. (16) found significant associations of occupation-based socioeconomic mobility with risk of AD. These associations became non-significant after accounting for education. Results from the SALSA study found that older Mexican Americans with more advantaged childhood to adulthood SEP trajectories experienced slower cognitive decline as measured by the 3MSE and short-term verbal memory test, compared to those with disadvantaged trajectories (62). Results from a population-based study among middle-aged Finnish men showed that the effect of childhood SEP disadvantages on cognitive function may be buffered by upward mobility in later stages (77). Similarly, Luo et al. (33) showed an

association between lifecourse SEP mobility and cognitive function among participants aged 50 and above of the Health and Retirement Study.

Further results from the SEP trajectory analyses provide evidence that education plays a uniquely important role in the pathway linking life course SEP and dementia/CIND and acts as a decisive transition in one's life course trajectory. While participants with an upward trajectory and high education (LHH) had similar hazard coefficient as participants with high SEP (HHH), participants with upward trajectory and low education did not differ from those with low SEP. We also examined the impact of education on the downward trajectory by comparing those with high and low education. Participants with high education had lower hazards of dementia/CIND than those with low education (data not shown). A growing body of literature describes the protective effect of education on cognition and dementia/CIND (6, 10-11, 13, 15, 19, 21, 98, 106-107). Exposure to stimulating learning environment at early stages in life may result in better brain development due to increased neuronal branching and synaptic density (96, 115). At older ages, maintenance of cognitive function is more common than neurogenesis. Early experiences may contribute in old age to 'brain reserve' or capacity through compensating strategies that help to maintain function and delay the clinical manifestation of dementia/CIND.

Results from the cumulative SEP disadvantage analyses showed a relationship between continuity of disadvantaged exposure over the life course and risk of dementia/CIND in age-adjusted models. Our results are in agreement with reports from other studies. For example, results from Sao Paulo Ageing and Health Study (SPAH) found a dose-response relationship between cumulative adversity and prevalent dementia

(21). With regard to cognitive function, few studies reported an association between cumulative socioeconomic disadvantage and worse cognitive functioning (33, 77). Similar associations were also discussed by Lynch et al. (116) showing a direct association between sustained economic hardship and cognitive function.

Our results are in accordance with other longitudinal-based studies that show a greater risk of dementia/CIND in those with cardiometabolic risk factors (52, 117-124). Such risk factors may act as mediators on the pathway between life course SEP and dementia/CIND. Accounting for them attenuated but did not eliminate the association between high SEP in particular and dementia/CIND. Results from this analysis are also in agreement with the literature emphasizing the importance of alcohol consumption as a protective factor for dementia/CIND via underlying cardiovascular mechanisms (125). In this study, participants with high SEP were two times more likely to have consumed alcohol compared to participants with low SEP.

There are few limitations in this study that are worth noting. First, participants had to survive till age 60 and above to be eligible in this study. Moreover, due to the longitudinal nature of the study, participants who died or dropped out are likely to be more socioeconomically disadvantaged and show worse cognitive functioning. Consequently, the observed associations are likely smaller than what they may have been in the absence of such attrition. Second, childhood socioeconomic measures were self-reported probably resulting in some reporting bias. To address this concern, we created a composite measure based on various childhood SEP indicators. Third, SEP may be a marker for other unmeasured factors that influence dementia/CIND such as chronic malnutrition or environmental risk factors hence possibly contributing to residual

confounding as occurs in most research. Despite these limitations, this is the first study to examine changes in life course SEP and incidence of dementia/CIND among a cohort of older Mexican Americans followed for over a decade. The current study expands a literature on dementia/CIND that is mainly cross-sectional (77) or that lacks SEP measures across the lifecourse (14, 16). The current analysis did not rely on self-reported type-2 diabetes and hypertension which are important risk factors for dementia/CIND. Furthermore, the diagnosis of dementia/CIND followed a thorough multistage process. Finally, even though the overall variability in SEP is generally lower in this population compared to non-Hispanic Whites, an effect of life course SEP on dementia/CIND was identified. Therefore, the results may be more pronounced in other race/ethnic groups where there is more variability in SEP.

In sum, findings in this study demonstrate an association between life course SEP and dementia/CIND, further highlighting that neurodegeneration processes are shaped by life course experiences. This study provides evidence that diabetes and stroke are important risk factors for dementia/CIND and account for part of the SEP-dementia/CIND gradient. These findings are of crucial importance to U.S. Hispanics because of their increasing burden with cardiometabolic risk factors (51, 53). Prevention of dementia/CIND should start early in life by developing interventions targeted at delaying its onset as well as strategies for maintaining cognitive functioning throughout life.

Figure 3.1. Conceptual Framework of Socioeconomic Trajectories. H, High; L, Low; SEP, Socioeconomic Position.

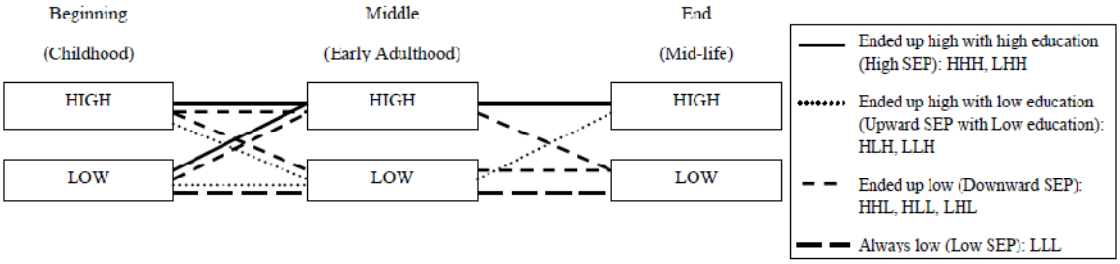


Figure 3.2. Survival to dementia/CIND by SEP trajectory group, SALSA, 1998-2008. Results were adjusted for age at enrollment, alcohol consumption, type-2 diabetes, and stroke. CIND, Cognitive Impairment Without Dementia; SALSA, Sacramento Area Latino Study on Aging; SEP, socioeconomic position.

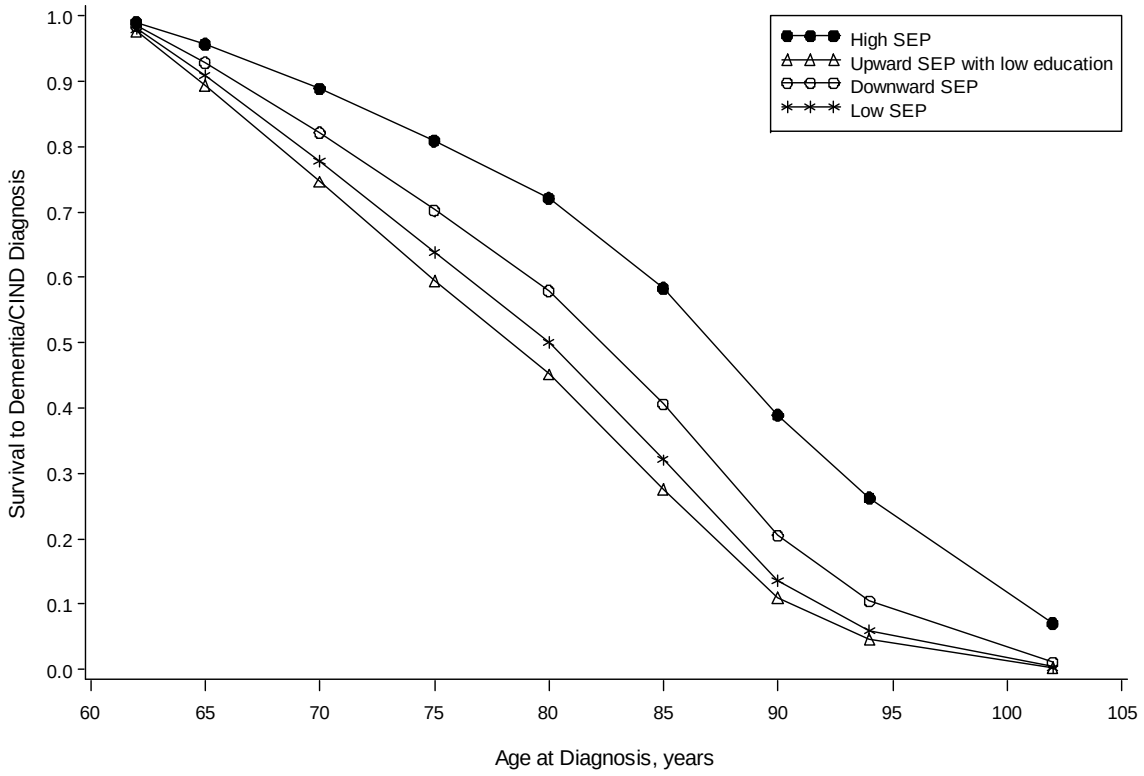


Table 3.1. Incidence Rates (per 1000/y) of Dementia/CIND by SEP Trajectory Group, SALSA, 1998-2008.

SEP trajectory	Number of cases	Person-years at risk	Incidence Rate	95% Confidence Interval	Incidence Rate Ratio (REF=Low SEP)
High SEP: HHH, LHH	19	1,860.8	10.4	-1.2, 22.0	0.3
Upward SEP with low education: LLH, HLH	14	496.2	29.0	-8.1, 66.1	0.9
Downward SEP: LHL, HHL, HLL	126	5,530.4	22.8	12.8, 32.8	0.7
Low SEP: LLL	75	2,338	32.1	12.7, 51.5	1.0
Total	234	10,225.4	23.0	14.1, 31.9	-

Abbreviations: CIND, Cognitive Impairment Without Dementia; SALSA, Sacramento Area Latino Study on Aging; SEP, Socioeconomic Position.

Table 3.2. Life Course Socioeconomic Characteristics of the Study Population Free of Dementia/CIND at Baseline (n=1634), by SEP Trajectory Group, SALSA, 1998-2008.

SEP mobility	All		High SEP HHH, LHH		Upward SEP /Low education LLH, HDH		Downward SEP LHL, HL HLL		Low SEP LLL		*P* value
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	
Covariates	**N=1634**		**n=262**	**16.6**	**n=78**	**4.9**	**n=865**	**54.8**	**n=375**	**23.7**	
Adulthood and mid-life characteristics											
Education in years [a]	7.3	5.3	14.6	2.8	6.7	3.4	6.7	4.7	3.9	3.2	<0.0001
Major lifetime Occupation											<0.0001
Manual	1262	78.6	0	0.0	0	0.0	865	100.0	375	100.0	
Non-Manual	343	21.4	262	1000	78	100.0	0	0.0	0	0.0	
Old age Household Income											<0.0001
Low (<$1,500)	1043	63.9	60	22.9	49	62.8	595	68.8	302	80.5	
High (≥$1,500)	588	36.1	202	77.1	29	37.2	270	31.2	73	19.5	
Childhood Characteristics											
Father's education											<0.0001
Less than elementary	1171	72.9	171	65.3	46	59.0	576	66.6	357	95.2	
Elementary or more	435	27.1	91	34.7	32	41.0	289	33.4	18	4.8	
Mother's education											<0.0001
Less than elementary	1167	72.7	154	58.8	55	70.5	584	67.5	357	95.2	
Elementary or more	439	27.3	108	41.2	23	29.5	281	32.5	18	4.8	
Father's occupation											<0.0001
Manual or unemployed	1416	88.2	229	87.4	68	87.2	726	83.9	371	98.9	
Non-manual	190	11.8	33	12.6	10	12.8	139	16.1	4	1.1	
Food deprivation while growing up	342	21.3	50	19.1	15	19.2	100	11.6	170	45.3	<0.0001
Sibling mortality	791	49.3	128	48.9	44	19.2	300	34.7	304	81.1	<0.0001
Life course cumulative SEP [a]	5.4	1.5	3.7	1.1	4.8	1.1	5.3	0.9	7.2	0.4	<0.0001

Abbreviations: CIND, Cognitive Impairment Without Dementia; SALSA, Sacramento Area Latino Study on Aging; SEP, Socioeconomic Position.
[a] Data are expressed as mean and SD

Table 3.3. Prevalence of Socio-Demographic and Health Conditions Among the Study Population Free of Dementia/CIND at Baseline (N=1634) and Their Bivariate Associations With the Risk of Dementia/CIND Over From Cox Proportional Hazard models, SALSA, 1998-2008.

Baseline Covariates	**No**	**%**	**HR**	**95%CI (*P* value)**
Age at enrollment [a]	70.1	6.7	0.82	0.79, 0.86 (<0.01)
Gender				
Men	681	41.7	0.86	0.65, 1.15 (0.32)
Women	953	58.3	1.00	
Nativity				
Mexican-born	821	50.5	1.05	0.79, 1.41 (0.72)
U.S. born	806	49.5	1.00	
Health insurance				
Yes	1477	90.6	0.77	0.42, 1.42 (0.39)
No	154	9.4	1.00	
Smoking status				
Ever	876	53.7	1.02	0.77, 1.36 (0.90)
Never	755	46.3	1.00	
Alcohol consumption				
≥2 drinks/week	307	18.8	0.55	0.33, 0.92 (0.02)
<2 drinks/week	584	35.8	0.64	0.44, 0.94 (0.02)
Never	740	45.4	1.00	
Body Mass Index (BMI) Category (kg/m^2)				
≥30	716	44.2	0.75	0.52, 1.10 (0.14)
25.0-29.9	600	37.0	0.82	0.53, 1.27 (0.36)
<25.0	305	18.8	1.00	
Waist circumference (cm)				
High tertile	547	33.5	0.92	0.61, 1.40 (0.68)
Middle tertile	569	34.9	1.00	0.68, 1.47 (0.99)
Low tertile	515	31.6	1.00	
Diabetes treatment				
Diabetic with treatment	331	20.3	1.96	1.23, 3.12 (0.01)
Diabetic without treatment	195	12.0	1.56	0.88, 2.77 (0.12)
Not diabetic	1105	67.7	1.00	
Hypertension				
Yes	1005	61.5	0.93	0.70, 1.25 (0.65)
No	629	38.5	1.00	
Stroke				
Yes	125	7.7	2.07	1.34, 3.20 (0.00)
No	1509	92.3	1.00	-
Systolic blood pressure (mm Hg) [a]	138.4	18.8	1.00	0.99, 1.01 (0.74)
Diastolic blood pressure (mm Hg) [a]	76.0	10.7	0.99	0.98, 1.01 (0.29)

Abbreviation: SALSA, Sacramento Area Latino Study on Aging.
[a] Data are expressed as mean and SD

Table 3.4. Bivariate Associations Between Life Course Socioeconomic Conditions and Risk of Dementia/CIND Over the Study Follow-up Time From Cox Proportional Hazard models, SALSA, 1998-2008.

Covariates	**HR**	**95%CI (*P* value)**
Childhood SEP		
Mother's education		
Less than elementary vs. REF: elementary or more	1.44	0.75, 2.75 (0.24)
Father's education		
Less than elementary vs. REF: elementary or more	1.04	0.77, 1.41 (0.78)
Mother's occupation		
Manual or housewives vs. REF: Non-manual	1.57	0.34, 7.31 (0.53)
Father's occupation		
Manual or unemployed vs. Non-manual	1.11	0.56, 2.22 (0.75)
Food deprivation while growing up		
Ever vs. Never	1.13	0.78, 1.64 (0.51)
Childhood Sibling mortality		
Yes vs. No	1.09	0.71, 1.67 (0.66)
Early adulthood SEP		
Participants' education		
Less than elementary vs. Elementary or more	1.70	1.16, 2.51 (0.01)
Mid-life SEP		
Major lifetime Occupation		
Manual vs. Non-manual	1.45	0.89, 2.33 (0.13)

Abbreviation: SALSA, Sacramento Area Latino Study on Aging

Table 3.5. Associations Between Life Course SEP Trajectory and Risk of Dementia/CIND From a Series of Cox proportional Hazards Models, SALSA, 1998-2008.

	Model 1		Model 2	
Independent variable	**HR**	**95%CI (p value)**	**HR**	**95%CI (*P* value)**
SEP trajectory, childhood- early adulthood- mid life				
High SEP: HHH, LHH	0.4	0.23, 0.84 (0.01)	0.49	0.24, 0.98 (0.04)
Upward SEP with low education: LLH, HLH	1.1	0.55, 2.32 (0.74)	1.17	0.56, 2.43 (0.67)
Downward SEP: LHL, HHL, HLL	0.7	0.54, 1.15 (0.21)	0.80	0.54, 1.18 (0.25)
Low SEP: LLL	1.0		1.00	
Old age Household income				
Low			1.06	0.72, 1.58 (0.75)
High			1.00	
Alcohol consumption				
≥2 drinks/week			0.67	0.38, 1.15 (0.14)
<2 drinks/week			0.70	0.47, 1.04 (0.08)
Never			1.00	
Diabetes				
Diabetic with treatment			1.70	1.10, 2.63 (0.02)
Diabetic without treatment			1.48	0.82, 2.66 (0.18)
Not diabetic			1.00	
Stroke				
Yes			1.82	1.16, 2.86 (0.01)
No			1.00	

Abbreviation: SALSA, Sacramento Area Latino Study on Aging.

[a] All models adjust for age at enrollment in the study

Chapter 4

Life course Socioeconomic Position and Risk of Depressive Symptoms in Older Mexican Americans: Results from the Sacramento Area Latino Study on Aging

4.1 Introduction

There is a wealth of evidence that supports an association between childhood and adulthood socioeconomic conditions and depression later in life, including depressive symptoms (23-31, 33-40). While such evidence have been shown to vary by culture and ethnic background, the available studies lack race/ethnic diversity with a majority focusing on non-Hispanic White and European populations (25-29, 31, 34, 36-38, 40, 126-130). Furthermore, the socioeconomic gradient in depression within U.S. minority populations has not been comprehensively explored, with the majority of previous work either concerning outdated comparisons of non-Hispanic White and Black populations or using limited socioeconomic indicators (24, 27, 116, 131-133).

U.S. Hispanics are a fast growing minority (47) with sixty percent of Mexican descent. Previous work has shown a greater overall prevalence of depressive symptoms among older Mexican Americans compared to non-Hispanic Whites and African Americans (54-59). However, the socioeconomic gradient of depressive symptoms remains relatively unexplored among older Mexican Americans; a majority of the work is cross-sectional and does not address the multiple dimensions of socioeconomic conditions (134-138).

The purpose of the present analysis was to investigate the influence of life course socioeconomic conditions on elevated depressive symptoms in an older cohort of Mexican Americans followed for up to a decade. Specifically, we hypothesize that: 1) there will be different trajectories of life course socioeconomic mobility and which will have different influences on depressive symptoms later in life, and 2) participants with higher cumulative socioeconomic disadvantage will have higher levels of depressive symptoms later in life.

4.2 Materials and Methods

Study population

A total of 1,789 community-dwelling older Mexican Americans residing in California's Sacramento Valley and aged 60-101 in 1998-99 were recruited as part of the Sacramento Area Latino Study n Aging (SALSA). SALSA is a longitudinal cohort study. A detailed description of the study population and the recruitment of SALSA participants have been described elsewhere (69). SALSA was approved by the Institutional Review Board (IRB) at the University of Michigan and the University of California, San Francisco and Davis. At baseline, clinical data was collected with a two-hour interview at participants' homes and participants were re-assessed every 12-15 months for a total of seven follow-up visits. The average annual attrition including mortality and loss to follow-up was 5% through 2007 and mortality surveillance is still ongoing.

Measures

Depressive symptoms: We assessed depressive symptoms using the 20-item version of the Center for Epidemiologic Studies- Depression Scale (CES-D). The CES-D was

administered to all SALSA participants at baseline and each follow-up visit. The CESD was used in both English and Spanish by using a methodology that incorporated consensus between native Spanish speakers on the bi-directional translation (54). While cultural factors have been suggested to influence the manifestation and expression of depressive symptoms (139-140), the CES-D has been widely used to assess depressive symptoms among older populations (141-143), including Latinos (136, 144-147). Moreover, the CESD is suggested to have high validity and reliability when administered to community-dwelling older adults (146, 148-149). In the present study, participants were asked to report the presence of any of 20 symptoms on a four-point Likert-type scale during the week prior to the interview ('never', 'little of the time', 'some of the time', 'most of the time'). A total score (range of 0 to 60) was calculated by summing the 20 items. To classify participants with elevated depressive symptoms, the CES-D total score was categorized using a standard cutoff of 16 or greater (150).

Life course SEP mobility: We included socioeconomic position (SEP) measures from three life stages: childhood, adulthood and old age. Parental education and occupation, food deprivation while growing up, and childhood sibling mortality were measures of childhood SEP. Both mother's and father's education were classified as low (did not complete elementary school) or high (elementary school or more). Mother's occupation was classified as low (manual or housewives) or high (non-manual) and father's occupation was classified as low (manual or unemployed) or high (non-manual). Participants also reported how often they did not have enough to eat while growing up; this was re-coded as low (ever lacked enough to eat) or high (never). Participants reported if any siblings died in childhood which was classified as present or absent.

Participants with no siblings (1.77%) were classified as having no sibling mortality. To estimate overall childhood SEP, all childhood SEP variables were assigned a score of 0 (high SEP) or 1 (low SEP) and then added together into a composite measure. The childhood SEP score (range 0 to 6) was split at the median of 4 and coded into 0 (high SEP) or 1 (low SEP). A participant's ultimate educational attainment, a measure of early adulthood SEP, was obtained by asking them the years of education they completed and then classified as low (≤elementary) or high (>elementary). Participants reported their major lifetime occupation, a measure of mid-life SEP, which was classified as low (manual, unemployed, or housewives) or high (non-manual).

Using SEP indicators from all three life stages, a six-level life course SEP mobility measure was created, with each level representing a distinct trajectory from childhood to early adulthood and mid-life (Figure 1): 1) low SEP at all stages (referent category): LLL; 2) downward SEP with low education: HLL; 3) downward SEP with high education: LHL or HHL; 4) upward SEP with low education: LLH or HLH; 5) upward SEP with high education: LHH; and 6) high SEP at all stages: HHH (33, 77).

Cumulative SEP disadvantage: To estimate cumulative disadvantage, dichotomous childhood, early adulthood, and mid-life SEP measures were summed together. The resulting measure ranged from 0 to 8 with a greater score representing greater cumulative disadvantage.

Covariates: Socio-demographic variables included participants' age, gender, marital status, and place of birth. Participants reported their baseline marital status (married, single, or widowed/divorced). Participants in this study were either born in the U.S. or

born in Mexico or another Latin American country but then migrated to the U.S. Nativity was constructed based on participants' report of their country of birth and was coded as US-born or Mexican/Latin American-born. Nearly all immigrants were born in Mexico (94.5%). Participants reported their baseline smoking status (ever/never) and number of alcoholic drinks per week which was categorized into never, <2 drinks/week, or ≥2 drinks/week. Household income during the last month was also reported at baseline which was split at the median and categorized into low (income < $1,500) or high (income ≥$1,500). Clinical data such as fasting-blood glucose levels and blood pressure were collected at each home visit. Diabetes was ascertained as a self-report of an MD diagnosis, use of any diabetes medication, and/or a fasting glucose level ≥126 mg/dl (109). Hypertension was ascertained as a self-report of an MD diagnosis, use of medication, a systolic blood pressure >140 mm Hg, and/or a diastolic blood pressure >90 mm Hg (110). A stroke event was ascertained by self-report of an MD diagnosis, including hospitalization for stroke. Anthropometric measures including height (in cm) and weight (in Kg) were measured. Body mass index (BMI) (in Kg/m^2) was derived and then categorized into normal (<25.0), overweight (25.0-29.9), and obese (≥30). Prescription antidepressant medications were obtained by a medicine cabinet inventory done by the interviewers during home interviews. These were classified using a coding methodology from the National Center for Health Statistics at the Center for Disease Control and Prevention (CDC) (151). Use of antidepressant medications at any time across the study period was included in this analysis.

4.3 Statistical Analyses

In univariate analyses, two-tailed chi-square tests for categorical variables and one-way ANOVA for continuous variables were used to test for statistical differences in the distribution of the socioeconomic indicators across the various SEP trajectories. Generalized estimating equations (GEE) were used to assess bivariate and multivariate associations between lifecourse SEP measures (trajectories of SEP mobility and cumulative SEP) and elevated depressive symptoms at each follow-up visit across the study period (152). In addition to those commonly found associated with depressive symptoms in the literature, inclusion of covariates at the multivariate level was based on: 1) their association with depressive symptoms and 2) their association with life course SEP, both at the bivariate level. Variables such as nativity and gender were modeled as time invariant. While smoking status, alcoholic drinks per week, and SEP indicators were only measured at baseline, other variables such as depressive symptoms, BMI, diagnoses of diabetes, stroke, and hypertension, and use of antidepressant medications were assessed annually and were modeled as time-varying covariates. Beta coefficients (β), 95% confidence intervals (CI) and two-sided P values were computed from binomial regressions. Time was measured as the number of follow-up visits. In initial analyses, the association between the risk of elevated depressive symptoms and the number of follow-up visits followed a quadratic function and a quadratic term for time was included. Multiplicative interactions between time, nativity, gender and each life course SEP measure were tested separately and significant interactions were retained in the final models. The association between trajectories of SEP mobility and depressive symptoms was modified by time. This was analyzed using the methods described by Figueiras et al. (153) to calculate the Risk Ratio (RR) and 95% CI of the effect of interest when the

effect measure modifier (time) was not the reference category (Figures 3). The association between cumulative SEP disadvantage and depressive symptoms was modified by nativity however the association was largely explained by the inclusion of other covariates. Monthly household income usually declines in retirement and is not an accurate measure of a history of past income among geriatric populations. It was not included in the derived life course SEP measures but as a covariate in the multivariate analyses. Use of antidepressant medications was not adjusted for because it is conceptually collinear with depressive symptoms and constitutes a "collider" on the pathway between SEP and depressive symptoms (154). Use of antidepressants was examined by SEP mobility groups for participants with elevated versus normal depressive symptoms. All statistical analyses were performed using SAS v.9.2 (87).

Data Imputation

Prior to imputation, one fourth of the participants had missing data at any point during the study follow up time. Most of this was due to mortality (n=522). Multiple imputation was performed for the entire SALSA dataset to accommodate incomplete data points. It is a sequential regression multivariate imputation (SRMI) approach that conditions on all observed variables as predictors (88-89). The different imputations are run in a cyclic manner that overwrites previously drawn values and build interdependence between the imputed values. By using all available variables, the multiple imputation approach provides unbiased estimates while improving efficiency compared to other alternative analytical approaches such as the list-wise deletion analysis. While such alternative approaches assume that data are missing completely at random, an assumption that is rarely valid in epidemiologic studies (90), the SMRI approach used in this analysis

imposes a less restrictive assumption. The efficiency of the estimates levels-off after the production of few imputed datasets (88), hence five imputations were produced for the SALSA dataset using the Imputation and Variance Estimation Software (91). Baseline and six follow-up examinations were available for this analysis.

4.4 Results

Table 1 presents the baseline socioeconomic indicators of the study population overall and by SEP mobility groups. Nearly 64% (63.4%) of the sample was in a low or downward trajectory with low education group. Over 49% of Mexican-born participant had a downward trajectory combined with low education and nearly 29% were always in a low SEP group. Overall, mean years of educational attainment was 7.2 (SD= 5.3) and more than two-thirds of the participants had a manual lifetime occupation. Around 65% of the participants reported a low current household income. The majority of the participants had parents with less than elementary education and fathers with a manual occupation. Around 22% of the participants experienced food deprivation while growing up and less than half of the participants experienced sibling mortality during childhood. Mean cumulative socioeconomic disadvantage across the life course was 5.4 (SD=1.5). Moreover, the various SEP indicators differed significantly by lifecourse SEP mobility groups. Participants with disadvantaged life course SEP trajectories were more likely to have worse childhood, early adulthood, and mid-life socioeconomic conditions, compared to those with more advantageous SEP trajectories.

Table 2 presents the distribution of baseline characteristics of the study population and their bivariate associations with risk of elevated depressive symptoms across the

study period. The mean enrollment age in the study was 70.65 years (SD=7.11), with greater age associated with greater risk of elevated depressive symptoms. The majority of the participants were women, born in Mexico, and were married. Women, Mexican-born participants, and widowed/divorced participants had a greater risk of elevated depressive symptoms across the study period compared to their referent groups. Almost all participants reported having health insurance at baseline, which was associated with a lower risk of elevated depressive symptoms compared to not having health insurance. The majority of the participants reported consuming alcohol which was associated with a lower risk of elevated depressive symptoms compared to no alcohol consumption. The majority of participants had ever smoked and 43.4% of the participants had a baseline BMI $\geq$30 Kg/m^2. At baseline, one-third of the participants had a diagnosis of type-2 diabetes but this was not associated with an elevated CESD. More than 9% of the participants reported having a stroke at baseline which was associated with a greater risk of elevated depressive symptoms compared to those with no stroke. Around two-thirds of the participants had a diagnosis of hypertension which was associated with a lower risk of elevated depressive symptoms compared to those with no hypertension. Finally, 7.6% of the participants were using anti-depressants at baseline which was associated with a greater risk of elevated depressive symptoms compared to not using anti-depressants.

Figure 2 compares the percent of ever using any antidepressant medications by SEP mobility group among participants with normal versus elevated baseline depressive symptoms. Across all SEP mobility groups as well as overall, a greater proportion of participants with elevated depressive symptoms ever used antidepressant medication compared to those with normal depressive symptoms. Furthermore, a greater proportion

of ever using antidepressant medications was also found among participants with advantageous SEP trajectories. However, the latter association was only significant for participants with elevated CESD. For example, 51.9% of the participants with elevated CESD and who maintained high SEP ever used anti-depressant medications compared to 32.3% among those with elevated CESD but who maintained low SEP. Results remained similar after adjusting for having health insurance.

Table 3 presents the results of the multivariate associations between life course SEP mobility and risk of elevated depressive symptoms. In model 1, participants who maintained high SEP across the life course had significantly lower risk of elevated depressive symptoms at baseline compared to participants who maintained low SEP (β=-1.03; 95% CI= -1.42, -0.64). Participants with upward or downward SEP trajectories who achieved high education had lower risk of elevated depressive symptoms at baseline compared to participants with low SEP across the life course (β=-0.91; 95% CI= -1.55, -0.27 and β=0.68; 95% CI= -1.00, -0.36, respectively). Participants with upward or downward trajectories but who achieved low education did not differ in their risk of depressive symptoms from those who maintained low SEP across the life course. In the fully adjusted model, all associations were attenuated but significance remained. As shown in model 2 by the interactions between SEP indicators, time, and time squared, the effect of SEP on the risk of elevated depressive symptoms changes over time (see Figure 3). Overall, the risk of elevated depressive symptoms was linear except for participants who maintained high SEP or with an upward trajectory/low education whose risk followed a negative quadratic function. For example, among participants who maintained high SEP across the life course compared to those with low SEP across the life course,

the RR ranged from 0.68 at baseline (T0) to 0.90 at T4 and to 0.63 at T6. The risk of depressive symptoms among participants who maintained low SEP across their life course followed a positive quadratic function- the risk decreased across the study time (data not shown).

Table 4 presents the results of the multivariate associations between cumulative SEP disadvantage and risk of elevated depressive symptoms. In model 1, the association between cumulative disadvantage and risk of elevated depressive symptoms was modified by nativity. For every increase in 1 standard deviation of cumulative SEP disadvantage, the risk of elevated depressive symptoms increased by 23% for a U.S. born and by 6% for a Mexican-born. In the fully adjusted model 2, the interaction between cumulative disadvantage and nativity became non-significant. For every increase in one standard deviation of cumulative disadvantage, the risk of elevated depressive symptoms increased by 11% for a U.S.-born and by 2% for a Mexican-born. Model 2 of table 4 is further illustrated in Figure 4 which shows the association between cumulative SEP disadvantage and risk of elevated depressive symptoms, by nativity. At every level of disadvantage, the risk was higher among the Mexican-born than the U.S.-born. As the number of disadvantages increases, the risk elevated depressive symptoms increased among both groups however, to a greater extent among the U.S.-born than the Mexican-born.

4.5 Discussion

In this population-based study of older Mexican Americans, we provide evidence of an association between socioeconomic position across the life course and risk of

elevated depressive symptoms later in life. In particular, participants who maintained high SEP across the life course had a 50% lower risk of depressive symptoms at baseline compared to those who maintained low SEP across the life course. The risk of elevated depressive symptoms among participants with high SEP increased with time. Participants with an upward or downward trajectory who achieved high education had 47% and 37% lower risk of depressive symptoms compared to those who maintained low SEP, respectively. Participants with an upward or downward trajectory who achieved low education had similar risk of depressive symptoms as those who maintained low SEP. Increased cumulative SEP disadvantage was associated with increased risk of elevated depressive symptoms however, to a greater extent for the Mexican-born than the US-born. Adjustment for socio-demographic, health behaviors and health-related conditions attenuated these associations.

Our results provide evidence that trajectories of SEP mobility influence depressive symptoms later in life. The health benefits of upward mobility are only observed when the participant achieved high SEP during early adulthood (education), as marked by the lower risk of depressive symptoms compared to those who maintained low SEP across the life course. The detrimental effects of downward mobility may be buffered by having high educational attainment during early adulthood as marked by the lower risk of depressive symptoms, compared to those who maintained low SEP. The protective effects of an advantaged/high childhood SEP may be diluted by downward mobility in later stages (HLL), as marked by the similar risk of depressive symptoms compared to those who maintained low SEP.

Several mechanisms by which life course SEP may influence depressive symptoms have been proposed. First, the social and physical environment during childhood, including material deprivation and economic hardship, may negatively influence the development of psychological well-being through perceived social comparison and inequity (26, 31, 155-161) which may in turn result in increased risk of psychosocial effects later in life (162). During early adulthood, educational experiences are very crucial to the development of self-esteem and thus may influence psychological well-being (26, 163). Finally, major lifetime occupation defines various aspects of labor force participation which may influence psychological well-being, including depressive symptoms (26, 126, 164-165). Other health behaviors and health-related factors may also contribute to the socioeconomic gradient in depressive symptoms, however such associations have not been well established (26). Given the life course context of depressive symptoms, the greater the exposure to negative and stressful events throughout life, the greater the risk for psychological disorders, especially in the absence of adequate coping resources (40, 166).

Our findings are in agreement with previous work examining social/SEP mobility and depressive symptoms. For example, results from the 1998 Health and Retirement Study (HRS) showed a cross-sectional association between SEP mobility and depressive symptoms of U.S. older adults (33). In a prospective cohort study of participants of the Newcastle Thousand Families study, Tiffin et al. (34) found that men with downward social class mobility reported poorer mental health at age 50 compared with those with an upward mobility. Further results from our trajectory analyses provide evidence that education plays a decisive role in the pathway linking life course SEP and depressive

symptoms later in life (40). For example, when we examine the impact of education on the downward trajectory by comparing those with high and low education, we find that participants with high education had lower risk of depressive symptoms than those with low education. This finding corroborates a body of literature that describes the protective effect of education on depressive symptoms (33, 35-36, 39, 134-137). According to Stansfeld et al. (40), education is an important factor in shaping intra-generational mobility such as employment opportunities which in turn affect the development of social status and self-esteem whose influence on psychological well-being is crucial (26).

Further results from the SEP trajectory analyses showed an increase then a decrease in the risk of elevated depressive symptoms across the study visits among participants who maintained high SEP compared to those who maintained low SEP across the life course. It is possible that participants who maintained high SEP across the life course and who were depressed at later follow-ups (as marked by the increase in risk after baseline) were more likely to drop out leaving a healthier population as marked by the decrease in risk towards the end of the study period, though not significant. As for participants who maintained low SEP across their life course, they showed the highest risk of depressive symptoms at baseline and were thus more likely to drop out resulting in a decrease in their risk of depressive symptoms across the study time.

Results from the cumulative SEP disadvantage analyses showed a significant association between cumulative disadvantage across the life course and risk of depressive symptoms later in life. Such results are in agreement with other studies. For example, Luo et al. (33) reported an association between cumulative life course SEP disadvantage and risk of depressive symptoms among participants of the Health and Retirement Study.

Similar associations were discussed by Kahn et al. (35) showing a significant association between sustained economic hardship and depressive symptoms among an older population of Washington DC, metropolitan area. More importantly, our results showed that the Mexican-born had a greater risk of depressive symptoms than the U.S.-born with a decreasing gap as the number of deprivations increases. Similarly, Gonzalez et al. (59) showed that at older ages, the foreign-born ethnic groups have a greater prevalence of lifetime major depression compared the U.S.-born ethnic groups. Our findings are consistent with a hypothesis which suggests that the physical and psychological advantages experienced by the foreign-born earlier in life fade away at older ages when accumulated SEP disadvantages cannot buffer the increasing health needs and health costs (59, 167-168). Furthermore, the decreasing gap that we observe between the Mexican-born and the U.S.-born as the number of deprivations increases may suggest several interpretations. It is possible that as the number of socioeconomic deprivations increases, Mexican-born with worse health and depressive symptoms return to their home country. Consequently, we are left with a 'survivor' population which might be more resistant to the detrimental cumulative effects of deprivation on depressive symptoms. The results may also be attributed to differentials in the perception of stress and deprivation between the two nativity groups, whereby deprivation might constitute a normal state for the Mexican-born compared to the U.S.-born (35). Similar interpretations were made by Kahn et al. (35) whereby the effect of sustained economic hardship was more pronounced on the depressive symptoms of Whites compared to African Americans residing in Washington, DC metropolitan area.

Our results are also in accordance with previous literature showing that participants with cardiovascular risk factors experience a greater risk of depressive symptoms (136, 146, 169). While such risk factors might act as mediators on the pathway between life course SEP and depressive symptoms (170), adjusting for these risk factors only attenuated and did not eliminate the socioeconomic gradient in depressive symptoms. In particular, the vascular depression hypothesis has been recently evidenced among a cohort of Mexican Americans as part of the Hispanic Established Population for the Epidemiologic Study of the Elderly (EPESE), whereby increased cardiovascular risk factors was associated with increased risk of elevated depressive symptoms independent of other covariates (146).

There are a few limitations in this study that are worth noting. Due to the longitudinal nature of the study, participants who died or dropped out are likely to be more socioeconomically disadvantaged and show worse mental health. Consequently, the observed associations may be smaller than what they may have been in the absence of such attrition. Second, childhood socioeconomic measures were self-reported probably resulting in some non-differential reporting bias. Third, SEP may be a marker for other unmeasured factors that influence depressive symptoms such as environmental risk factors hence possibly contributing to residual confounding. Fourth, we were unable to disentangle the effect that childhood mental health might have on one's socioeconomic mobility, also known as 'health selection'. Finally, despite that CESD is thought to be predictive of current and future major clinical depression (136), the absence of a structured interview for a clinical diagnosis of depression limits our interpretation beyond elevated depressive symptoms. This becomes especially important when using CESD to

predict clinical major depression among ethnic minorities such as U.S. Hispanics (144, 171) and for whom the factor structure of CESD differs from that of non-Hispanic Whites (145-146). Despite these limitations, this is the first study to examine changes in life course SEP and risk of depressive symptoms among older Mexican Americans. In addition to having repeated measures of depressive symptoms, the current study goes beyond the predominantly cross-sectional earlier studies (25, 33, 35, 37, 134-138, 172), and published work that has limited race/ethnic diversity (25-26, 28-29, 31, 34, 36-38, 40, 127, 130), or earlier work that ignores the multi-dimensional nature of SEP (26, 34-35, 38, 40, 134-138). Our analyses did not utilize self-reported health conditions such as type-2 diabetes and hypertension which are important risk factors for depressive symptoms. Furthermore, the current study had repeated measures on these health-related risk factors which were accordingly modeled as time-varying covariates. Finally, even though the overall variability in SEP is generally lower in this population compared to non-Hispanic Whites, an effect of life course SEP on depressive symptoms later in life was identified. Therefore, the results may be more pronounced in other race/ethnic groups where there is more variability in SEP.

In summary, findings in this study provide evidence for an association between life course socioeconomic conditions and depressive symptoms later in life among Mexican Americans, highlighting the importance of life course experiences in shaping mental health in this Latino study population. Stroke was found to be an important risk factor for depressive symptoms and accounted for part of its socioeconomic gradient. These findings provide a more in-depth understanding of the mechanisms that mediate the associations between SEP and depressive symptoms. Future studies are needed to

replicate our results in other ethnic/minority or socially disadvantaged groups and to test interventions across the life course.

Figure 4.1. Conceptual Framework of Life Course Socioeconomic Trajectories.

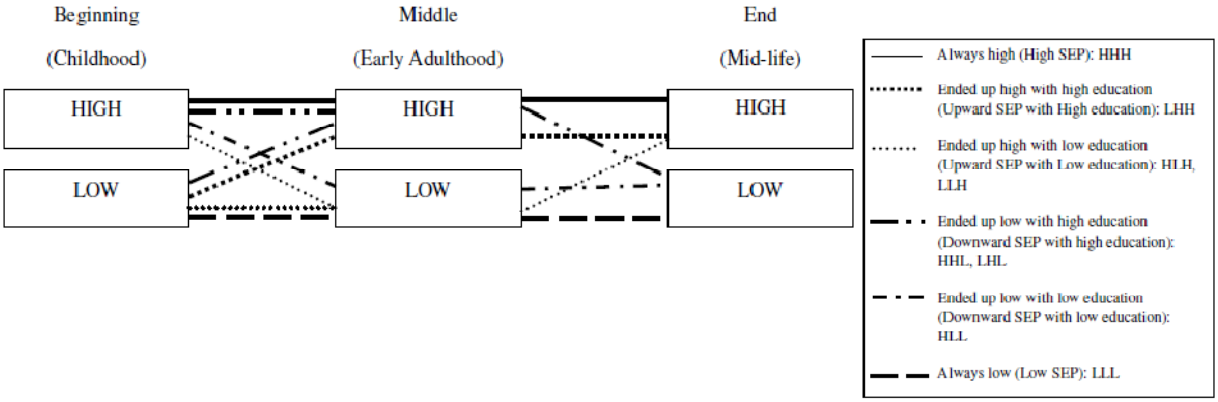
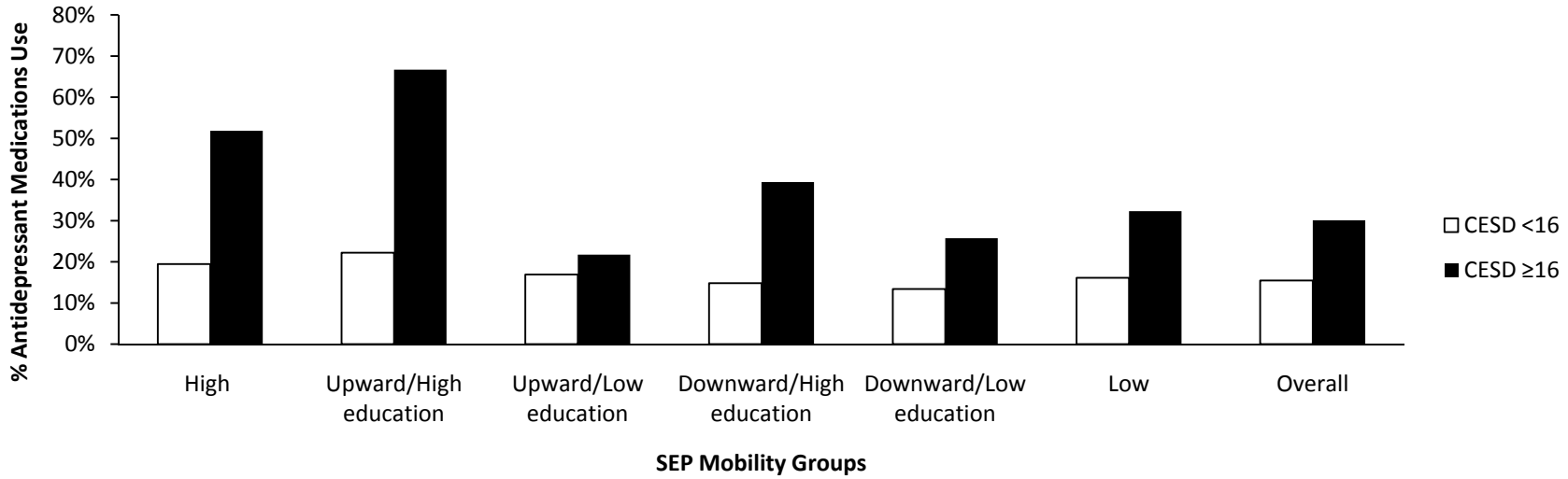
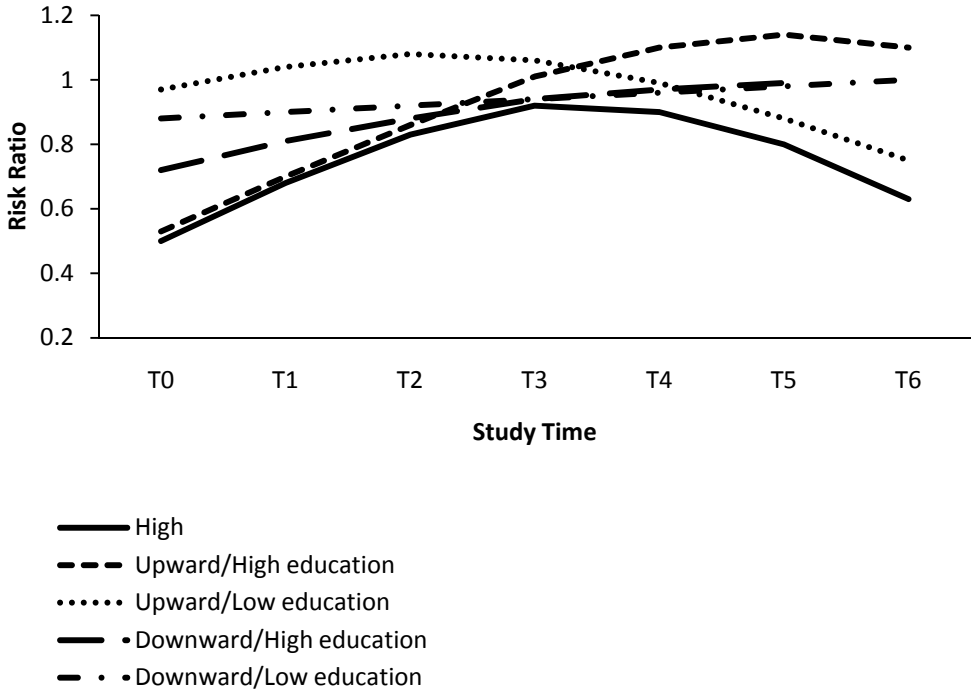


Figure 4.2. Comparison of participants with elevated versus normal depressive symptoms on the baseline CESD score and percent ever using antidepressant medications, by SEP mobility groups, Sacramento Area Latino Study on Aging, 1998-2008.



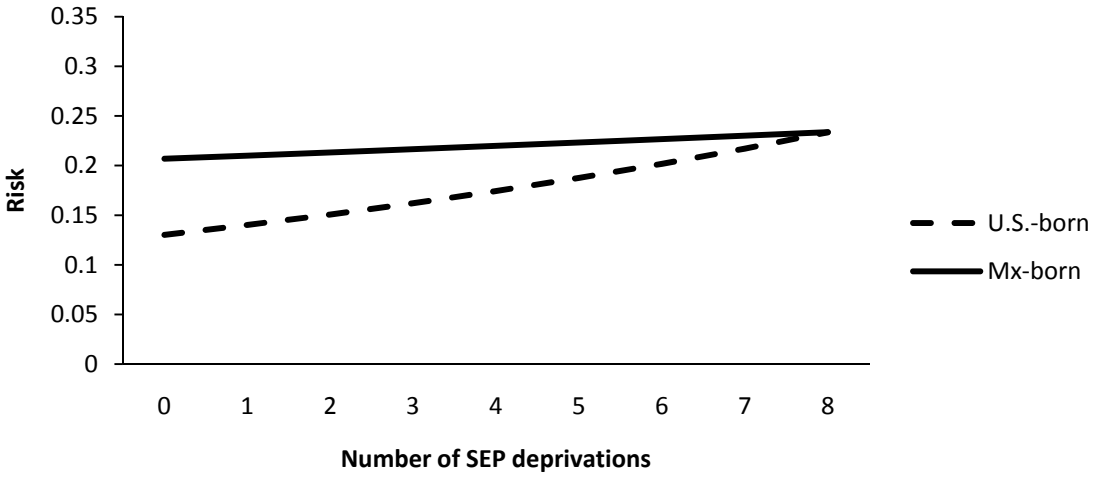
*P-value=0.2831 among participants with CESD <16 and P-value=0.0169 among participants with CESD ≥16.

Figure 4.3. The risk of elevated depressive symptoms across the study period, by SEP mobility groups compared to those who maintained low SEP, Sacramento Area Latino Study on Aging, 1998-2008. Results are based on the adjusted model (2) of table 3.



*The risk Ratio (RR) of elevated depressive symptoms comparing participants with various SEP mobility groups to those who maintained low SEP at each of the time/study visits were derived using the method described by Figueiras et al 1998. This is performed by centering the time variable at the corresponding study visit at which the RR is derived.

Figure 4.4. Associations between life course cumulative disadvantages and risk of elevated depressive symptoms, by nativity, Sacramento Area Latino Study on Aging, 1998-2008.



*Results were adjusted for time, time squared, past-month household income, enrollment age, gender, marital status, alcohol consumption, health insurance, and stroke.

Table 4.1. Life Course Socioeconomic Characteristics of the Study Population at Baseline (n=1789), by SEP Mobility Category, SALSA, 1998-2008.

SEP mobility	All	High	Upward/ high education	Upward/ low education	Downward/ high education	Downward/ low education	Low	*P* value
Covariates	**N=1789**	**n=212 (12.3)**	**n=69 (4.0)**	**n=88 (5.1)**	**n=222 (12.9)**	**n=716 (41.5)**	**n=418 (24.2)**	
Nativity, n (% Mexican-born)	908 (51.0)	41 (19.3)	14 (20.3)	48 (54.6)	67 (30.2)	447 (62.4)	262 (62.7)	<0.0001
Education in years, mean (SD)	7.2 (5.3)	14.8 (3.0)	14.1 (2.3)	6.4 (3.5)	13.0 (1.8)	4.6 (3.3)	3.9 (3.3)	<0.0001
Occupation, n (%)								<0.0001
Manual	1386 (78.8)	0 (0.0)	0 (0.0)	0 (0.0)	222 (100.0)	716 (100.0)	418 (100.0)	
Non-Manual	372 (21.2)	212 (100.0)	69 (100.0)	88 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Old age Household Income, n (%)								<0.0001
Low (<$1,500)	1168 (65.4)	48 (22.6)	18 (26.1)	58 (65.9)	101 (45.5)	559 (78.1)	340 (81.3)	
High (≥$1,500)	618 (34.6)	164 (77.4)	51 (73.9)	30 (34.1)	121 (54.5)	157 (21.9)	78 (18.7)	
Father's education, n (%)								<0.0001
Low	1275 (72.7)	118 (55.7)	64 (92.8)	53 (60.2)	144 (64.9)	478 (66.8)	396 (94.7)	
High	478 (27.3)	94 (44.3)	5 (7.3)	35 (39.8)	78 (35.1)	238 (33.2)	22 (5.3)	
Mother's education, n (%)								<0.0001
Low	1280 (73.0)	102 (48.1)	66 (95.7)	64 (72.7)	147 (66.2)	489 (68.3)	394 (94.3)	
High	473 (27.0)	110 (51.9)	3 (4.4)	24 (27.3)	75 (33.8)	227 (31.7)	24 (5.7)	
Father's occupation, n (%)								<0.0001
Manual or unemployed	1548 (88.3)	176 (83.0)	69 (100.0)	75 (85.2)	191 (86.0)	599 (83.7)	414 (99.0)	
Non-manual	205 (11.7)	36 (17.0)	0 (0.0)	13 (14.8)	31 (14.0)	117 (16.3)	4 (1.0)	
Food deprivation while growing up, n (% yes)	383 (21.9)	22 (10.4)	32 (46.4)	16 (18.2)	42 (18.9)	69 (9.6)	195 (46.7)	<0.0001
Sibling mortality, n (% yes)	864 (49.3)	79 (37.3)	57 (82.6)	51 (58.0)	92 (41.4)	230 (32.1)	340 (81.3)	<0.0001
Cumulative disadvantage, mean (SD)	5.4 (1.5)	3.3 (0.9)	5.2 (0.4)	4.9 (1.1)	4.7 (1.2)	5.6 (0.6)	7.2 (0.4)	<0.0001

Abbreviations: SALSA, Sacramento Area Latino Study on Aging; SEP, Socioeconomic Position.

[a] High SEP: HHH, LHH; Upward SEP with low education: LLH, HDH; Downward SEP: LHL, HLL, HHL; Low SEP: LLL

Table 4.2. Prevalence of Socio-Demographic and Health Conditions Among the Study Population at baseline and Their Unadjusted Associations With depressive symptoms Over the Study Follow-up Time From GEE Logistic Regression, SALSA, 1998-2008.

Covariates	**N=1789**	**β**	**95%CI**	***P* value**
Age at enrollment, mean (SD)	70.65 (7.11)	0.01	0.01, 0.02	0.0001
Gender, n (%)				
Women	1044 (58.4)	0.56	0.47, 0.66	<0.0001
Men	745 (41.6)	1.00		
Nativity, n (%)				
Mexican-born	908 (51.0)	0.26	0.17, 0.34	<0.0001
U.S. born	874 (49.0)	1.00		
Marital status, n (%)				
Widowed/divorced	681 (38.1)	0.29	0.20, 0.37	<0.0001
Single	52 (2.9)	-0.19	-0.50, 0.12	0.2231
Married	1053 (59.0)	1.00		
Health insurance, n (%)				
No	166 (9.3)	-0.19	-0.33, -0.04	0.0153
Yes	1620 (90.7)	1.00		
Alcohol consumption, n (%)				
≥2 drinks/week	324 (18.1)	-0.48	-0.62, -0.35	<0.0001
<2 drinks/week	623 (34.9)	-0.21	-0.30, -0.12	<0.0001
Never	839 (47.0)	1.00		
Smoking status, n (%)				
Ever	958 (53.6)	-0.06	-0.14, 0.02	0.1347
Never	828 (46.4)	1.00		
Body Mass Index (BMI) Category (kg/m^2), n				
<25	338 (19.1)	-0.02	-0.14, 0.10	0.763
25.0-29.9	665 (37.5)	1.00		
≥30	769 (43.4)	0.0003	-0.15, 0.15	0.9962
Diabetes, n (%)				
Yes	595 (33.3)	0.07	-0.02, 0.16	0.1409
No	1194 (66.7)	1.00		
Stroke, n (%)				
Yes	168 (9.4)	0.28	0.09, 0.46	0.0035
No	1621 (90.6)	1.00		
Hypertension, n (%)				
Yes	1112 (62.2)	-0.13	-0.25, -0.01	0.0287
No	677 (37.8)	1.00		
Anti-depressant use, n (%)				
Yes	135 (7.6)	0.38	0.29, 0.48	<0.0001
No	1651 (92.4)	1.00		

Abbreviation: GEE, General Estimating Equation; SALSA, Sacramento Area Latino Study on Aging

Table 4.3. Multivariate GEE Logistic Regression Models for the Associations Between Life Course SEP Mobility and Elevated Depressive Symptoms, SALSA, 1998-2008.

	Model 1			Model 2		
Independent variable	**β**	**95%CI**	***P* value**	**β**	**95%CI**	***P* value**
SEP mobility (Referent: Low SEP)						
High	-1.03	-1.42, -0.64	<0.0001	-0.69	-1.08, -0.30	0.0005
Upward/high education	-0.91	-1.55, -0.27	0.0059	-0.64	-1.28, 0.004	0.0514
Upward /low education	-0.10	-0.44, 0.24	0.5609	-0.03	-0.36, 0.30	0.8407
Downward/high education	-0.68	-1.00, -0.36	<0.0001	-0.46	-0.77, -0.15	0.0039
Downward/Low education	-0.15	-0.34, 0.03	0.1044	-0.13	-0.30, 0.05	0.1607
Time	-0.19	-0.32, -0.07	0.0029	-0.18	-0.31, -0.06	0.0037
Time squared	0.02	0.001, 0.04	0.0406	0.02	0.001, 0.04	0.049
SEP mobility x Time						
High x Time	0.37	0.07, 0.68	0.0165	0.36	0.06, 0.66	0.0173
Upward/high education x Time	0.33	-0.20, 0.86	0.216	0.31	-0.21, 0.83	0.2366
Upward/low education x Time	0.11	-0.20, 0.42	0.4898	0.10	-0.20, 0.40	0.5095
Downward/high education x Time	0.14	-0.12, 0.41	0.2947	0.14	-0.12, 0.40	0.2771
Downward/low education x Time	0.03	-0.16, 0.21	0.7848	0.02	-0.15, 0.20	0.7944
SEP mobility x Time squared						
High x Time squared	-0.05	-0.11, -0.005	0.0324	-0.05	-0.10, -0.005	0.0322
Upward/high education x Time-squared	-0.03	-0.12, 0.05	0.415	-0.03	-0.11, 0.05	0.4616
Upward/low education x Time-squared	-0.03	-0.08, 0.03	0.3585	-0.02	-0.08, 0.03	0.3759
Downward/high education x Time-sq squared	-0.01	-0.05, 0.03	0.627	-0.01	-0.06, 0.03	0.5999
Downward/low education x Time-squared	-0.0004	-0.03, 0.03	0.9772	-0.004	-0.03, 0.03	0.9788
Low household income (Referent: high)				0.44	0.30, 0.58	<0.0001
Age at enrollment				-0.002	-0.01, 0.005	0.5697
Women (Referent: Men)				0.47	0.37, 0.57	<0.0001
Mexican-born (Referent: U.S.-born)				0.10	0.01, 0.19	0.0299
Marital status (Referent: married)						
Widowed/divorced				0.02	-0.07, 0.11	0.6959
Single				-0.27	-0.57, 0.03	0.0776
Alcohol consumption (Referent: never)						
≥2 drinks/week				-0.09	-0.23, 0.06	0.2285
<2 drinks/week				-0.10	-0.19, -0.01	0.0382
Health Insurance (Referent: no)				-0.37	-0.53, -0.21	<0.0001
Stroke (Referent: no)				0.22	0.04, 0.40	0.016

Abbreviation: GEE, General Estimating Equation; SALSA, Sacramento Area Latino Study on Aging; Time-sq, Time squared

[a] High SEP: HHH, LHH; Upward SEP with low education: LLH, HDH; Downward SEP: LHL, HLL, HHL; Low SEP: LLL.

Table 4.4. Multivariate GEE Logistic Regression Models for the Associations Between Life Course Cumulative Deprivation and Elevated Depressive Symptoms, SALSA, 1998-2008.

	Model 1			Model 2		
Independent variable	**β**	**95%CI**	***P* value**	**β**	**95%CI**	***P* value**
Cumulative disadvantage (CD)	0.14	0.08, 0.20	<0.0001	0.07	0.01, 0.13	0.0179
Mexican-born (Referent: U.S.-born)	0.80	0.40, 1.20	0.0002	0.46	0.06, 0.86	0.0248
Mexican-born*CD	-0.10	-0.17, -0.03	0.0048	-0.06	-0.13, 0.01	0.1044
Time	-0.14	-0.21, -0.06	0.0003	-0.13	-0.20, -0.06	0.0004
Time-sq	0.02	0.004, 0.03	0.0072	0.02	0.004, 0.03	0.0105
Low household income (Referent: high)				0.48	0.35, 0.61	<0.0001
Age at enrollment				-0.002	-0.01,	0.5899
Women (Referent: Men)				0.46	0.36, 0.57	<0.0001
Marital status (Referent: married)						
Widowed/divorced				0.02	-0.08, 0.11	0.7349
Single				-0.31	-0.62, -0.01	0.0446
Alcohol consumption (Referent: never)						
≥2 drinks/week				-0.09	-0.23, 0.05	0.2179
<2 drinks/week				-0.10	-0.20, -0.01	0.0301
Health Insurance (Referent: no)				-0.37	-0.52, -0.21	<0.0001
Stroke (Referent: no)				0.21	0.03, 0.39	0.0222

Abbreviation: GEE, General Estimating Equation; SALSA, Sacramento Area Latino Study on Aging

Chapter 5

Conclusion

In the current dissertation we examined the associations between life course socioeconomic circumstances among older Mexicans and Mexican Americans and cognitive function, dementia/CIND, and depressive symptoms. Below is a description of the major findings by chapter.

5.1 Major findings

In chapter 2, using data from MHAS and SALSA, we found that the influence of childhood SES, indicated by mother and father's education, on cognitive function later in life was accounted for by one's educational attainment. Migration status was found to modify the associations between participant's education and cognitive function for the U.S.-born. In chapter 3, using data from the SALSA study, we provided evidence of an association between life course SEP and dementia/CIND, further highlighting that neurodegeneration processes are shaped by life course experiences. This study provided evidence that diabetes and stroke are important risk factors for dementia/CIND and accounted for part of the socioeconomic gradient in dementia/CIND. Finally in chapter 4, using data from the SALSA study, we provided evidence for an association between life course socioeconomic conditions and risk of depressive symptoms later in life, highlighting the importance of life course experiences in shaping mental health. Stroke

was found to be an important risk factor for depressive symptoms and accounted for part of its associated socioeconomic gradient.

5.2 Public health significance

Despite increasing evidence linking socioeconomic conditions and mental health outcomes later in life, no research has prospectively examined such associations among Mexican Americans or accounted for the multi-dimensional aspect of socioeconomic position. Accordingly, the findings of the current dissertation fill an important methodological gap in the literature. This dissertation used novel techniques by examining the influence of socioeconomic mobility across the life course on aging conditions and resulted in findings that would benefit the fast-growing U.S. Hispanic population.

All three analyses (Chapters 2, 3, and 4) suggested that mental health later in life is shaped by socioeconomic exposures across the life course. Importantly, the findings provided evidence that childhood disadvantages may be buffered by later life experiences, educational attainment in particular. However, educational attainment is greatly influenced by parental engagement and childhood to early adulthood environment. Consequently, promoting an interest in schooling and a better educational achievement constitute an important point of intervention particularly for children of low SEP families. There is ample evidence showing that family monitoring and cohesion are associated with better academic achievement (173). Accordingly, school-based and community-based interventions that engage the parents with their children's schooling and academic achievements are needed. Moreover, promoting classroom belonging with the teachers and classroom social support are suggested to result in better educational

outcomes especially for children of racial/ethnic minorities (173). Furthermore, given our sensitivity to the characteristics of the neighborhood in which we live, providing stimulating exposures such as libraries and fostering their use through school-based programs and community-based programs may offset some of disadvantages experienced within the households/families.

Our findings further provided evidence that cardiometabolic risk factors such as stroke and type-2 diabetes account for some of the observed associations between socioeconomic conditions and mental health later in life. The patterning of SEP and type-2 diabetes has been suggested to operate through various mechanisms such as health behavioral mechanisms (including diet, physical activity, etc) and stress-related mechanisms. Both mechanisms have been suggested to influence trends of BMI as well as inflammatory and immune-related responses. This is of particular importance among Latino populations whose migration to the U.S. often results in an accumulation of exposures and stressors associated with type-2 diabetes. Indeed, longer residence in the U.S. has been associated with higher BMI among Latino migrants (174). Given that type-2 diabetes represents a pathophysiologic process taking place over long periods of time, one example of potential interventions would be to target school-aged children by promoting school-based programs that encourage greater physical activity and healthier lunches (175).

This work has great implications for the aging community as a whole and U.S. Hispanics, in particular. The availability of a data with over a decade of follow-up provided a unique opportunity to examine and understand the associations between earlier life course socioeconomic circumstances and health conditions later in life. Using

a life course framework, we provided support that the influence of socioeconomic exposures accumulates over time. However, we also provided insight into potential points of intervention specifically during childhood and early adulthood and which could possibly break the series of risks accumulating over time and thus help reduce the associated health effects. Future research plans will build on this work by further examining some of the bio-behavioral pathways of aging conditions using other longitudinal techniques which will address some of the shortcomings of mediation and unobserved confounding such as structural equation modeling and propensity scores. Furthermore, and in light of the importance of cardiometabolic risk factors, future research plans will examine inflammatory and immune-related markers (ideally with repeated measurements across the life course) as pathways between life course socioeconomic conditions and health later in life. This will provide further insight into the timing of some of the associated interventions and will help in translating epidemiologic data into effective policies and interventions. Finally, more work addressing similar research questions among other minority or socially disadvantaged groups is needed to replicate our findings.

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