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Original Contribution

Childhood and Life-Course Socioeconomic Position and Cognitive Function in the Adult Population of the Hispanic Community Health Study/Study of Latinos

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The Hispanic/Latino population experiences socioeconomic adversities across the lifespan and is at greater risk of cognitive impairment, yet little is known about the role of life-course socioeconomic position (SEP) in cognitive function in this population. Using baseline data (2008–2011) from adults (aged 45–74 years) of the Hispanic Community Health Study/Study of Latinos, we assessed the association between childhood SEP and socioeconomic mobility with cognitive function, and whether this association was mediated by midlife SEP. Childhood SEP was assessed using parental education. An index combining participants' education and household income represented midlife SEP. Socioeconomic mobility was categorized as stable low, downward or upward mobility, and stable high-SEP. Cognitive function measures were modeled using survey linear regression with inverse-probability weighting, accounting for covariates. We used mediation analysis to estimate the indirect effect of childhood SEP on cognition through midlife SEP. High childhood SEP was associated with global cognition in adulthood (coefficient for parental education beyond high school vs. less than high school = 0.26, 95% confidence interval: 0.15, 0.37). This association was partially mediated through midlife SEP (indirect effect coefficient = 0.16, 95% confidence interval: 0.15, 0.18). Low SEP through the life course was associated with the lowest cognitive function. This study provides evidence that life-course SEP influences cognitive performance in adulthood.

adults; cognition; Hispanics; Latinos; life course; social mobility; socioeconomic position

Abbreviations: ACME, average causal mediation effect; ADRD, Alzheimer's disease and related dementia; CI, confidence interval; HCHS/SOL, Hispanic Community Health Study/Study of Latinos; IPW, inverse probability weighting; SEP, socioeconomic position.

Since childhood is a period of dramatic brain growth and plasticity (1), low socioeconomic position (SEP) and adversities in early life may affect brain development, leading to lasting effects on cognitive aging (2–5). Previous research has linked low SEP with changes in brain structure and functioning in areas related to memory, language, and executive functioning (2, 3, 5, 6). In addition, low SEP experienced during childhood may influence cognitive performance and dementia in adulthood (7–17). However, whether childhood SEP influences later-life cognitive function directly or through adulthood SEP has been less studied (8, 12). Furthermore, less research has been done to assess the role of socioeconomic mobility and the accumulation of socioeconomic adversities throughout the life course on later-life adverse cognitive outcomes (7, 8).

In the life-course epidemiology literature, the associations between exposures and health outcomes across different life stages have been explained through specific life-course frameworks, including the critical period, accumulation of risks, pathways, and social mobility models (18, 19). According to the critical period model, low SEP in childhood can lead to poor nutrition, an inadequately stimulating home

environment, and psychological stress; in turn, these influence brain development and neural functioning during infancy and throughout childhood, affecting cognitive performance across the lifespan (2, 20). According to the accumulation of risks model, as exposures combine and aggregate over time, the damage to biological systems also accumulates (18). Thus, the combination of individual SEP throughout the life course might influence cognitive function in adulthood (20). The pathways or chain-of-risk model posits that the association between childhood SEP and adult cognitive function might be partly explained by SEP in adulthood (8, 19, 21), while the social mobility model posits that changes in socioeconomic conditions during the life course positively or negatively influence health behaviors, access to resources, and life opportunities that in turn influence cognitive function later in life. Although several studies have assessed the association between SEP at different stages of the life course and cognitive function in adulthood (7–17), fewer studies have formally integrated the life-course models in their evaluations (7, 8, 12–14).

In the United States, the Hispanic/Latino population is at increased risk of cognitive impairment relative to non-Hispanic Whites (22, 23). It is expected that by 2060 the number of members of the Hispanic/Latino population in the United States living with Alzheimer disease and related dementia (ADRD) will increase dramatically compared with other ethnic groups. (24) The burden of risk factors for ADRD is also high in this population (25, 26). Persons of Hispanic/Latino heritage also experience extensive socioeconomic adversities during their lifespan (27–29). However, most of the studies examining the role of socioeconomic conditions on cognitive function have focused on non-Hispanic populations, with fewer studies including the Hispanic/Latino population (14, 30). To address this gap, this study aimed to assess the influence of childhood SEP on cognitive function in a population of Hispanic/Latino adults of diverse heritage backgrounds of the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), to test the critical period model. We also evaluated whether this association is mediated through midlife SEP to test the pathways model. Additionally, we assessed whether socioeconomic mobility from childhood to adulthood influences cognitive function, which allowed us to test the social mobility model.

METHODS

Study population

We examined data from the HCHS/SOL, a multicenter population-based cohort study conducted in 4 major US cities (Bronx, New York; Chicago, Illinois; Miami, Florida; and San Diego, California) (31).

Participants were selected through a stratified, multistage, area probability sample design to provide a representative sample of the 4 target communities and consider several heritage backgrounds: Central American, Mexican, Cuban, Dominican, Puerto Rican, and South American (32). For this study, we conducted a cross-sectional analysis, using data from adults aged 45–74 years who were examined for cognitive function ($n = 9{,}596$) at baseline (2008–2011). Of this sample, we excluded 265 participants with incomplete data on covariates, for a final analytical sample of 9,331. The study was reviewed and approved by each participating institution's review board. Written informed consent was obtained from all participants.

Measurement of cognitive function

Five standardized cognitive function tests were administered during the baseline examination in face-to-face interviews by trained interviewers. Details have been described elsewhere (33). In brief, the assessment included the Six-Item Screener (SIS), a brief measure of global mental status (34); the 2 scores of the Brief Spanish-English Verbal Learning Test (B-SEVLT) (35), a measure of verbal learning and memory; the Controlled Oral Word Association or Word Fluency Test (WF) (36), a measure of verbal functioning; and the Digit Symbol Substitution Test (DSS) of the Wechsler Adult Intelligence Scale–Revised, a measure of psychomotor speed and sustained attention (37). We derived a global cognition score using confirmatory factor analysis on these 5 measures (38). To facilitate comparison, we obtained z scores for each cognitive measure and global cognition based on their mean and standard deviation.

Measurement of SEP

Childhood SEP. We used parental educational attainment as a proxy for childhood SEP. Using participants' reports of their father's and mother's maximum level of education, we selected the highest education achieved by either the father or mother and created the following categories: father or mother with less than a high-school education, father or mother with a high-school education, and father or mother with more than a high-school education.

Midlife SEP. Midlife SEP was determined through an index combining participants' self-reported educational level (dichotomized as less than high school and high school or more) and annual household income (dichotomized as less than $30,000 and $30,000 or more). We then summed across categories to obtain the midlife SEP index, ranging from 0 to 2, with a higher score indicating higher SEP. We dichotomized the index into the following categories: lower midlife SEP (score: 0) and higher midlife SEP (score: $\geq$1).

Socioeconomic mobility

We classified participants into socioeconomic mobility categories from childhood to adulthood (8, 39) using dichotomized childhood SEP based on parental education (less than high-school education and high-school education or more) and the index of midlife SEP (lower SEP and higher SEP). By combining these 2 indicators of SEP, we created 4 categories of socioeconomic mobility (i.e., stable low SEP: low childhood SEP and low midlife SEP; upward mobility: low childhood SEP and high midlife SEP; downward mobility: high childhood SEP and low midlife SEP; and stable high SEP: high childhood SEP and

high midlife SEP) (Web Figure 1, available at https://doi.org/10.1093/aje/kwad157).

Covariates

Confounders of the association between each life-course SEP exposure and cognitive function were selected based on variables that may influence each measure of life-course SEP and cognitive function (33, 40). Specifically, for childhood SEP, we included as potential confounders the year of birth (linear), sex (male or female), Hispanic/Latino background (Mexican, Cuban, Puerto Rican, Dominican, Central American, South American, or other/mixed), and place of birth (born in the 50 US states/DC or outside the 50 US states/DC). These factors have been also associated with cognitive function in Hispanic/Latino populations (33). For midlife SEP, in addition to the previous variables, we included childhood SEP; field center (Bronx, Chicago, Miami, or San Diego); marital status (married or living with a partner; single, separated, divorced, or widow/widower); years in the United States (<10 years or ≥ 10 years); language preference (English or Spanish); and health insurance coverage (yes or no). We also included behavioral and clinical factors because they may influence midlife SEP and are known risk factors for cognitive function in our population (33). These included smoking status (never/former smoker or current smoker); alcohol use level (no current use, low-risk drinker, or at-risk drinker based on gender-specific cutoff for weekly alcohol use) (41); physical activity level (inactive or low activity, medium activity, or high activity) (42); depressive symptoms based on the 10-item Center for Epidemiological Studies Depression Scale (CESD-10), a self-report measure of depression (43); hypertension (yes or no based on measured systolic and diastolic blood pressure of $\geq 140/90$ mm Hg or antihypertensive medication use); diabetes mellitus (no diabetes, prediabetes, or diabetes based on the definition of the American Diabetes Association and glucose-lowering medication use) (44); prevalent cardiovascular disease or stroke (yes or no, based on a combination of identified possible old myocardial infarction on an baseline electrocardiogram, or self-report of medical diagnosis of a heart attack, cardiovascular procedures, or medical diagnosis of stroke); and self-reported health status (excellent/good, fair, or poor based on self-reported health as part of the Short-Form 12-Item Health Survey (SF-12), version 2. A similar rationale was followed to select the covariates for socioeconomic mobility.

Statistical analysis

We estimated population-based summary statistics to describe the distribution of sociodemographic characteristics weighted to the target population of the HCHS/SOL. We quantified the association between childhood and midlife SEP and socioeconomic mobility with cognitive function using survey linear regression models. However, since covariates downstream of childhood SEP (e.g., midlife SEP, cardiovascular disease, etc.) may act as mediators, their direct inclusion in the regression models can result in collider stratification bias (45–47). Therefore, we conducted inverse probability weighting (IPW) to remove confounding for these variables without blocking their potential mediation (46, 48). Using logit models for each life-course SEP exposure, we calculated stabilized IPW as the inverse probability of being exposed given each set of covariates. To predict the stabilized IPW for each exposure, we included only the covariates that may influence each measure of SEP at each life-course stage as described above (see Web Appendix 1). Then, using the calculated stabilized IPW along with the factors of the complex sampling design (i.e., clustering, stratification, and sampling probability weights), we conducted weighted linear regression models to estimate the association between each life-course SEP exposure and cognitive function, represented as beta coefficients and their 95% confidence intervals (CIs). We assessed the balance in covariates between exposed and unexposed individuals using standardized mean differences. For most covariates there was no remaining association with the exposures (Web Tables 1–2).

Since 12%, 6%, and 17% of the study population had missing data on parental education, annual household income, and physical activity, respectively, all analyses were conducted using 50 sets of complete imputed data sets. We conducted multiple imputation in Stata (StataCorp, LLC, College Station, Texas) (49, 50), using sequential imputation and chained equations from a set number of trials (51, 52). In the pooling step and accounting for the within-and-between-imputation variability, we obtained summary estimates and 95% CIs of the associations between each life-course SEP exposure and cognitive function.

Since sociocultural factors may play a role in our estimated associations, we assessed interaction by including terms for the interactions of age, sex, place of birth, Hispanic/Latino background, years in the United States, language preference, and age of immigration with childhood and adulthood SEP and socioeconomic mobility in our regression models. We also assessed the interaction of childhood SEP with midlife SEP.

Finally, since performance on the cognitive function tests might be influenced by the participant's educational level, we conducted a sensitivity analysis using only household income as our measure of midlife SEP.

Mediation analysis

To test the pathways model, we conducted a mediation analysis following the approach by Ima et al. (53, 54). We decomposed the total effect of childhood SEP on each measure of cognitive function into the direct and indirect effect through midlife SEP. We used childhood SEP and midlife SEP as exposure and mediator, respectively. For this analysis, by including the set of covariates described above, we assumed no unmeasured confounding for the exposure-mediator-outcome relationship as well as no mediator-outcome confounder affected by the exposure itself. We also assumed a binomial distribution with a probit link for the exposure-mediator regression model and a linear distribution for the outcome model.

For each measure of cognitive function and accounting for the complex sampling design, we calculated the average causal mediation effect (ACME), a measure of the indirect effect of childhood SEP on cognitive function mediated through midlife SEP; the direct effect, which represents the effect of childhood SEP on cognitive function controlling for the pathway through midlife SEP and all other confounders; and the proportion of the total effect that is mediated, a measure of the magnitude of the ACME relative to the total effect (53, 54).

Descriptive and regression analyses were performed with Stata, version 17.1 (StataCorp). Mediation analyses were performed with R, version 3.1.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

On average, the population was born in 1953 (standard deviation, 8 years), predominantly female (55%), of Mexican (31%) background, born outside of the 50 US states/DC (91%), had lived less than 10 years in the 50 US states/DC (79%), and had Spanish as the preferred language (86%). Regarding behavioral factors, 21%, 4.5%, and 68% of the population were current smokers, at risk of alcohol use disorder, and inactive or with low physical activity, respectively. We found that the mean score for depressive symptoms was 7 (standard deviation, 6), while 44%, 28%, 10%, and 7% of the population were hypertensive, diabetic, self-reported having been diagnosed with cardiovascular disease or stroke, and self-rated their health as poor, respectively. Almost 65% of the population had parents with less than a high-school education, and 33% had midlife lower SEP; 25% remained in a low SEP throughout their life course, while 40% showed upward socioeconomic mobility. For most of the cognitive function measures, the mean baseline score was half (Controlled Oral Word Association or Word Fluency Test and Brief Spanish-English Verbal Learning Test sum and recall) or a third (Digit Symbol Substitution Test) of the maximum score (Table 1).

Associations for childhood SEP: critical period model

After accounting for confounding using IPW, we found a greater global cognition z score among adults whose parents had a higher educational level. The population group whose father or mother had a high-school education (coefficient = 0.21, 95% CI: 0.12, 0.31) or more than high school (coefficient = 0.26, 95% CI: 0.15, 0.37) showed higher global cognition z scores when compared with those whose parents had less than a high-school education. Results were consistent across measures of cognitive function, except for the Six-Item Screener (Table 2).

Associations for midlife SEP: pathways model

We found an association between midlife SEP and cognitive function. Higher midlife SEP was associated with greater z scores for global cognition (coefficient = 0.46, 95% CI: 0.38, 0.54), compared with those with lower midlife SEP. Results were consistent across all measures of cognitive function (Table 2).

We also found that childhood SEP was associated with midlife SEP, with participants having greater SEP during childhood showing a higher probability of greater SEP during adulthood (for father or mother with a high-school education, coefficient = 0.99, 95% CI: 0.73, 1.24; for father or mother with more than a high-school education, coefficient = 1.56, 95% CI: 1.25, 1.87). The mediation analysis also showed that the association between childhood SEP and cognitive function was partly mediated through midlife SEP (Table 3) Among the population whose father or mother had a high-school education, over a total effect of 0.22 (95% CI: 019, 0,25), we observed an ACME of childhood SEP on the standardized global cognition score of 0.09 (95% CI: 0.08, 0.11), mediated through midlife SEP. This ACME indicates that 44% (95% CI: 38, 52) of the total effect of childhood SEP on global cognition is mediated through midlife SEP. Similarly, among the population whose father or mother had more than a high-school education, of the total effect of childhood SEP on global cognition (0.43, 95% CI: 0.35, 0.47), 40% (95% CI: 34, 47) is mediated through midlife SEP (ACME = 0.16, 95% CI: 0.15, 0.18).

Associations for socioeconomic mobility: social mobility model

After accounting for confounding, we found that the population with a stable low SEP from childhood to adulthood (i.e., low childhood SEP and low midlife SEP) showed the lowest levels of cognitive function. In contrast, the population in the stable high SEP had the highest levels of cognitive function (global cognition coefficient = 0.68, 95% CI: 0.58, 0.78). In addition, the population with low childhood SEP but upward socioeconomic mobility showed a greater global cognition z score (coefficient = 0.39, 95% CI: 0.30, 0.48) than those with stable low SEP. These results were consistent across measures of cognitive function (Table 4).

We did not find evidence of interactions of childhood or adulthood SEP or socioeconomic mobility with age, sex, being US- or foreign-born, Hispanic/Latino background, years in the United States, language of preference, and age of immigration in relation to cognitive function. Similarly, we did not find evidence of interaction between childhood SEP and midlife SEP.

Results were consistent in sensitivity analyses that used annual household income as the measure of midlife SEP (Web Table 3).

DISCUSSION

In this population-based cohort study using a variety of cognitive function tests, we found that high childhood SEP, assessed through parental educational attainment, was associated with higher performance on cognitive-related tasks among middle-aged and older Hispanic/Latino adults. We also found that midlife SEP partially mediated the association between childhood SEP and cognitive performance. This study also supports the hypothesis that socioeconomic

Table 1. Descriptive Statistics at Baseline for an Adult Population Aged 45–74 Years, Hispanic Community Health Study/Study of Latinos, United States, 2008–2011

Characteristic	Weighted (*n* = 9,331)	
	No.	%
Covariates		
Year of birth[a]	1953 (8.2)	
Sex		
Women	5,799	54.6
Men	3,532	45.4
Hispanic/Latino background		
Dominican	811	9.2
Central American	923	6.6
Cuban	1,541	27.3
Mexican	3,525	31.2
Puerto Rican	1,713	17.9
South American	627	5.4
More than one/other	191	2.3
Born in the 50 US states/DC	885	9.2
Years lived in the 50 US states/DC		
≥10 years	1,668	21.1
Language preference		
Spanish	8,085	85.9
Field center		
Bronx, New York	2,214	25.9
Chicago, Illinois	2,253	12.8
Miami, Florida	2,479	36.7
San Diego, California	2,385	24.5
Marital status		
Married or living with a partner	5,070	53.3
Health insurance coverage	5,174	57.5
Smoking status		
Current smoker	1,757	20.6
Alcohol use level		
No current use	5,350	55.9
Low-risk drinker	3,603	39.6
At-risk drinker	378	4.5
Physical activity level		
Inactive or low	5,176	67.7
Moderate	1,495	18.8
High	1,023	13.5
Depressive symptoms[a]	7.5 (6.4)	
Hypertension	3,790	43.7
Diabetes		
No diabetes	2,437	24.9
Prediabetes	4,243	46.7
Diabetes	2,651	28.4

Table continues

Table 1. Continued

Characteristic	Weighted (n = 9,331)	
	No.	%
CVD or stroke	822	9.9
Health status		
Excellent or good	5,955	64.1
Fair	2,729	28.5
Poor	647	7.4
Childhood SEP		
Father or mother with less than high-school education	5,665	64.8
Father or mother with high-school education	1,391	18.2
Father or mother with more than high-school education	1,166	16.9
Midlife SEP		
Lower SEP (score: 0)	3,320	32.7
Higher SEP (score: ≥1)	6,011	67.3
Socioeconomic mobility		
Stable low SEP	2,297	24.8
Downward mobility	380	4.6
Upward mobility	3,368	40.0
Stable high SEP	2,177	30.6
Cognitive function[a]		
Global cognition z score	−0.0 (1.0)	
B-SEVLT sum (0–45)	22.4 (5.7)	
B-SEVLT recall (0–15)	8.0 (2.9)	
WF	18.3 (7.2)	
DSS (0–90)	33.9 (13.4)	
SIS (0–6)	5.3 (0.9)	

Abbreviations: B-SEVLT, Brief Spanish-English Verbal Learning Test; CVD, cardiovascular disease; DSS, Digit Symbol Substitution Test; SEP, socioeconomic position; SIS, Six-Item Screener; WF, Controlled Oral Word Association or Word Fluency Test.

[a] Values are expressed as mean (standard deviation).

mobility is associated with cognition in adulthood, with those in stable low SEP throughout their lifespan showing the worst cognitive function.

Overall, this study contributes to previous literature by providing evidence, using IPW to adjust for confounding, that in the HCHS/SOL population, early-life socioeconomic conditions have a long-lasting influence on cognitive aging regardless of adult education and income and the mediating role of midlife SEP, associations seldom explored in Hispanic/Latino population. In addition, our study also adds to the growing evidence on the importance of exploring the role of SEP from a life-course perspective as an important determinant of cognitive health in middle-aged and older adults.

Our results are consistent with some (7–9, 11, 12, 55, 56) but not all (8, 57, 58) previous research, with some studies showing that childhood SEP has a direct association with cognitive performance (7–9, 11, 12, 55, 56), while other studies found that this association is fully mediated by adulthood income and education (8, 57, 58). Faul et al. (8), using nationally representative data from the Health and Retirement Study and the English Longitudinal Survey of Ageing, found that high childhood SEP (ascertained as an index combining father or parental unemployment, financial difficulties, and father's occupation) was associated with higher baseline cognitive function in both cohorts. However, the long-lasting influence of childhood SEP on later-life cognition was evident only for the English cohort. After adjusting for adulthood education and wealth, this association was no longer present for the US cohort. According to that study, in the US context and for a predominantly non-Hispanic White population (5% are Hispanic), the association between childhood SEP and cognitive performance was explained by adulthood education and wealth (8). Similarly, Barnes et al. (59), using data from the Chicago Health and Aging Project, found that for African American adults, once

Table 2. Association Between Childhood and Midlife Socioeconomic Position With Cognitive Function in an Adult Population Aged 45–74 Years, Hispanic Community Health Study/Study of Latinos, United States, 2008–2011[a]

Measure of Life-Course SEP	Global Cognition		B-SEVLT Sum		B-SEVLT Recall		WF		DSS		SIS	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Childhood SEP												
Father or mother with less than high-school education	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent
Father or mother with high-school education	0.21	0.12, 0.31	0.16	0.07, 0.26	0.14	0.05, 0.24	0.19	0.07, 0.32	0.38	0.28, 0.48	0.09	−0.05, 0.23
Father or mother with more than high-school education	0.26	0.15, 0.37	0.21	0.09, 0.34	0.13	0.02, 0.24	0.26	0.14, 0.37	0.41	0.32, 050	0.01	−0.12, 0.14
Midlife SEP												
Lower SEP (score: 0)	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent
Higher SEP (score: ≥1)	0.46	0.38, 0.54	0.41	0.33, 0.49	0.31	0.23, 0.39	0.51	0.43, 0.60	0.59	0.50, 0.66	0.31	0.22, 0.39

Abbreviations: B-SEVLT, Brief Spanish-English Verbal Learning Test; CI, confidence interval; DSS, Digit Symbol Substitution Test; SEP, socioeconomic position; SIS, Six-Item Screener; WF, Controlled Oral Word Association or Word Fluency Test.

[a] The outcome regression models were weighted with the stabilized inverse probability weights to adjust for the set of covariates defined at each life-course stage. Childhood SEP included year of birth, sex, Hispanic/Latino background, and whether US- or foreign-born. Midlife SEP added childhood SEP, field center, years lived in the 50 US states/DC, language preference, health insurance coverage, marital status, smoking status, alcohol use level, physical activity, depressive symptoms, hypertension, diabetes, self-report of medical diagnosis of cardiovascular disease or stroke, and self-rated health status.

Table 3. Mediation Analysis for the Association Between Childhood Socioeconomic Position and Cognitive Function Through Midlife Socioeconomic Position in an Adult Population Aged 45–74 Years, Hispanic Community Health Study/Study of Latinos, United States, 2008–2011[a]

Measure of Life-Course SEP	Global Cognition		B-SEVLT Sum		B-SEVLT Recall		WF		DSS		SIS	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Childhood SEP												
Father or mother with high-school education												
ACME	0.09	0.08, 0.11	0.08	0.07, 0.09	0.06	0.05, 0.07	0.11	0.09, 0.12	0.15	0.13, 0.16	0.06	0.05, 0.08
Direct effect	0.12	0.09, 0.15	0.12	0.08, 0.14	0.07	0.04, 0.09	0.13	0.10, 0.16	0.22	0.19, 0.25	0.04	0.01, 0.07
Total effect	0.22	0.19, 0.25	0.19	0.16, 0.22	0.13	0.10, 0.16	0.24	0.21, 0.27	0.37	0.34, 0.40	0.10	0.08, 0.13
% of mediated effect	43.9	37.7, 52.0	42.0	34.6, 51.0	48.6	37.8, 63.0	44.7	38.3, 52.0	39.7	35.4, 44.0	63.7	48.2, 84.0
Father or mother with more than high-school education												
ACME	0.16	0.15, 0.18	0.13	0.12, 0.15	0.10	0.09, 0.12	0.18	0.16, 0.20	0.25	0.22, 0.27	0.11	0.09, 0.13
Direct effect	0.25	0.19, 0.31	0.23	0.17, 0.28	0.13	0.08, 0.19	0.26	0.21, 0.31	0.44	0.39, 0.50	0.08	0.02, 0.13
Total effect	0.43	0.35, 0.47	0.36	0.31, 0.42	0.24	0.18, 0.30	0.44	0.39, 0.49	0.67	0.63, 0.74	0.19	0.13, 0.24
% of mediated effect	39.9	33.7, 47.0	37.5	30.8, 45.0	44.9	34.6, 59.0	40.6	34.8, 48.0	35.7	32.1, 0.40	59.7	44.3, 83.0

Abbreviations: ACME, average causal mediation effect; B-SEVLT, Brief Spanish-English Verbal Learning Test; CI, confidence interval; DSS, Digit Symbol Substitution Test; SEP, socioeconomic position; SIS, Six-Item Screener; WF, Controlled Oral Word Association or Word Fluency Test.

[a] Adjusted for year of birth, sex, Hispanic/Latino background, whether US- or foreign-born, field center, years lived in the 50 US states/DC, language preference, health insurance coverage, marital status, smoking status, alcohol use level, physical activity, depressive symptoms, hypertension, diabetes, self-report of medical diagnosis of cardiovascular disease or stroke, and self-rated health status.

Table 4. Association Between Socioeconomic Mobility and Cognitive Function in an Adult Population Aged 45–74 Years, Hispanic Community Health Study/Study of Latinos, United States, 2008–2011[a]

Socioeconomic Mobility[b]	Global Cognition		B-SEVLT Sum		B-SEVLT Recall		WF		DSS		SIS	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Stable low	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent	0	Referent
Downward	0.15	−0.02, 0.31	0.07	−0.09, 0.24	0.09	−0.06, 0.25	0.15	−0.06, 0.37	0.29	0.13, 0.46	−0.05	−0.24, 0.13
Upward	0.39	0.30, 0.48	0.34	0.25, 0.43	0.27	0.18, 0.36	0.47	0.36, 0.57	0.53	0.44, 0.62	0.26	0.16, 0.35
Stable high	0.68	0.58, 0.78	0.59	0.49, 0.69	0.45	0.36, 0.54	0.71	0.60, 0.82	0.93	0.83, 1.02	0.37	0.26, 0.47

Abbreviations: B-SEVLT, Brief Spanish-English Verbal Learning Test; CI, confidence interval; DSS, Digit Symbol Substitution Test; SEP, socioeconomic position; SIS, Six-Item Screener; WF, Controlled Oral Word Association or Word Fluency Test.

[a] The outcome regression models were weighted with the stabilized inverse probability weights to adjust for covariates, including the year of birth, sex, Hispanic/Latino background, whether US- or foreign-born, field center, years lived in the 50 US states/DC, language preference, health insurance coverage, marital status, smoking status, alcohol use level, physical activity, depressive symptoms, hypertension, diabetes, self-report of medical diagnosis of cardiovascular disease or stroke, and self-rated health status.

[b] Stable low: low childhood SEP and lower midlife SEP; downward: high childhood SEP and lower midlife SEP; upward: low childhood SEP and higher midlife SEP; stable high: high childhood SEP and higher midlife SEP.

education was accounted for, financial adversities during childhood were no longer associated with cognitive function. In contrast, our findings support that, for the target Hispanic/Latino population included in this study, childhood SEP has a long-lasting and direct influence on cognitive function in adulthood.

Although these inconsistent results across studies might be explained by differences in the study populations, measurements of childhood SEP, domains of cognitive function, mediators, and the analytical approaches used, other sociocultural factors, such as experiences of racism and discrimination endured by the Hispanic/Latino population over the life course, might also explain some of these differences. For example, acculturative stress (i.e., psychosocial stress experienced due to the process of adapting to new cultural norms) (60) and experiences of discrimination (61) have been associated with worse cognitive function and cognitive-related disability in this population. The intersection of these factors with early-life socioeconomic adversities may increase and exacerbate adverse cognitive outcomes in Hispanic/Latino population.

Our results showing that social mobility over the life course strongly influences cognitive health in adulthood are consistent with previous studies (8, 11, 13). Having a period of high SEP throughout a person's life seems to provide some protection for cognitive function in adulthood. Similarly, upward social mobility seems to compensate for the negative results of earlier deprivation. Those with low SEP in childhood that later achieved greater education and income had higher cognitive performance than those with a similar childhood background who remained in a stable low SEP in adulthood.

Our findings support the models proposed in the life-course framework (18, 19). First, the long-lasting and independent association between childhood SEP and later-life cognitive function supports the critical period model. Differential access to material resources such as income, nutritious food, and a cognitively stimulating home environment are some of the mechanisms that may explain this association. Limited access to these resources due to low childhood SEP can affect brain growth and development (2–5), influencing later-life cognitive function. Second, in support of the pathways model, we found that midlife SEP is one pathway through which childhood SEP influences later-life cognition. However, this is not the only mechanism, since some studies have found that cognitive ability in adolescence (12) and young adulthood (57), cultural capital (57), and midlife health (12) also mediate this association. Third, in support of the social mobility model, we found that changes in socioeconomic conditions throughout the life course influence later-life cognitive function. Socioeconomic mobility may determine differential access to economic resources, quality of education, health care, a cognitively stimulating job, and health behaviors that in turn influence later-life cognitive health (8, 55, 57). In addition to the life-course model, our findings also support the brain reserve hypothesis, which asserts that high educational achievements in adulthood promote a protective buffer or supply reserve to cope with the progression of cognitive impairment and later risk of dementia in older adults (18, 19, 62, 63). The

evidence supporting these theoretical models provided by this study helps to further elucidate some of the mechanisms underlying the influence of life-course SEP on cognitive aging.

There are some limitations to consider when interpreting our results. This is a cross-sectional analysis using baseline information, limiting causal inference. Thus, further longitudinal studies are needed to assess the association between life-course SEP with trajectories of cognitive decline. We used parental educational attainment as a proxy for childhood SEP; however, other relevant measures—such as parental occupation, household assets, and wealth—were not available. Furthermore, this information was collected retrospectively based on participants' self-reports, which might be subject to recall bias and could have influenced our main associations. Similarly, household assets and wealth were not considered for ascertaining midlife SEP, nor were changes in SEP between premigration and postmigration in adulthood. Results from our IPW and mediation analysis depended on the assumption of no unmeasured confounding, which cannot be fully ruled out. Balance was not achieved for all covariates of the socioeconomic mobility exposure; thus, we cannot discard residual confounding. We cannot address the possibility of reverse causation, since cognitive ability may also influence an individual's earning potential. Finally, although some of the cognitive tests used in this study have been validated and normative data have been obtained for the Hispanic/Latino population (64, 65), other psychometric properties are not available.

Despite these limitations, the results of this study are supported by several factors. First, we used IPW to reduce potential confounding. We also conducted a mediation analysis to disentangle the combined role of childhood and midlife SEP on later-life cognition. Second, we used data from a large population-based cohort study with participants being representative of the communities sampled. This study also provides evidence for, to our knowledge, the largest sample of the Hispanic/Latino population in the United States, providing greater representation for this minority ethnic group than previous studies evaluating cognitive function in adult population. Finally, the variety of cognitive function tests allowed us to assess the influence of childhood and life-course SEP on several domains of cognitive function, with consistent results.

In conclusion, this study found evidence that SEP in childhood and throughout the life course are associated with cognitive performance in middle-aged and older Hispanic/Latino adults. Our results have important public health implications since the Hispanic/Latino population is expected to have the largest increase in ADRD prevalence in the coming decades (24), has the highest rates of some vascular risk factors associated with cognitive impairment relative to other ethnic groups (66, 67), and experiences extensive socioeconomic adversities throughout the life course (27–29). Therefore, policies focused on alleviating early-life socioeconomic adversities, ensuring access to education in childhood and throughout the life course, and increasing opportunities for social mobility are crucial interventions to increase later-life cognitive reserve, protect cognitive health, and delay the onset of ADRD.

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