

# Lifecourse Socioeconomic Changes and Late-Life Cognition in a Cohort of U.S.-born and U.S. Immigrants: Findings from the KHANDLE Study

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## Research article

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# Abstract

**Background:** Low socioeconomic status in early and late life has been associated with lower late-life cognition. Less is known about how changes in socioeconomic status from childhood to late life are associated with late-life cognition, especially among diverse populations of older adults.

**Methods:** In a multi-ethnic sample (n=1,353) of older adults, we used linear regression to test associations of change in a comprehensive measures socioeconomic status (financial, cultural, and social domains) from childhood to late life with semantic memory, episodic memory, and executive function. We tested whether the association between SES trajectory and late-life cognition differed by populations who resided in the U.S. during childhood or immigrated to the U.S. as adults.

**Results:** Participants with low childhood/high late life financial capital had better semantic memory ( $\beta=0.18$ ; 95% CI: 0.04, 0.32) versus those with low financial capital in both childhood and late life, regardless of childhood residence. We observed a significant interaction in the association of verbal episodic memory and cultural capital by childhood residence ( $p=0.08$ ). Participants with a foreign childhood residence had higher verbal episodic memory if they had low childhood/high later life cultural capital ( $\beta=0.32$ ; 95% CI: 0.01, 0.63), but lower verbal episodic memory if they had high childhood/low late life cultural capital ( $\beta=-0.40$ ; 95% CI: -0.94, 0.13). Having high lifecourse social capital was associated with better verbal episodic memory scores among those with a U.S. childhood ( $\beta=0.34$ ; 95% CI: 0.14, 0.55), but lower verbal episodic memory among those with a foreign childhood ( $\beta=-0.10$ ; 95% CI: -0.51, 0.31).

**Conclusions:** High financial and cultural capital in late life is associated with better cognition, regardless of early childhood SES or childhood residence. Providing increased financial and educational opportunities that contribute to higher late-life SES may produce better cognitive functioning among diverse populations of older adults.

## Background

Cognitive impairment and dementia in late life is a growing public health issue with substantial racial/ethnic and socioeconomic disparities.(1–3) Several studies have found higher rates of dementia among immigrant populations in the U.S. and western Europe.(4–6) As the population of older adults in the U.S. diversifies, it is critical to understand the relationships between lifecourse experiences and late-life cognition to effectively target interventions that reduce the risk of dementia and decrease disparities.

Prior work has demonstrated the importance of early life conditions for dementia incidence.(7, 8) Several studies have observed a positive association between childhood socioeconomic status (SES) and midlife and late-life cognitive outcomes,(9–13) while some have found that these relationships are mediated by adult SES(11, 12, 14–16) and/or childhood cognitive abilities.(11–13) Few have considered how changes in SES – or trajectories – across the lifecourse may shape late-life cognitive outcomes, especially among racially/ethnically diverse groups, including immigrant populations. One prior study using the Health and

Retirement Survey (15% non-white participants) found that high lifecourse SES was predictive of higher cognition and slower cognitive decline, with education most strongly associated with baseline cognition and late-life income most strongly associated with rate of cognitive decline.(17) Another study among an ethnically Mexican cohort residing in the U.S. found that incident cognitive impairment and dementia were highest among those with low SES across the lifecourse, followed by those with low childhood SES and low educational attainment but otherwise high adulthood SES.(18) However, as the older adult population grows more heterogenous, more research is needed to understand how differences in lifecourse SES trajectories impact late-life cognitive health in diverse racial/ethnic and immigrant populations. This question is particularly poignant for today's older adults, who experienced a rapidly changing political economy and cultural climate. Changes in immigration policy in 1965 allowed for more arrivals from Latin America and Asia as opposed to Europe, which, coupled with racism and increasing socioeconomic inequality, have been theorized to alter assimilation and socioeconomic opportunities for these groups.(19)

Using Bourdieu's forms of capital(20) as a theoretical framework and insights from prior validation of measuring childhood SES in older adults,(21) we constructed comprehensive measures of childhood and late-life SES defined by three domains: financial, cultural, and social capital. This approach to operationalizing SES allows for a more thorough and explicit examination of the specific experiences and resources embedded in social status, and how these might differentially impact late-life cognition in diverse groups. Financial capital is an economic indicator based on income and/or wealth that is commonly used to operationalize SES. Cultural capital is a reflection of both "material and symbolic profits" that are typically transmitted from one generation to the next and can be operationalized via educational attainment.(20) This conceptualization of education is important in the context of late-life cognition, as it acknowledges the indirect pathway of education on late-life cognitive health through its role in transmitting status and opportunity,(22) as opposed to the often hypothesized direct pathway in dementia research of cognitive stimulation. Social capital is defined as access to real or potential resources available through one's social connections, and includes benefits that are often intertwined with economic and cultural capital(20, 23) Operationalization of social capital is challenging and has been met with differing disciplinary approaches.(24) In this analysis, we operationalized social capital as having trusting close relationships, which is theorized to provide social support and psychological wellbeing.(25)

Our study objective was to examine how these three forms of capital in childhood and late adulthood, and changes in having high versus low capital from childhood to late adulthood are associated with late-life cognition in a diverse cohort of Asians, Blacks, Latinos and Whites. We additionally sought to explore whether these patterns differ based on country of birth and residence during childhood (U.S. vs. foreign). Findings will highlight how SES-trajectories may differentially shape late-life cognitive outcomes among diverse populations and provide insights for potential mechanisms for the SES-late-life cognition relationship.

## Methods

### Sample

We used Wave 1 data from the Kaiser Healthy Aging and Diverse Life Experiences (KHANDLE) cohort (n = 1,712), comprised of community-dwelling older adults residing in the San Francisco Bay area and Sacramento valley. KHANDLE aims to evaluate how life course and sociocultural factors influence late-life brain health and cognitive decline and may contribute to racial/ethnic disparities. Individuals eligible for KHANDLE were long-term members of Kaiser Permanente Northern California (KPNC) who were age 65 or older on January 1, 2017 and had previously participated in one or more Kaiser Permanente Multiphasic Health Checkups (MHC) between 1964 and 1985. The MHC were a series of optional check-ups offered as part of routine care to KPNC members in San Francisco and Oakland, California and included comprehensive questionnaires and clinical examination. Stratified random sampling by race/ethnicity and educational attainment was used with the goal of recruiting approximately equal proportions of Asian, Black, Latino, and White participants and diversity in educational attainment. Exclusion criteria included: electronic medical record diagnosis of dementia or other neurodegenerative disease, or presence of health conditions that would impede participation in study interviews (hospice activity in the past 12 months, history of severe chronic obstructive pulmonary disease in the past 6 months, congestive heart failure hospitalizations in the past 6 months, and history of end stage renal disease or dialysis in the past 12 months). Participants were interviewed in their homes or at KPNC clinics from March 2017 to December 2018. The study was approved by the KPNC and University of California Davis Institutional Review Boards and all enrolled participants provided written informed consent.

### Measures

**Cognition.** Three cognitive domains (verbal episodic memory, semantic memory, and executive function) were derived from the Spanish and English Neuropsychological Assessment Scales (SENAS).(26, 27) The SENAS is a battery of cognitive tests that has undergone extensive development using item response theory methodology for valid comparisons of cognition and cognitive change across racial/ethnic and linguistically diverse groups. The SENAS was administered during wave 1 interviews in either English or Spanish. Details of the administration procedures, development, and psychometric characteristics have been described in detail elsewhere.(26, 27) Each cognitive domain was z-standardized using the Wave 1 sample mean and standard deviation.

**Socioeconomic Trajectories.** Childhood and late-life SES were assessed by self-reported measures from KHANDLE Wave 1 that we theoretically mapped onto the constructs of financial, cultural, and social capital.(20) Table 1 provides a crosswalk between the KHANDLE measures and forms of capital. Financial capital was assessed with the following questions: 1) Childhood financial status was considered to be low if 1) the participant reported ever having to go hungry due to financial circumstances; or 2) the participant reported their childhood family finances were poor relative to others

and that their parents did not own their childhood home. In late life, financial capital is low if the participant meets any of the following criteria: receives supplemental security income or state/county welfare; receives financial assistance from friends or family; has a household income less than \$55,000 annually, or is often worried about having enough money to pay for living expenses and has a household income less than \$75,000 annually. Although these income cutoffs are relatively high, the values were chosen based on the median household 2018 income in California of \$75,000 and the high cost of living in northern California where participants currently reside.(28)

Table 1  
KHANDLE measures used to assess forms of capital in childhood and late adulthood.

	<b>Childhood</b>	<b>Late Adulthood</b>
<b>Low Financial Capital</b>	Q: "When you were growing up, how often did you skip a meal or go hungry because there was not enough money to buy food?"  A: Ever had this experience vs. never	Q: "What was the total income (before taxes) for you and your spouse in the past year?"  Q: "Which sources of income do you or your spouse receive?"
	Q: "Think about your family when you were growing up, from birth to age 16. Would you say your family during that time was pretty well off financially, about average, or poor?"  A: Poor vs. well off/about average	A: Receives supplemental security income or cash assistance from state/county welfare program or help from family/friends or has household income < US\$55K.
	Q: "During your childhood, did your family mainly: rent, pay a mortgage/own a home, have other living arrangements?"  A: Parents rented vs. owned home/other living arrangements	Q: "How often do you worry about not meeting your expenses with your current income?"  A: Always/often vs. Never Sometimes AND has household income < US\$75K
<b>Low Cultural Capital</b>	Q: "What was the highest educational level of your (mother/father) or the (woman/man) who raised you?"  A: One or both parents had ≤ 8th grade education.	Q: "What is the last grade or highest level in school you completed and got credit for?"  A: ≤High School diploma/GED
<b>Low Social Capital</b>	Q: "During your childhood, how often was there someone in whom you could talk to, trust and confide?"  A: None/a little of the time vs. some/most/all of the time.	Q: "Is there any one special person you know that you feel very close and intimate with – someone you share confidences and feelings with, someone you feel you can depend on?"  A: No vs. Yes

Low childhood cultural capital was defined as having one or both parents with no more than an 8th - grade education while low late-life cultural capital was defined as the participant having a high school diploma/passing the general educational development (GED) test, or less. Although many participants

completed their education as young adults, we classified educational attainment as a later-life construct as KPNC records indicate that a portion of KHANDLE participants (about 35% of women and 25% of men) obtained additional education between ages 25 and 65. We varied the cut-offs for low childhood and late-life cultural capital because of generational and historical differences in the level of educational attainment expected and required to attain an average level of social status.

We defined social capital as having someone in whom the participant trusts/trusted that they can confide in and depend on. Low social capital in childhood was defined by participant report of rarely or sometimes having a confidante. In late-life, low social capital was defined as not having one person in whom the participant could trust and depend on.

Using these dichotomized measures, we created four SES trajectories for each form of capital: 1) consistently high capital; 2) high childhood and low late life capital; 3) high later life and low childhood capital; 4) consistently low capital.

**Demographics.** Participants self-reported their country of birth and, if applicable, the age at which they immigrated to the U.S. We constructed an indicator variable of childhood residence where participants were classified as having a foreign childhood if they were born outside of the U.S. and did not immigrate to the U.S. until they were age 16 or older. Race/ethnicity was self-reported at participant interview, or obtained from the participant's medical record when missing, and classified as non-Latino White, non-Latino Black, non-Latino Asian, or Latino. Gender and age at KHANDLE Wave 1 were obtained from participant medical records.

## Analysis

Participant demographics and prevalence of low childhood and late-life forms of capital are presented among those who did and did not reside in the U.S. during childhood. We tested associations between the forms of capital in childhood and adulthood using Spearman's rank correlation with significance at  $p = 0.05$ . In our sample, 201 (11.4%) were missing one or more measures of childhood capital; of these, 195 were missing both paternal and maternal educational attainment. Forty-nine (2.9%) of the participants were missing one or more measures of late-life capital; 27 were missing information on childhood residence, three were missing information on all three cognitive domains and one was missing race/ethnicity. To correct for missingness in our multivariable analyses we used Multiple Imputation with Chained Equations (MICE) with 5 imputations to account for missingness in all models. For each form of capital, linear regression was used to examine the association between socioeconomic trajectory and late-life cognition, adjusting for age at KHANDLE Wave 1, gender, race/ethnicity, and childhood residence. In separate analyses, we evaluated whether childhood residence modified the association between socioeconomic trajectory and late-life cognition. Lastly, we estimated the association between socioeconomic trajectory and late-life cognition in models stratified by childhood residence. All analyses were performed in Stata 14.2 (StataCorp, College Station, TX).

## Results

About 28% of participants were born and resided outside of the U.S. until at least age 16. Among those with a childhood residence outside of the U.S., 51% were Asian, 31% were Latino, 17% were White and 1% were Black. By contrast, 35% of participants with a U.S. childhood residence were White, 28% were Black, 19% were Asian and 18% were Latino (Table 2). Although there was no difference by childhood residence in prevalence of low financial capital in childhood or late life, we observed differences in some of the individual measures of financial capital: Those residing outside of the U.S. were more likely to report experiencing childhood hunger (17% vs. 12%), while those who resided in the U.S. as children were more likely to report being poor in childhood relative to others they knew (35% vs. 27%), and more likely to report later life financial worries (22% vs. 15%). Those who resided outside of the U.S. had lower childhood and later life cultural capital than those who resided in the U.S. as children. Additionally, participants residing outside of the U.S. as children were more likely to have low later life social capital (14% vs. 10%), though there was no difference by residence in low childhood social capital.

Table 2  
Demographic characteristics of KHANDLE participants by childhood residence.

	US Childhood (n = 1,058)	Foreign Childhood (n = 295)
Age (mean, SD)	75.1 (6.5)	76.3 (6.2)
Female (n, %)	636 (60.1)	170 (57.6)
<b>Race/Ethnicity</b>		
Asian	2092 (19.1)	151 (51.2)
Black	299 (28.3)	3 (1.0)
Latinx	191 (18.1)	90 (30.5)
White	366 (34.6)	51 (17.3)
<b>Low Childhood Financial Capital</b>		
Ever go hungry due to finances	123 (11.7)	50 (17.1)
Parents did not own childhood home	405 (38.4)	112 (38.4)
Family was poor relative to others	338 (34.5)	76 (27.0)
<b>Low Childhood Cultural Capital</b>		
Father and/or mother earned $\leq$ 8th-grade education	388 (36.7)	154 (52.2)
<b>Low Childhood Social Capital</b>		
Never/sometimes had someone trust and confide	401 (37.9)	111 (37.6)
<b>Low Later Life Financial Capital</b>		
Participant receives SSI, state welfare, support from friends/family or earns < 55K annually	348 (33.0)	102 (35.1)
Always/often worries about having enough to cover living expenses AND earns < 75K annually	208 (21.9)	39 (14.9)
<b>Low Later Life Cultural Capital</b>		
Education $\leq$ High School/General Education Diploma	125 (11.8)	57 (19.3)
<b>Low Later Life Social Capital</b>		
Does not have someone to confide in or can depend on	102 (9.6)	42 (14.2)
<b>Financial Capital Trajectory</b>		
Consistently High	501 (47.4)	146 (49.5)
Low Childhood, High Adult	145 (13.7)	42 (14.2)

	US Childhood (n = 1,058)	Foreign Childhood (n = 295)
High Childhood, Low Adult	298 (28.2)	76 (25.8)
Consistently Low	114 (10.8)	31 (10.5)
<b>Cultural Capital Trajectory</b>		
Consistently High	615 (58.1)	127 (43.1)
Low Childhood, High Adult	318 (30.1)	111 (37.6)
High Childhood, Low Adult	55 (5.2)	14 (4.8)
Consistently Low	70 (6.6)	43 (14.6)
<b>Social Capital Trajectory</b>		
Consistently High	615 (58.1)	165 (55.9)
Low Childhood, High Adult	341 (32.2)	88 (29.8)
High Childhood, Low Adult	42 (4.0)	19 (6.4)
Consistently Low	60 (5.7)	23 (7.8)

We observed weak correlations between forms of capital with only four pairwise combinations correlating above 0.10: childhood and later-life cultural capital (0.18); childhood cultural capital and childhood financial capital (0.18); later life cultural capital and later-life financial capital (0.15); and childhood and later life social capital (0.14). In examining SES trajectories, we noted differences by childhood residence in cultural capital trajectories where a higher proportion of participants who resided in the U.S. during childhood had high lifecourse cultural (58% vs. 43%) while a higher proportion of participants who resided outside of the U.S. in childhood had low lifecourse cultural (15% vs. 7%). We observed limited differences in trajectories of financial or social capital by childhood residence.

## Financial Capital

In pooled linear regression models using low lifecourse financial capital as the reference, having high lifecourse financial capital was associated with better executive function ( $\beta = 0.28$ ; 95% CI: 0.15, 0.40) and semantic memory ( $\beta = 0.25$ ; 95% CI: 0.13, 0.37). The association with verbal episodic memory was about half as large ( $\beta = 0.12$ ; 95% CI: -0.02, 0.26). Those with low childhood/high late-life financial capital also had higher semantic memory ( $\beta = 0.18$ ; 95% CI: 0.04, 0.32), (Fig. 1). In stratified analyses, high lifecourse financial capital was associated with better executive function and semantic memory among both participants with a foreign childhood (executive function:  $\beta = 0.21$ ; 95% CI: -0.07, 0.50; semantic memory:  $\beta = 0.33$ ; 95% CI: 0.02, 0.63) and a U.S. childhood (executive function:  $\beta = 0.29$ ; 95% CI: 0.15, 0.44

; semantic memory:  $\beta = 0.24$ ; 95% CI: 0.12, 0.37). There was no evidence that place of childhood residence modified the association of lifecourse financial capital with any cognitive domain.

## Cultural Capital

In pooled analyses using low lifecourse cultural capital as the reference, those with high lifecourse cultural capital and low childhood/high later life cultural capital were associated with significantly better cognition across all cognitive domains (Fig. 2). We observed a significant interaction in the association of cultural capital with verbal episodic memory ( $p = 0.08$ ). In stratified analyses, having high lifecourse cultural capital compared to low lifecourse cultural capital produced a higher estimated verbal episodic memory score among those with a foreign childhood ( $\beta = 0.56$ ; 95% CI: 0.26, 0.86) than those with a U.S. childhood ( $\beta = 0.35$ ; 95% CI: 0.11, 0.58). Having low childhood/high later life cultural capital was associated with better verbal episodic memory among both those with a foreign childhood ( $\beta = 0.32$ ; 95% CI: 0.01, 0.63) and a U.S. childhood ( $\beta = 0.30$ ; 95% CI: 0.06, 0.53). Having high childhood/low later life cultural capital was associated with a substantially lower verbal episodic memory score among those with a foreign childhood ( $\beta = -0.40$ ; 95% CI: -0.94, 0.13), but not a U.S. childhood ( $\beta = -0.03$ ; 95% CI: -0.33, 0.28).

## Social Capital

Compared with participants who had low lifecourse social capital, we found significantly higher executive function and verbal episodic memory among those with high lifecourse social capital (executive function  $\beta = 0.37$ ; 95% CI: 0.20, 0.54; verbal episodic memory  $\beta = 0.24$ ; 95% CI: 0.06, 0.42), low childhood/high late-life social capital (executive function  $\beta = 0.31$ ; 95% CI: 0.13, 0.48; verbal episodic memory  $\beta = 0.20$  (0.01, 0.39), and higher executive function among those with high childhood/low late-life social capital ( $\beta = 0.41$ ; 95% CI: 0.18, 0.65), (Fig. 3). Pooled effects for differences by lifecourse trajectory in the association of social capital with semantic memory were null. We did not observe significant interactions by childhood residence for any cognitive domain. In stratified models, we observed better executive function and verbal episodic memory scores among those with a U.S.-based childhood who reported high social capital at any point in the lifecourse. Among those with a foreign childhood residence, the effects of high social capital at any point in the lifecourse were associated with better executive function scores but had negative or null associations with semantic memory and verbal episodic memory.

## Discussion

In this multi-ethnic sample of older adults, individuals with high adult SES averaged better cognition. Although individuals who had advantaged SES in both childhood and late life generally had the best cognitive outcomes, advantaged childhoods generally did not predict better cognitive outcomes unless the socioeconomic advantage was maintained into adulthood. Similar patterns were observed for financial security and education, although the magnitudes of association between educational

advantage and cognitive domains were generally larger than for financial security. We observed some differences in the associations with social capital by childhood residence. Specifically, having high social capital at any point in the lifecourse was associated with better verbal episodic memory among those with a U.S. childhood, but not a foreign childhood. Overall, these findings suggest that socioeconomic status in later life may be more important for late-life cognition than childhood socioeconomic status, regardless of childhood residence.

Our findings are consistent with prior studies of SES which found those with higher late-life SES had better cognition(29–31) and slower cognitive decline,(32) and that upward mobility was associated with better cognitive outcomes compared to downward mobility or consistently low lifecourse SES.(29, 32) Additionally, our study supports prior findings that the strongest associations for cognitive level are for education compared to financial resources.(30, 32) The observed benefits of education may operate through its direct effect on cognitive stimulation or through selection of individuals into receiving more education. However, our findings for the benefits of high later life financial capital for all participants and high social capital among participants with a U.S. childhood could also suggest the cognitive benefits of access to material and psychosocial resources in late life. Overall, these findings suggest that policies that support financial opportunities in midlife and late life may be a key approach to reducing the risk of cognitive impairment in later life. This idea is further supported by a natural experiment that found inflation adjustments that increased Social Security income in the 1970s were predictive of better cognitive function and slower cognitive decline.(33) Increasing educational opportunities in midlife and late-life could also play an important role in late-life cognition.

Our study adds to this literature by demonstrating that upward mobility in financial and cultural capital is predictive of better late-life cognition in heterogenous populations, while the cognitive penalty of a downward trajectory in cultural capital is associated with worse cognition in participants with a foreign childhood but is null among those with a U.S. childhood.

Our findings for the impact of upward mobility in cultural and financial capital among populations with foreign childhoods are particularly salient in today's political-economic climate, where many non-White immigrants have experienced a segmented assimilation pattern that limits opportunities for upward mobility and the social and health benefits that correspond.(34) These experiences are distinct from those of European immigrants of the early 20th Century and the participants in this study, the majority of whom emigrated from Spanish speaking and Asian countries by 1970, and suggest that limitations to socioeconomic mobility among immigrants today may hinder public health efforts to reduce the risk of cognitive impairment and dementia in an increasingly heterogenous aging population.

Several limitations should be noted. This study relied on cross-sectional data to assess late-life cognition without the ability to control for cognition earlier in life or other potentially time-varying confounders of lifecourse SES. Our findings may be biased by variation in cognition established early in the lifecourse rather than changes resulting from lifecourse SES trajectories.(35, 36) We cannot fully account for the duration of “exposure” for each of these late-life SES indicators as they were assessed in late life, but

may have been established in young adulthood. Additionally, due to power restrictions this study combined diverse race/ethnic groups into U.S. versus foreign childhood residence. In this study, about half of the foreign childhood group is classified as Asian and are from linguistically and culturally diverse countries. Those classified as Latino in this study predominately emigrated from Mexico. This heterogeneity in the foreign childhood group make it difficult to disentangle to what extent differences are due to childhood residence versus experiences based on racial/ethnic identity. Finally, participants of this study are long-term members of KPNC and their access to healthcare may not reflect the experience of the broader population.

Nonetheless, this study had several strengths that contribute to our understanding of how SES trajectories may contribute to late life cognition. This study explicitly examined how different domains of SES may intersect with other forms of identity – nativity and childhood residence – that shape early and late-life social experiences.(37) Additionally, no prior studies of SES trajectories and late-life cognitive outcomes have, to our knowledge, included a measure of SES equivalent to social capital in this study. This measure is an important component of SES as prior research has suggested that SES may influence health through a psychosocial stress response based on one’s relative position in a social hierarchy.(38, 39) Social capital, as operationalized here, may play an important role in how lifecourse SES influences late-life health outcomes. That we only observed associations between social capital and late-life cognition among those with a US childhood may reflect differences in how social capital is experienced in immigrant populations. Finally, that we observed cognitive benefits of higher late-life SES compared to those with low lifecourse SES in a sample of participants who are decades-long members of KPNC suggests the benefits of higher SES on health go beyond access to quality healthcare.

Overall, our study provides optimistic insights for promoting healthy cognitive aging. Specifically, we found evidence that later-life socioeconomic status may be more important for late-life cognition than childhood socioeconomic status. Public health programs and policies that help to improve socioeconomic status and increase upward mobility in midlife and late life may help to reduce poor cognitive outcomes among diverse older adults.

## Abbreviations

KHANDLE

Kaiser Healthy Aging and Diverse Life Experiences study

KPNC

Kaiser Permanente Northern California

MHC

Multiphasic Health Checkups

MICE

Multiple Imputation using Chained Equations

SENAS

Spanish and English Neuropsychological Assessment Scale

## Declarations

**Ethics approval and consent to participate:** The KHANDLE study was approved by the Kaiser Permanente Northern California and University of California Davis Institutional Review Boards. All enrolled participants provided informed consent.

**Consent for publication:** Not Applicable

**Availability of data and materials:** The datasets used during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** RLP conceptualized the study, conducted analysis, and wrote the manuscript. KMG contributed to the methods, presentation of results and revised the manuscript. PG contributed to the KHANDLE data collection and design; theoretical framework, methods, presentation of results and revised the manuscript. ERM contributed to the KHANDLE data collection and design; theoretical framework and revised the manuscript. MMG is co-investigator of the KHANDLE study, provided analytic support, contributed to the theoretical framework, and revised the manuscript. DMM is co-investigator of the KHANDLE study, contributed to the methods and revised the manuscript. CD is co-investigator of the KHANDLE study, contributed to the methods and revised the manuscript. RAW is PI of the KHANDLE study, contributed to the study design, methods, theoretical framework, and presentation of results, provided analytic support and revised the manuscript. All authors read and approved the final manuscript.

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## References

1. Alzheimer's Association. Alzheimer's disease facts and figures. *Alzheimer's Dement* 2020 Mar. 2020;16(3)(1):391–460.
2. Mayeda ER, Glymour MM, Quesenberry CP, Whitmer RA. Inequalities in dementia incidence between six racial and ethnic groups over 14 years. *Alzheimer's Dement* [Internet]. 2016 [cited 2016 Nov 4];12(3):216–24. Available from: <http://www.sciencedirect.com/science/article/pii/S1552526015030319>.

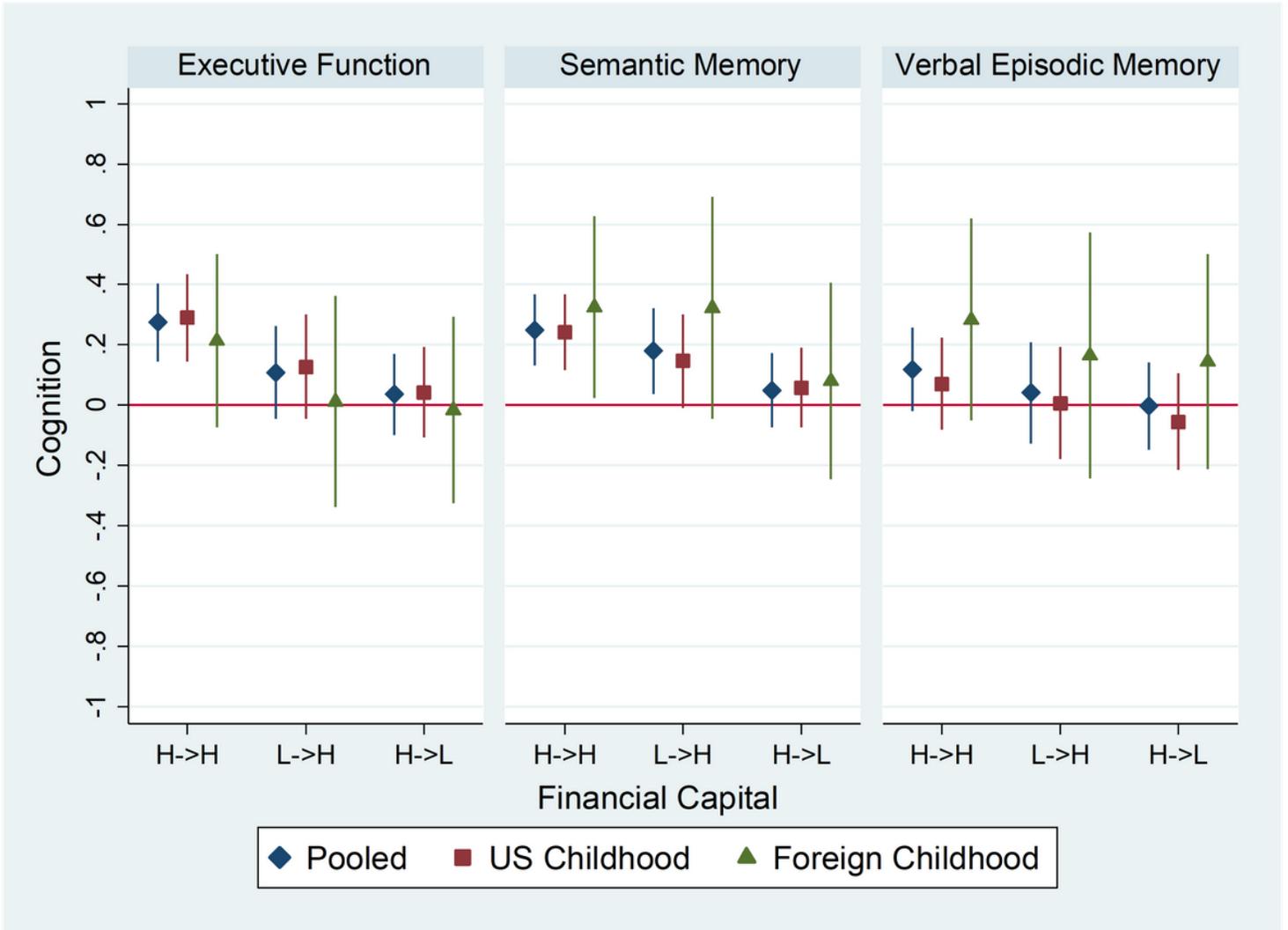
3. Koster A, Penninx BWJH, Bosma H, Kempen GJIM, Newman AB, Rubin SM, et al. Socioeconomic differences in cognitive decline and the role of biomedical factors. *Ann Epidemiol* [Internet]. 2005 Sep 1 [cited 2017 Dec 27];15(8):564–71. Available from: <http://www.sciencedirect.com/science/article/pii/S104727970500061X>.
4. Segers K, Benoit F, Colson C, Kovac V, Nury D, Vanderaspolden V. Pioneers in migration, pioneering in dementia: First generation immigrants in a European metropolitan memory clinic. *Acta Neurol Belg*. 2013;113(4):435–40.
5. Adelman S, Blanchard M, Rait G, Leavey G, Livingston G. Prevalence of dementia in African-Caribbean compared with UK-born White older people: Two-stage cross-sectional study. *Br J Psychiatry* [Internet]. 2011 Aug [cited 2020 Aug 19];199(2):119–25. Available from: [www.haringey.gov.uk](http://www.haringey.gov.uk).
6. Moon H, Badana ANS, Hwang SY, Sears JS, Haley WE. Dementia Prevalence in Older Adults: Variation by Race/Ethnicity and Immigrant Status. *Am J Geriatr Psychiatry*. 2019 Mar 1;27(3):241–50.
7. Gilsanz P, RoseMayeda E, Glymour MM, Quesenberry CP, Mungas D, DeCarli CS, et al. Birth in high infant mortality states and dementia risk in a cohort of elderly African American and white health care members. *Alzheimer Dis Assoc Disord* [Internet]. 2019 [cited 2020 Jul 17];33(1):1–6. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6374212/>.
8. Gilsanz P, Mayeda ER, Glymour MM, Quesenberry CP, Whitmer RA. Association between birth in a high stroke mortality state, race, and risk of dementia. *JAMA Neurol* [Internet]. 2017 [cited 2020 Jul 17];74(9):1056–62. Available from: <https://jamanetwork.com/journals/jamaneurology/article-abstract/2645931>.
9. Vable AM, Eng CW, Mayeda ER, Basu S, Marden JR, Hamad R, et al. Mother's education and late-life disparities in memory and dementia risk among US military veterans and non-veterans. *J Epidemiol Community Heal* [Internet]. 2018 [cited 2019 Dec 18];72:1162–7. Available from: <http://dx.doi.org/10.1136/jech-2018-210771>.
10. Melrose RJ, Brewster P, Marquine MJ, MacKay-Brandt A, Reed B, Farias ST, et al. Early life development in a multiethnic sample and the relation to late life cognition. *Journals Gerontol - Ser B Psychol Sci Soc Sci* [Internet]. 2015 Jul [cited 2018 May 29];70(4):519–31. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24389122>.
11. Beck A, Franz CE, Xian H, Vuoksimaa E, Tu X, Reynolds CA, et al. Mediators of the Effect of Childhood Socioeconomic Status on Late Midlife Cognitive Abilities: A Four Decade Longitudinal Study. *Innov Aging* [Internet]. 2018 Jan 1 [cited 2020 Jan 28];2(1). Available from: <https://academic.oup.com/innovateage/article/doi/10.1093/geroni/igy003/4910370>.
12. Zhang Z, Liu H, Choi S won. Early-life socioeconomic status, adolescent cognitive ability, and cognition in late midlife: Evidence from the Wisconsin Longitudinal Study. *Soc Sci Med*. 2020 Jan 1;244:112575.

13. Staff RT, Chapko D, Hogan MJ, Whalley LJ. Life course socioeconomic status and the decline in information processing speed in late life. *Soc Sci Med* [Internet]. 2016 [cited 2017 Oct 16];151:130–8. Available from: [https://ac.els-cdn.com/S0277953616300193/1-s2.0-S0277953616300193-main.pdf?\\_tid=cb4d53a2-b291-11e7-9b1b-00000aab0f27&acdnat=1508172671\\_ed90c0df12744e5959740dd52ffdf657](https://ac.els-cdn.com/S0277953616300193/1-s2.0-S0277953616300193-main.pdf?_tid=cb4d53a2-b291-11e7-9b1b-00000aab0f27&acdnat=1508172671_ed90c0df12744e5959740dd52ffdf657).
14. Lyu J, Burr JA. Socioeconomic Status Across the Life Course and Cognitive Function Among Older Adults. *J Aging Health* [Internet]. 2016 Feb 24 [cited 2019 Dec 18];28(1):40–67. Available from: <http://journals.sagepub.com/doi/10.1177/0898264315585504>.
15. González HM, Tarraf W, Bowen ME, Johnson-Jennings MD, Fisher GG. What do parents have to do with my cognitive reserve? Life course perspectives on twelve-year cognitive decline. *Neuroepidemiology*. 2013 Aug;41(2):101–9.
16. Everson-Rose SA, Mendes De Leon CF, Bienias JL, Wilson RS, Evans DA. Early Life Conditions and Cognitive Functioning in Later Life. *Am J Epidemiol* [Internet]. 2003 Dec 1 [cited 2018 Jan 2];158(11):1083–9. Available from: <https://academic.oup.com/aje/article-lookup/doi/10.1093/aje/kwg263>.
17. Marden JR, Tchetgen Tchetgen EJ, Kawachi I, Glymour MM. Contribution of Socioeconomic Status at 3 Life-Course Periods to Late-Life Memory Function and Decline: Early and Late Predictors of Dementia Risk. In: *American Journal of Epidemiology* [Internet]. 2017 [cited 2019 Dec 18]. p. 805–14. Available from: <https://academic.oup.com/aje/article/186/7/805/3852262>.
18. Al Hazzouri AZ, Haan MN, Kalbfleisch JD, Galea S, Lisabeth LD, Aiello AE, et al Life-course socioeconomic position and incidence of dementia and cognitive impairment without dementia in older Mexican Americans: Results from the Sacramento Area Latino Study on Aging. Whitfield K, Angel JL, Wong R, editors. *Am J Epidemiol* [Internet]. 2011 May 15 [cited 2016 Sep 9];173(10):1148–58. Available from: <http://journals.sagepub.com/doi/10.1177/0898264311421524>.
19. Stepick A, Stepick CD. The complexities and confusions of segmented assimilation. *Ethn Racial Stud* [Internet]. 2010 Jul [cited 2020 Sep 14];33(7):1149–67. Available from: <https://www.tandfonline.com/doi/abs/10.1080/01419871003599518>.
20. Bourdieu P. The forms of capital. In: Richardson J, editor. *Handbook of Theory and Research for the Sociology of Education*. Westport: Greenwood; 1986. pp. 241–58.
21. Vable AM, Gilsanz P, Nguyen TT, Kawachi I, Glymour MM. Validation of a theoretically motivated approach to measuring childhood socioeconomic circumstances in the Health and Retirement Study. Fraser A, editor. *PLoS One* [Internet]. 2017 Oct 13 [cited 2019 Dec 18];12(10):e0185898. Available from: <http://dx.plos.org/10.1371/journal.pone.0185898>.
22. Zajacova A, Lawrence EM. The Relationship between Education and Health: Reducing Disparities Through a Contextual Approach [Internet]. Vol. 39, *Annual Review of Public Health*. Annual Reviews Inc.; 2018 [cited 2020 Aug 24]. p. 273–89. Available from: <https://doi.org/10.1146/annurev-publhealth->
23. Granovetter M. The Strength of Weak Ties: A Network Theory Revisited. *Sociol Theory*. 1983;1:201.

24. Uphoff EP, Pickett KE, Cabieses B, Small N, Wright J. A systematic review of the relationships between social capital and socioeconomic inequalities in health: A contribution to understanding the psychosocial pathway of health inequalities [Internet]. Vol. 12, International Journal for Equity in Health. BioMed Central; 2013 [cited 2020 Sep 14]. p. 54. Available from: <http://equityhealthj.biomedcentral.com/articles/10.1186/1475-9276-12-54>.
25. Moore S, Kawachi I. Twenty years of social capital and health research: A glossary. J Epidemiol Community Health [Internet]. 2017 Jan 13 [cited 2020 Sep 14];71(5):513–7. Available from: <http://jech.bmj.com/>.
26. Mungas D, Reed BR, Haan MN, Gonzalez H. Spanish and English Neuropsychological Assessment Scales: Relationship to demographics, language, cognition, and independent function. Neuropsychology. 2005;19(4):466–75.
27. Mungas D, Reed BR, Crane PK, Haan MN, González H. Spanish and English Neuropsychological Assessment Scales (SENAS): Further Development and Psychometric Characteristics. Psychol Assess [Internet]. 2004 Dec;16(4):347–59. Available from: <http://doi.apa.org/getdoi.cfm?doi=10.1037/1040-3590.16.4.347>.
28. United States Census Bureau. U.S. Median Household Income Up in 2018 From 2017 [Internet]. Census.gov. 2018 [cited 2020 Jul 31]. Available from: <https://www.census.gov/library/stories/2019/09/us-median-household-income-up-in-2018-from-2017.html>.
29. Turrell G, Lynch JW, Kaplan GA, Everson SA, Helkala EL, Kauhanen J, et al. Socioeconomic position across the lifecourse and cognitive function in late middle age. Journals Gerontol - Ser B Psychol Sci Soc Sci [Internet]. 2002 Jan 1 [cited 2020 Aug 19];57(1):S43–51. Available from: <https://academic.oup.com/psychsocgerontology/article/57/1/S43/576202>.
30. Horvat P, Richards M, Malyutina S, Pajak A, Kubinova R, Tamosiunas A, et al. Life course socioeconomic position and mid-late life cognitive function in eastern europe. Journals Gerontol - Ser B Psychol Sci Soc Sci [Internet]. 2014 May 1 [cited 2020 Aug 19];69(3):470–81. Available from: <https://academic.oup.com/psychsocgerontology/article/69/3/470/625901>.
31. Luo Y, Waite LJ. The impact of childhood and adult SES on physical, mental, and cognitive well-being in later life. J Gerontol B Psychol Sci Soc Sci. 2005;60(2).
32. Marden JR, Tchetgen Tchetgen EJ, Kawachi I, Glymour MM. Contribution of Socioeconomic Status at 3 Life-Course Periods to Late-Life Memory Function and Decline: Early and Late Predictors of Dementia Risk. In: American Journal of Epidemiology [Internet]. Oxford University Press; 2017 [cited 2018 Jan 17]. p. 805–14. Available from: <http://academic.oup.com/aje/article/186/7/805/3852262/Contribution-of-Socioeconomic-Status-at-3>.
33. Ayyagari P, Frisvold D. The Impact of Social Security Income on Cognitive Function at Older Ages [Internet]. Vol. 2, NBER Working Paper Series. 2015 Nov [cited 2016 Nov 23]. Available from: <http://www.nber.org/papers/w21484>.

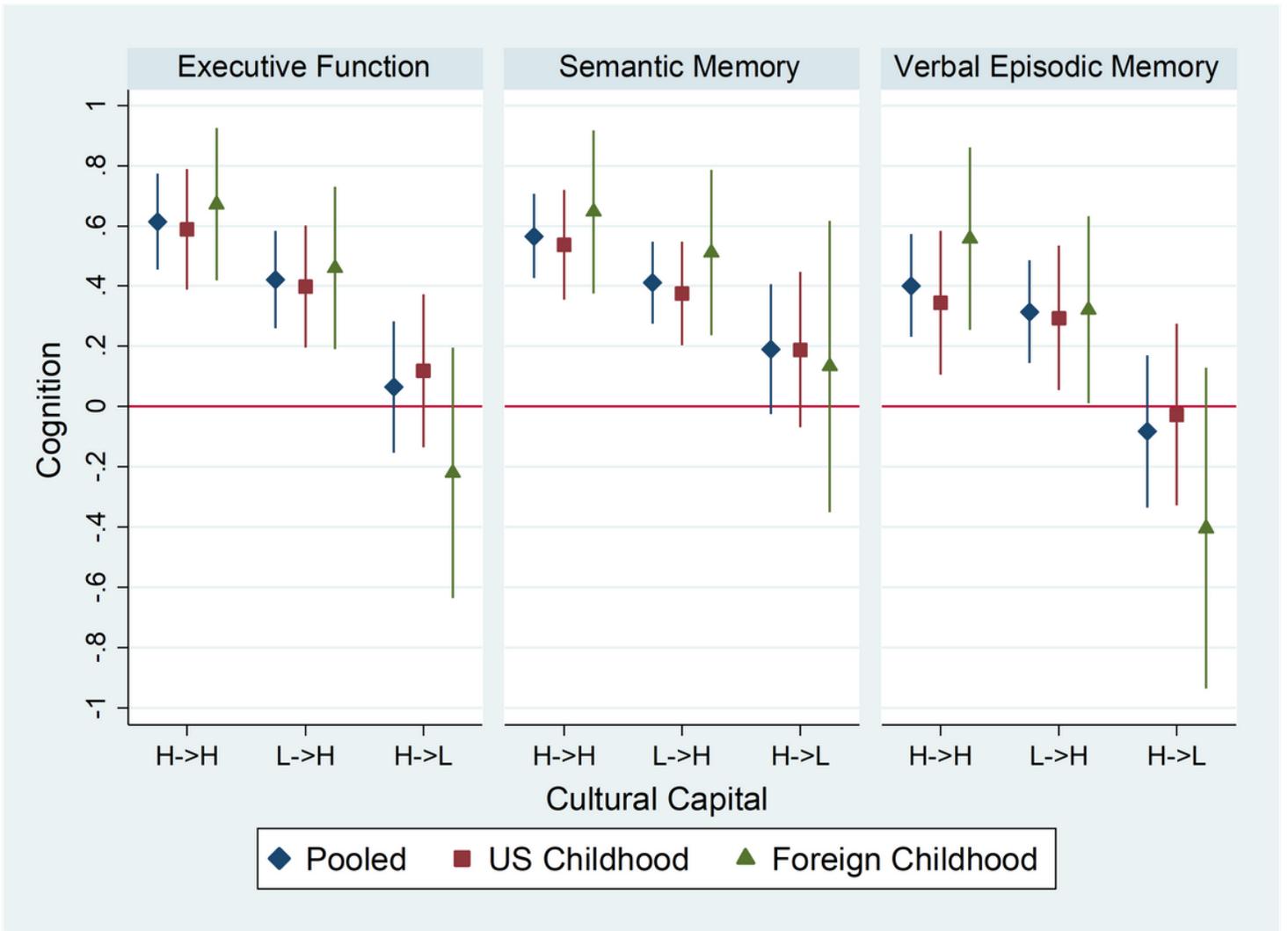
34. Portes A, Zhou M. The new second generation: Segmented assimilation and its variants. In: *The New Immigration: An Interdisciplinary Reader*. 2012. p. 85–101.
35. Harrati A, Glymour MM. Lifecourse epidemiology matures: Commentary on Zhang et al. “Early-life socioeconomic status, adolescent cognitive ability, and cognition in late midlife.” *Soc Sci Med*. 2019 Nov;112645.
36. Foverskov E, Mortensen EL, Holm A, Pedersen JLM, Osler M, Lund R. Socioeconomic Position Across the Life Course and Cognitive Ability Later in Life: The Importance of Considering Early Cognitive Ability. *J Aging Health* [Internet]. 2019 Jul 28 [cited 2019 Dec 18];31(6):947–66. Available from: <http://journals.sagepub.com/doi/10.1177/0898264317742810>.
37. Sherman-Wilkins T. Education as the Great Equalizer? Racial and Ethnic Differences in the Effect of Education on Cognitive Impairment in Later Life. *Geriatrics* [Internet]. 2019 Sep 5 [cited 2020 Jan 31];4(3):51. Available from: <https://www.mdpi.com/2308-3417/4/3/51>.
38. Marmot MG. Status syndrome. *Significance* [Internet]. 2004 Dec [cited 2017 Nov 18];1(4):150–4. Available from: <http://doi.wiley.com/10.1111/j.1740-9713.2004.00058.x>.
39. Wilkinson RG. Health, Hierarchy, and Social Anxiety. *Ann N Y Acad Sci* [Internet]. 1999 [cited 2018 Sep 2]; Available from: <https://nyaspubs.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1749-6632.1999.tb08104.x>.

## Figures



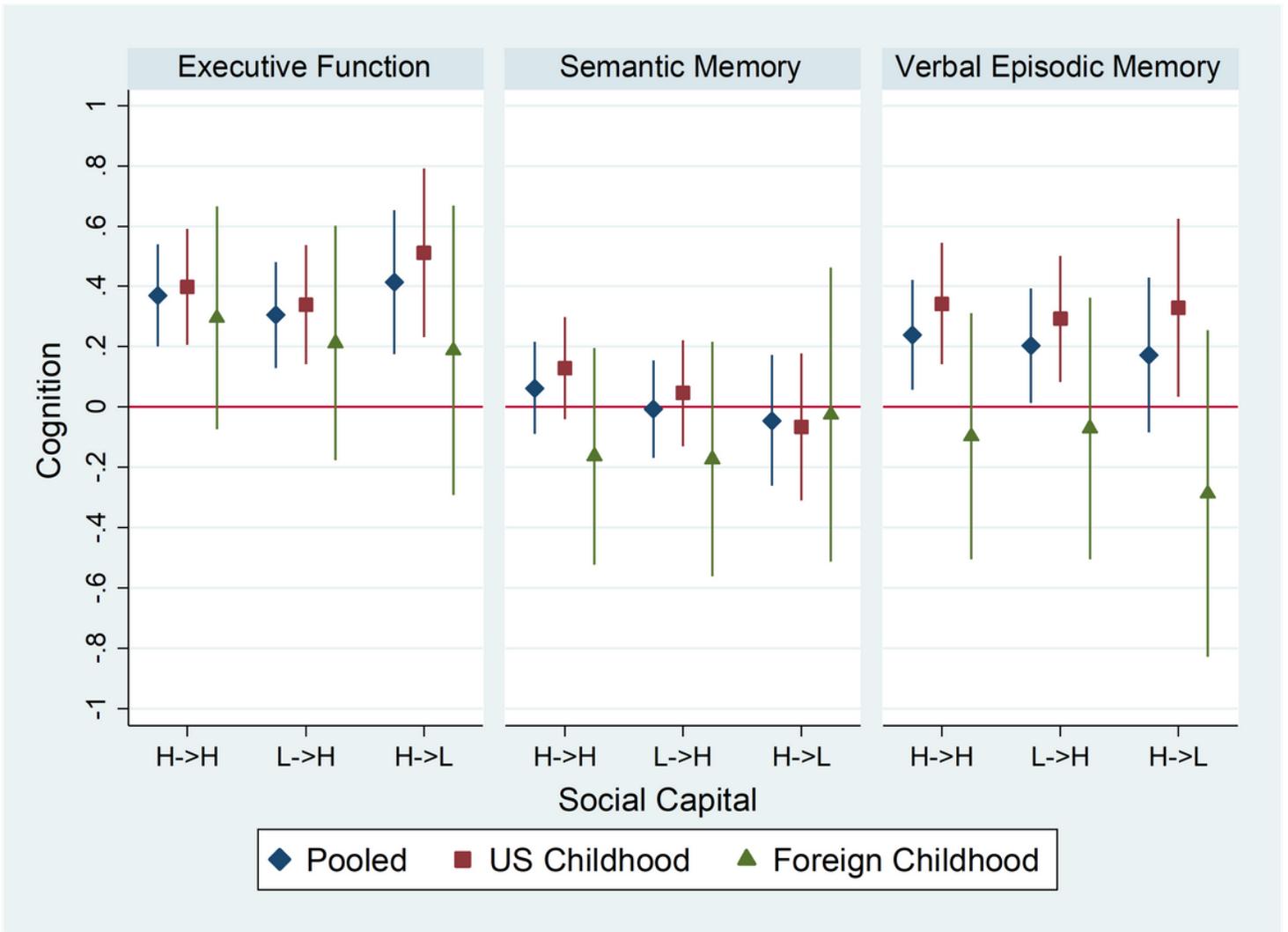
**Figure 1**

Linear regression with MICE point estimates and 95% confidence intervals for the association of financial capital trajectory and z-standardized late-life cognition, pooled and stratified by childhood residence. H->H=High Lifecourse Capital; L->H=Low Childhood, High Later Life Capital; H->L=High Childhood, Low Later Life Capital. Reference is Low Lifecourse Capital.



**Figure 2**

Linear regression with MICE point estimates and 95% confidence intervals for the association of cultural capital trajectory and z-standardized late-life cognition, pooled and stratified by childhood residence. H->H=High Lifecourse Capital; L->H=Low Childhood, High Later Life Capital; H->L=High Childhood, Low Later Life Capital. Reference is Low Lifecourse Capital.



**Figure 3**

Linear regression with MICE point estimates and 95% confidence intervals for the association of social capital trajectory and z-standardized late-life cognition, pooled and stratified by childhood residence. H->H=High Lifecourse Capital; L->H=Low Childhood, High Later Life Capital; H->L=High Childhood, Low Later Life Capital. Reference is Low Lifecourse Capital.