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Age at Migration and Cognitive Health Among Chinese Older Immigrants in the United States

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Abstract

Objectives: This study addressed two questions: (1) Is age at migration associated with cognitive function among Chinese older immigrants? and (2) what personal and environmental factors confound the above relationship?

Methods: Data were derived from the Population Study of Chinese Elderly (N = 2957). Quantile and linear regressions were used to examine the associations between age at migration and Mini-Mental State Examination (MMSE) and global cognitive function, respectively.

Results: Migration in late middle age (50–64) or late adulthood (65 or older) was associated with lower MMSE scores. Global cognition did not vary by age at migration. Associations between age at migration and MMSE were stronger among individuals with lower education or social engagement.

Discussion: Migrating late in one's life has important implications for cognitive health over the life course. Findings are helpful to identify vulnerable older immigrant segments and provide tailored interventions to promote their cognitive health.

Keywords

immigrants/migration; cognitive function; life course; social factors; socioeconomic status

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Introduction

Older immigrants are one of the fast-growing population segments in the United States. The number of US immigrants aged 60 or older is estimated to grow almost sixfold from 2.7 million in 1990 to 16 million by 2050 (Treas & Batalova, 2007). By 2060, a quarter of the US older populations will be foreign-born (Mizoguchi et al., 2019). As the US population becomes older and more diverse, there is a pressing need to understand older immigrants' health status and its determinants.

One important aspect of older immigrants' health is cognitive health, which is critical to their independence and overall quality of life. At what age an individual migrates has far-reaching implications for their language acquisition, socioeconomic status, social support, social engagement, and consequently cognitive health (Xu et al., 2017). However, empirical research on the association between age at migration and cognitive health is scarce and largely limited to Mexican immigrants. Little attention has been paid to Asian immigrants, who currently account for 31% of all US older immigrants (Mizoguchi et al., 2019) and will surpass Hispanics to be the largest immigrant group by 2055 (López et al., 2017).

Chinese is the largest Asian American group (López et al., 2017). The majority (63%) of Chinese Americans are foreign-born (Lopez et al., 2017), in comparison to 34% among US Latinos (Flores, 2017). Compared to the overall immigrant populations, Chinese immigrants tend to have more education, be employed in management occupations, and have higher household incomes but are also slightly more likely to live in families with an annual income that is below the poverty line (Echeverria-Estrada & Batalova, 2020). Although higher education and occupational status of Chinese immigrants may help foster greater cognitive reserve, providing them with more resources for adaptability to changes associated with migration, the mixed picture of their income points to the heterogeneity of this population and their divergent immigration/acculturation experience. In addition, Chinese immigrants are less likely to be proficient in English and speak English at home than the overall immigrant populations (Echeverria-Estrada & Batalova, 2020). Since bilingualism seems to be associated with greater cognitive complexity and flexibility (West et al., 2017), Chinese immigrants may be less likely to experience this cognitive benefit due to lack of English proficiency. Language difficulties can also be a chronic stressor and lead to reduced social network, discrimination, and ultimately have a negative impact on their cognitive function.

The substantial growth of Chinese immigrants, their distinctive population attributes, and lack of understanding of their cognitive aging relating to migration experience highlight the importance of examining immigration-related factors that may contribute to divergent cognitive outcomes in this population. Using cross-sectional data from a large population-based survey on older Chinese immigrants, this study addresses two research questions: (1) Is age at migration associated with immigrants' cognitive function in later life? and (2) what individual and environmental characteristics may confound the above relationship?

Why Age at Migration Matters

The life course theory describes the interplay between human life course, timing, individual agency, and environmental context (Elder et al., 2003). In this theory, "turning points"

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refer to key life events that often result in dramatic changes in life trajectories, which are long-term patterns of stability, changes, and associated status (Elder et al., 2003).

International migration is a turning point in one's life course as it often results in changed life trajectories in various domains such as health, economic well-being, family, and social life. International migration may affect individuals' cognition in many important ways. Xu et al. (2018) identified the following clusters of factors which explain the linkage between migration and cognition: socioeconomic status (SES), psychosocial factors (e.g., social support and stress), behavioral factors (e.g., diet and physical activities), physical and psychological health (e.g., chronic conditions and depression), and environmental factors (e.g., social environment). Immigration is often accompanied by financial difficulties, reduced social network and support, isolation, and high-risk life styles (e.g., unhealthy diet and substance use), which are all risk factors of cognitive well-being (Xu et al., 2017).

The life course theory further states that turning points have differential consequences for individuals depending on when such events occur in the life course (Elder & Johnson, 2003). At what age an individual migrates determines the duration and levels of exposure to many aspects of acculturation, having far-reaching implications for cognitive health. In stressful events such as migration, previous expertise and knowledge, behavioral routines, and familiar supportive environments are helpful resources for individuals to maintain cognitive capacity (Hertzog & Jopp, 2010). However, these resources may be unavailable for immigrants, particularly those who migrated in later life. Many later-life immigrants do not possess "expertise" in the new country; their behavioral routines are subject to gross disruption; their environmental sources of support may be limited or nonexistent in the host country (Treas & Batalova, 2007).

On the other hand, moving to a new country and learning a new language may entail a cognitively stimulating environment, potentially benefiting immigrants' cognitive health. Integrating different cultures or switching between two languages often requires individuals to use more complex solutions to resolve discrepancies in the acculturation process, thus are likely associated with greater cognitive flexibility (West et al., 2017). These processes again seem to vary by age at migration. For immigrants who spend the majority of their lives in the native countries, exposure to a new language is limited or nonexistent, and they may benefit less from the potentially cognitively stimulating environment relative to those who migrate early in life.

In addition, early-life and later-life immigrants may migrate for different reasons. While individuals who are at the earlier stages of the life course often migrate for employment/career opportunities, older immigrants often migrated for reasons such as reuniting with family (Treas & Batalova, 2007). For older immigrants, the greater likelihood of being unemployed is another missed opportunity to foster cognitive reserve. Secondary consequences of unemployment, such as decreased financial stability and lack of health insurance or meaningful social connections, may further heighten risk for cognitive decline in individuals who migrate later in the life course.

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Diversity is another major theme in the life course theory. Even among individuals who experience similar life events, there are diverse life course trajectories due to differences in personal attributes and environmental factors (Hutchison, 2010). In terms of cognitive health, certain inherent personal attributes and external environmental factors may supply individuals with greater ability to cope with challenging life events such as migration. Education has been shown to shape cognitive trajectories of individuals (Beydoun et al., 2014). Higher education attainment is often associated with better socioeconomic status, financial stability, and stronger sense of control over life, and together these factors are believed to increase cognitive reserve and mitigate cognitive decline over time (Le Carret et al., 2003). Externally, a supportive and engaging social environment may buffer the potential deleterious effects of stressful migration on cognitive health by helping immigrants to prevent social isolation, experience dynamic and cognitively simulating environment, and expand the repertoire of intellectual skills (James et al., 2011; Tang et al., 2020). These environmental factors are particularly important for older immigrants, who often face greater challenges in functional impairment, linguistic barriers, and smaller social networks than younger immigrants, hindering the extent to which they can engage in meaningful and stimulating social activities and "convert" them into cognitive abilities (Tang et al., 2018).

Age at Migration and Cognitive Health: Empirical Findings

Existing findings on age at migration and cognitive health in later life are mixed. Based on a sample of Mexican Americans in five southwestern states, Hill et al. (2012) found that older immigrants who migrated in midlife (age 20–49) had better cognitive function than the US-born; no differences were found between early- (migrated before age 20) and later-life (migrated after age 50) immigrants and the US-born. Cognitive complexities of acculturation associated with midlife migration, such as enhancing socioeconomic status through employment and developing new social relationships, may contribute to cognitive advantages of middle-life immigrants. Similar findings were reported by Garcia et al. (2017) using the same dataset, but only among male immigrants. Using a nationally representative sample (HRS), Garcia et al. (2020) further documented a higher risk of cognitive impairment among Latina immigrants who migrated before age 18, possibly due to greater exposure to social stressors and acculturative stress in formative preadulthood years. Conversely, a number of regional studies reported increased risks for cognitive impairment among later-life immigrants (migrated after age 50), in samples of foreign-born Mexican women (Garcia et al., 2017), and both men and women (Downer et al., 2018; Monserud, 2018). Lower levels of education, disrupted long-established social networks, and decreased social engagement/activities of later-life immigrants are believed to explain their poorer cognitive outcomes (Downer et al., 2018; Garcia et al., 2017; Monserud, 2018).

All the aforementioned studies focused on Mexican immigrants, and with only one exception (Garcia et al., 2020), have exclusively used Mini-Mental State Examination (MMSE) to assess cognitive function. Relying on other measures such as visuoperception, memory, attention, and executive function Statucka and Cohn (2019) failed to find significant relationships between age at immigration and cognition in Canadian immigrants in Toronto (majority were from Asia). Using measures such as name recall, backward counting, and object naming, Casanova and Aguila (2020) also reported lack of associations

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between age at migration and cognitive outcomes among older Mexican immigrants in the HRS. Taken together, existing evidence on age at migration and older immigrants' cognitive function is mixed and largely limited to Mexican immigrants. More research on Asian immigrants using more comprehensive assessment of cognitive function in addition to MMSE is needed.

The Present Study

This study used a large population-based sample of Chinese older immigrants in the United States to examine (1) the potential association between age at immigration and cognitive function and (2) personal and environmental factors that may confound such associations. Given greater cognitive challenges encountered by later-life immigrants and their fewer coping resources compared to those who migrated in early life, we hypothesized *H_1: Migrating at later age is associated with poorer cognitive health*. Given greater cognitive adaptability associated with high SES and supportive/simulating social environment, we further hypothesized *the association between age at migration and cognitive health is weaker among individuals with higher SES (H_2)* and *individuals with more supportive/stimulating social environment (H_3).*

Designs and Methods

Sample

Data were derived from the first wave of the Population Study of Chinese Elderly (PINE), a population-based epidemiological study of Chinese older adults in Chicago. Between 2011 and 2013, a total of 3157 respondents who aged 60 and above and self-reported as Chinese were recruited from more than 20 community-based social service agencies and organizations in the greater Chicago area. Interviews were conducted at participants' homes by bilingual interviewers. The PINE sample was representative of the Chinese older adults in the greater Chicago area (Simon et al., 2014). We excluded 15 respondents who were US-born, 94 respondents who had missing information on cognitive outcomes, and 73 respondents whose MMSE score was lower than 10, which indicates moderate to severe cognitive impairment in Chinese older populations (Yin et al., 2012). Given that only 18 respondents migrated before the age of 18, we further excluded these cases because migrating as a child may entail quite different experience from migrating as an adult. This led to our analytical sample of 2957 foreign-born Chinese older immigrants who migrated during adulthood. Compared to the included respondents, those who had missing information on cognitive outcomes or low MMSE scores were significantly older, less educated, and had poorer physical and mental health.

Measures

Cognitive health. We used two variables to assess overall cognitive health of older immigrants. Consistent with prior work on immigrants' cognitive health, we used the Chinese version Mini-Mental State Examination (C-MMSE) (Folstein et al., 1983), which has been validated in aging Chinese population (Chiu et al., 1994). To obtain a more comprehensive assessment of cognitive function beyond the MMSE, the PINE further

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assessed working memory, episodic memory, and executive function by (a) Digit Span Backwards assessment from the Wechsler Memory Scale-Revised, (b) immediate recall (EBMT) and delayed recall (EBDR) of the East Boston Story Test, and (c) the 11-item Symbol Digit Modalities Test (SDMT), respectively (for detailed information of each test, see Chang & Dong, 2014). To obtain the global cognitive function scores, the raw scores from the three tests, together with the C-MMSE, were first converted to Z-scores and then averaged. Such a composite measure allows the researcher to combine tests of various difficulty levels to capture a wider range of cognitive performance. Using standard Z-scores also has the statistical advantage of increasing power by reducing random variability within single tests (Chang & Dong, 2014). For both C-MMSE and global cognitive scores, higher scores indicate better cognitive function.

Age at migration was calculated by subtracting years lived in the United States from age. This variable was further coded into four categories to capture migration during different adulthood stages: early adulthood (18–34), early middle age (35–49), late middle age (50–64), and late adulthood (65+) (Medley, 1980). To be consistent with the prior research on age at migration and cognition (Garcia et al., 2017; Hill et al., 2012), we used age 50 instead of 45 (Medley, 1980) as cutoff for late middle age. In regression models, early adulthood was used as the reference group, with the other three coded as dichotomous variables (0 = no and 1 = yes).

Socioeconomic status included education and income. Education was measured in years. Income was measured by the log value of annual personal income that was rated on a scale ranging from 1 = $0–$4999 to 10 = ≥$75,000.

Social environment factors included social engagement, social support, neighborhood cohesion, and level of acculturation, which greatly shape how immigrants are engaged and integrated in the social environment (Berry, 1997). Social engagement was measured by 16 items assessing respondents' frequency in engaging in various activities (e.g., watching TV, listening to the radio, reading, playing games, going out to for a movie, and visiting relatives and friends) on a Likert scale ranging from 1 = once a year or less to 4 = every day or almost every day (α = .75). Social support was assessed by six questions rating the extent to which respondents liked to (1) open up to… and (2) rely on… for help (1 = hardly ever, 2 = some of the time, and 3 = often) regarding spouse, family members, and friends, respectively. A sum score of the six items was created (α = .73).

Neighborhood cohesion was measured by six questions assessing frequency that the respondents see neighbors talk outside, take care of each other, watch out for each other (0 = never, 1 = rarely, 2 = sometimes, and 3 = often), and the number of neighbors they know by name, have a friendly talk with once a week, and could call on for assistance (0 = none, 1 = 1–5, 2 = 6–10, 3 = 11–15, 4 = 16–20, and 5 = 21 or more). Each item was first converted to a Z-score and then was averaged to create a total neighborhood cohesion score (α = .86). Level of acculturation was measured by 12 questions on respondents' preference for speaking Chinese or English in different settings and preferred ethnicity of those they interact (1 = only Chinese to 5 = only English/Americans). The sum score ranged from

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12 to 60 (α = .92). For all the social environment factors, a higher score indicates a more supportive/simulating environment.

Control variables.—Demographic variables, health status, health behaviors, and immigration-related variables are important correlates of cognitive function among immigrants and were controlled for in the analyses (Beydoun et al., 2014). Age was measured in years. Woman and married were used as dichotomous variables (0 = no and 1 = yes), capturing respondents' gender and marital status, respectively. Indicators of health included activities of daily living (ADL) limitations, cardiovascular risks, chronic conditions, smoking behavior, and depressive symptoms. ADL was measured by levels of difficulties in performing eight daily activities (0 = none, 1 = sometimes, 2 = a lot, and 3 = most of the time) (Katz et al., 1963). ADL limitations were coded as a dichotomous variable, with 0 = no difficulties at all and 1 = any difficulties in performing any ADL tasks. Cardiovascular risks included two dummy variables indicating heart diseases (i.e., heart attack/coronary artery disease) or stroke (0 = no and 1 = yes). Chronic conditions included hypertension and diabetes (0 = none, 1 = having one condition, and 2 = having both conditions). Ever smoked measured respondents' smoking behavior (0 = no and 1 = yes). Depressive symptoms were measured by Patient Health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001). Respondents rated how often they experienced nine depressive symptoms during the past 2 weeks (0 = not at all, 1 = several days, 2 = a week or more, and 3 = nearly every day). The sum score ranges from 0 to 27, with higher scores indicating more depressive symptoms (α = .82). An immigration-related variable included family-related migration, a dichotomous variable that reflected whether respondents immigrated in order to reunite with family members (0 = no and 1 = yes).

Data Analysis

We presented sample characteristics by age at migration. To address the research questions, quantile and linear regressions were carried out to predict C-MMSE and global cognitive function, respectively. Quantile regression is an extension of linear regression in which conditional median instead of mean is calculated due to data skewness (of C-MMSE scores) (Koenker & Hallock, 2001). To test the last two hypotheses, interaction terms between age at migration and each indicator of SES and social environment were added into the regressions.

Results

Descriptive Results

Table 1 summarizes sample characteristics. Overall, the respondents were in their early seventies, with the majority being women (57.86%) and married (71.06%). On average, they had 9 years of education. About 6% of the respondents had some ADL limitations; 15% had heart diseases, 5% had stroke, and 61% had hypertension and/or diabetes; about 30% ever smoked. More than 70% of the respondents migrated for family reasons. Overall, the respondents had few depressive symptoms (M = 2.65 out of 27), acculturation (M = 15.15 out of 60), and social engagement (M = 15.15 out of 60), but relatively high social support (M = 30.17 out of 36).

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On average, the respondents migrated at the age of 53. Specifically, less than 10% migrated between 18 and 34; about a quarter migrated between 35 and 49; about half migrated between 50 and 64, and 14% migrated in later life. Respondents migrating at different life stages varied significantly in most demographic, SES, health, and social environment indicators. Overall, those who migrated in later life stages tended to be older, poorer, less acculturated, have poorer physical and mental health, and were more likely to migrate for family reasons. Both C-MMSE and global cognition scores were gradually reduced with a more advanced migrating age.

Regression Results on MMSE

Table 2 summarizes the regression results on MMSE scores. Model 1 showed that, adjusting for SES, social environmental factors, and control variables, both migrating in late middle age (50–64) and late adulthood (65 or older) were associated with poorer MMSE scores relative to migrating between 18 and 34. The finding suggests that even controlling for multiple disadvantages faced by migrants arriving after age 50 (e.g., lower income, lower acculturation, older age, poorer physical health, and more depressive symptoms, see Table 1), they were still more likely to have lower MMSE scores than those who migrated between 18 and 34. Instead, those who migrated in early middle age (35–49) had comparable MMSE scores as those who migrated between 18 and 34.

We further tested potential moderating effect of SES and social environment indicators. We presented subsets of moderation models that had at least one statistically significant interaction effect. Results showed that the negative relationship between age at migration and MMSE was stronger among immigrants who were less educated (Model 2) and who had lower acculturation level (Model 3), regardless of during what life stage they migrated, and among immigrants with lower social engagement, but only those who migrated after age 50 (Model 4).

To better understand these moderating effects, we carried out additional analyses examining associations between age at migration and MMSE scores among immigrants with different education (0–6 years, 7–12 years, and 13 years or above), social engagement (low, medium, and high levels based on mean ± 1 *SD*), and acculturation levels (low level = only spoke or interacted with Chinese, moderate/high level = speak some English, or interacted with some Americans). The findings are illustrated in Figure 1. The results showed that among immigrants who had elementary or lower education (0–6 years), older age at migration was associated with reduced MMSE scores. Such a reduction was less steep among immigrants who had some high school education (7–12 years). Among those who had college education or above (13 years or more), older age at migration was associated with slightly increased MMSE scores. Similarly, among immigrants who had low level of social engagement or acculturation, older age at migration was associated with lower MMSE scores. But among immigrants with a high level of social engagement or acculturation, the association between age at migration and increase in MMSE scores was negligible or likely positive.

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Regression Results on Global Cognition

Table 3 summarizes regression results on global cognition. Different from the results on MMSE, age at migration was not associated with global cognitive function when all the explanatory variables were adjusted (Model 1). Inspection of significant predictors in Model 1 and group differences in these variables (Table 1) shows that group differences in global cognition observed in Table 1 may be mainly attributed to differences in income, social engagement, acculturation level, and depressive symptoms across immigrants migrating in distinctive life stages. As for MMSE, we further tested moderation effect of SES and social environment factors. The results confirmed that the association between age at migration and global cognitive function varied by education, social engagement, and acculturation of the immigrants, with lower educated, less socially engaged, or less acculturated greatly affected by later age at migration (Figure 2).

Discussion and Implications

Focusing on age at migration, an important aspect of the migration experience, this study asked the question: is migrating at later life associated with poorer cognitive health among Chinese older immigrants? Our findings show that the answer seems to vary by specific measures of cognitive function. Measured by the Mini-Mental State Examination (MMSE), which is a commonly used screening tool for cognitive impairment, we found that migration at late middle age (50–64) and late adulthood (65 or later) was associated with lower MMSE scores, that is, greater cognitive impairment, while controlling for immigrants' demographic characteristics, SES, physical and mental health, acculturation level, and social environment. But for global cognitive function, which further included working memory, episodic memory, and executive function in this study, we found that although later-life immigrants in the sample had overall lower values on the sum scores than earlier-life immigrants, such differences disappeared when individual differences in explanatory factors were controlled for.

Interestingly, such a distinction seems to be consistent with prior research on the age at migration and cognitive health using either the MMSE solely (Downer et al., 2016; Garcia et al., 2017; Monserud, 2018), which reported negative relations between age at migration and MMSE scores, or studies using other measures such as executive function, reasoning, language, and intelligence (Casanova & Aguila, 2020; Statucka & Cohn, 2019; Touradji et al., 2001; Zahodne et al., 2014), which reported nonsignificant relationships between age at migration and these cognitive outcomes. These differences may speak to the complex and multifaceted nature of cognitive health, with different domains likely affected to different extents or in different ways by the immigration process.

The MMSE was originally developed as a brief screening tool to detect dementia in a clinical setting (Folstein et al., 1983). In this sense, our findings suggest that, when using the MMSE as a measure of cognitive functioning, migrating in late middle age or late adulthood might be associated with a higher risk for cognitive impairment. Individuals who migrated at different life stages may have different risks and/or protective factors associated with their cognitive performance in later life. For immigrants who migrated during early adulthood or early middle age, the migration process occurs during a life stage that is characterized

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by independence, productivity, and active social roles (Medley, 1980). Migration and acculturation during this life period is likely to require intense mobilization of mental and cognitive ability, which, in the long run, may benefit cognitive well-being in later life (Hill et al., 2012). Early-life migration may also have more acculturative opportunities, better occupational achievement, larger social networks, and thus they are able to accumulate social and financial resources that may protect them from having cognitive impairment in later life (Garcia et al., 2018). In contrast, individuals who migrate later in life may struggle to access or accumulate these social and economic resources. These disadvantages accumulating over time may lead to chronic activation of the physiological stress response at a more intense level, leading to "cognitive depletion" in later life (Monserud, 2018). Migrants who migrated during late middle age or late adulthood may also bring age-related physical and cognitive problems or have ongoing health decline before migration (Tang et al., 2019). These factors may complicate immigrants' capacity to adjust to the stressful acculturative process, thus rendering them more susceptible to cognitive impairment.

Though it remains the most commonly used cognitive measure in the immigrant health literature, the MMSE seems to effectively capture certain aspects of an immigrant's overall cognitive profile. Our findings showed that when evaluated by a wider range of measures, immigrants who migrated at different life stages had comparable global cognitive function. Such a finding may provide evidence to later-life immigrants' ability to sustain certain cognitive function, despite their higher risk of experiencing cognitive impairment. Arguably, compared to the MMSE test, the additional constructs encompassed in the global cognition measures, such as executive function, better capture the accumulated knowledge and skills that immigrants gained through education and experience. In our study, immigrants who migrated in late adulthood were older but better educated (Table 1), meaning that they arrived in the United States at an older age after attaining a relatively higher education. Even facing greater vulnerability than early-life immigrants, later-life immigrants' higher education may protect them against various stressors, helping them to maintain some key cognitive functioning measured in the global cognitive tests.

Despite the different associations between age at migration and the two measures of overall cognitive function, our findings partly support the second hypothesis, showing that having higher education buffered the potential cognitive disadvantages associated with migration in later life. Education is shown to be a strong protective factor of cognitive function (Meng & D'arcy, 2012). The protective and compensative effect of education includes enhanced brain structure and processing, occupational complexity, more active social networks, and participation in cognitively stimulating activities over the life course (Meng & D'arcy, 2012). It is likely that immigrants with higher education, together with their families, brought with them different economic and social resources upon migration. They may have better health literacy and access to health care and more resources to establish and maintain meaningful social ties in the local community. All these factors may position them more favorably when dealing with migration-/acculturation-related stress and, thus, limit the impact of age at migration and its related cognitive implications.

Regarding our third hypothesis, our results showed that among the four indicators of social environment, higher levels of social engagement and acculturation buffered the potential

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negative impact of later-life migration on cognitive function. These findings suggest that having a more cognitively stimulating environment may be more beneficial for older immigrants' cognition than having a supportive social environment. Older immigrants who are more socially engaged or who are more acculturated may be more likely to be integrated in the new environment that may offer opportunities for physical activity, learning, and social interactions. Participation in these social relationships and social activities could be cognitively stimulating, which may account for its protective effect against cognitive impairment. These social activities may also help immigrants prevent depressive symptoms and deal with migration-related stress, which are risk factors for later-life cognition. Such a benefit may be particularly significant for immigrants who migrated in later life, who often have limited economic, linguistic, and instrumental (e.g., transportation) resources for social engagement.

Several limitations of this study are worth mentioning. First, the sample of this study was from Chicago, which has one of the largest and well-preserved Chinese communities in the United States. Respondents' easier access to economic/social/cultural/healthcare resources offered by these ethnic communities has important implications on their language acquisition, social activities, and cognitive function. Findings should be replicated with samples from other geographic areas and immigrants of other race/ethnicities. Including a nonmigrant sample as a reference group will also help strengthen the internal validity of the investigation. Pertaining to the research design, this study used a cross-sectional design, which provides only a snapshot of cognitive profiles of immigrants who migrated at different ages. It is possible that those who migrated at earlier age may have better baseline cognitive health than those who migrated at later age. Ideally, longitudinal studies could follow immigrants who came to the United States at different life stages and test more complex structural equation models with confounding factors measured at different time points to depict the pathway through which age at migration affects later-life cognition. In terms of measurement, social support and social engagement measures were limited to activities in the host country; future studies could further obtain information of immigrants' social ties and engagement in the home country to fully understand the social aspects of migration and their implications for immigrants' cognitive health. Lastly, the nature of secondary data analysis prevents us from including other meaningful explanatory variables or moderators such as cultural value, stigmatization, and social isolation. Future research shall include these variables to provide a more complete picture of mechanisms through which age at migration may shape immigrants' later cognitive health.

Despite these limitations, this study is the first to use a large population-based sample of older Chinese immigrants to explicitly test the association between age at migration and cognitive health among this population. Our findings are largely consistent with those on aging Mexican immigrants (Downer et al., 2016; Garcia et al., 2017; Monserud, 2018), showing that migrating later in one's life may have important implications on factors associated with later-life cognitive function, putting later-life immigrants at a higher risk of experiencing cognitive impairment. This points to the importance of understanding sample characteristics and taking into consideration the diversity among specific ethnic groups when examining their health outcomes. Although Chinese immigrants on average have better SES, our sample consisted of a group of older immigrants who had overall low levels of education

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(Mean = 9 years), income (mean annual income was between $5000 and $10,000), and acculturation. Their disadvantaged status may render them with limited resources for coping with stresses associated with migration, which may hold true for other aging immigrant populations.

In addition, different from previous studies on Mexican immigrants that have used MMSE exclusively to capture cognitive health, by adding more comprehensive assessments of cognitive function and using global cognition as another outcome, our findings provide positive evidence of sustained cognitive performance among later-life Chinese immigrants, possibly via their better education before migration. By looking at the heterogeneity among older immigrants, our study further showed that less-educated immigrants and immigrants who were less socially engaged are more susceptible to cognitive challenges associated with migrating at advanced age.

These results have important research and practice implications. The different findings on the two outcomes point to the importance of using more compressive assessment besides the MMSE to fully assess and understand older immigrants' cognitive function. By emphasizing the heterogeneity among older immigrants in terms of age at migration and resources for cognitive reserve, findings of this study are helpful to identify vulnerable older immigrant segments and design tailored interventions to promote cognitive health. Specifically, immigrants who migrated in later life, particularly late-life immigrants who have less education and who do not have active social engagement in the local community, face greater risks of cognitive impairment. To promote cognitive health among older immigrants, programs should be designed to help immigrants, particularly those who migrated at later life, to establish meaningful social ties and engage in various social activities in the local community. Older immigrants represent a population whose knowledge and heritage are not well tapped by the society. Programs should be designed to help older immigrants become more active and contributing members of the society, which in turn will help them maintain cognitive well-being and achieve successful aging.

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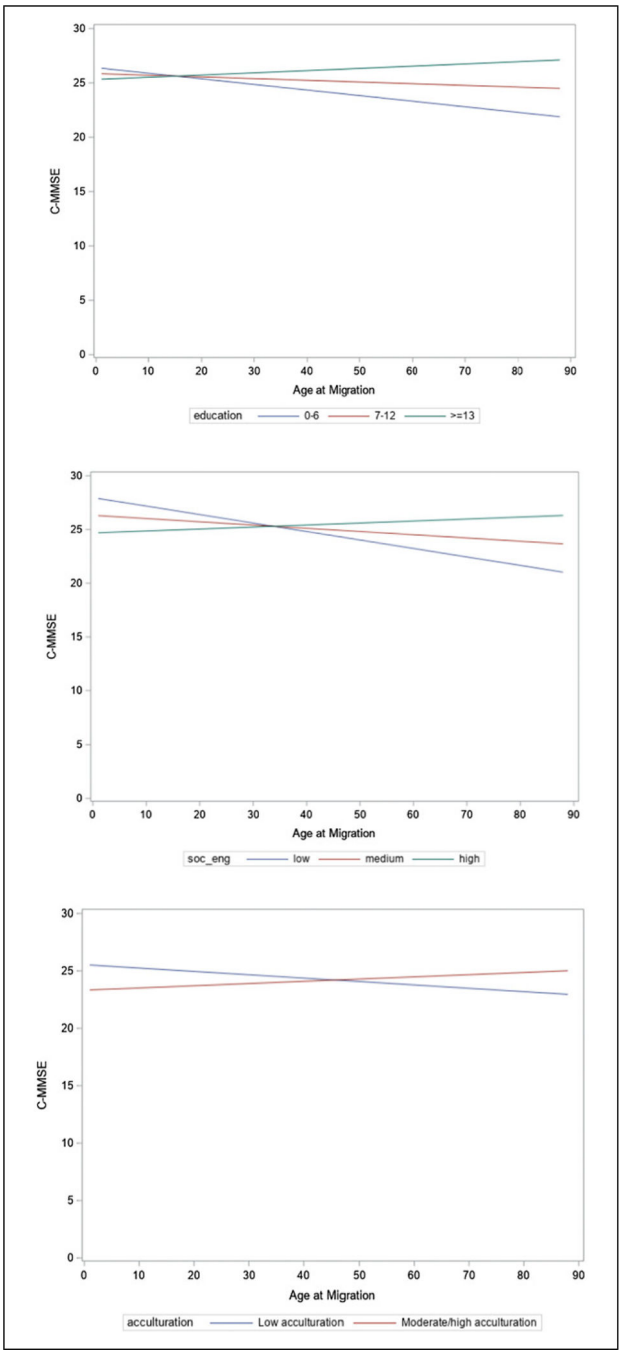

Figure 1.

Age at migration and Chinese version Mini-Mental State Examination among Chinese older immigrants by levels of education, social engagement, and acculturation.

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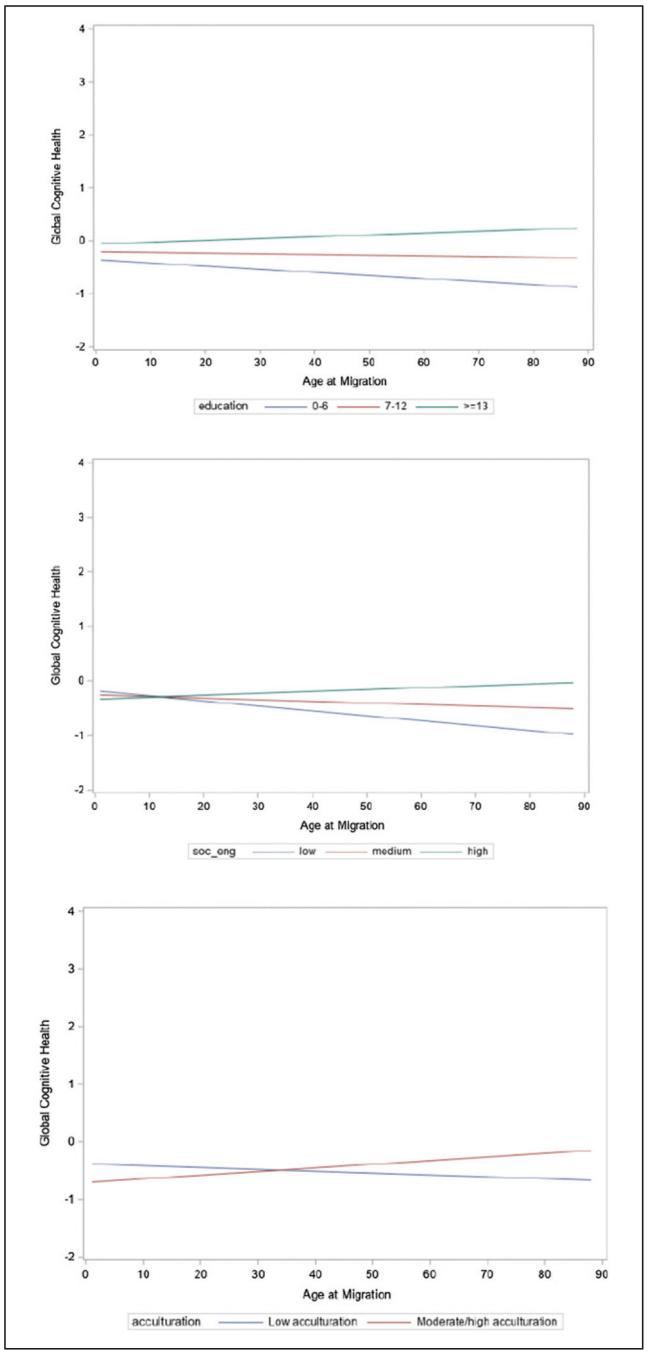

Figure 2.

Age at migration and global cognitive function among Chinese older immigrants by levels of education, social engagement, and acculturation.

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Table 1.

Sample Characteristics by Age at Immigration (*N = 2957*).

		Age of migration				
	Entire sample	**18–34**	**35–49**	**50–64**	**65 or Later**	
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	***p* value**[a]
Cognitive health						
C-MMSE	25.62 (3.96)	26.55 (3.44)	26.04 (3.57)	25.45 (4.01)	24.82 (4.57)	<.001
Global cognition	.02 (0.74)	0.21(0.64)	0.07 (0.68)	−0.02 (0.76)	−0.06 (0.86)	<.001
Age at migration	52.98 (12.79)	28.65 (4.94)	43.55 (4.22)	57.55 (4.10)	69.51 (3.87)	<.001
Socioeconomic status						
Years of education	8.94 (4.94)	9.31 (4.89)	8.71 (4.42)	8.60 (4.88)	10.31 (5.80)	<.001
Income	0.55 (0.46)	0.84 (0.56)	0.63 (0.47)	0.52 (0.41)	0.33 (0.37)	<.05
Social environment						
Social engagement	21.31 (8.94)	23.04 (8.70)	21.33 (8.53)	20.80 (9.06)	21.97 (9.18)	<.001
Social support	30.17 (3.18)	29.84 (3.37)	30.02 (3.25)	30.35 (3.13)	30.09 (3.06)	<.05
Neighborhood cohesion	0.01 (0.77)	−0.01 (0.66)	−0.06 (0.67)	0.04 (0.82)	0.04 (0.83)	<.05
Level of acculturation	15.11 (4.54)	19.88 (7.81)	15.34 (4.70)	14.23 (2.99)	14.75 (3.93)	<.001
Control variables						
Age	72.33 (8.00)	70.18 (7.64)	70.22 (7.46)	72.06 (7.18)	78.43 (6.65)	<.001
Woman	57.29%	59.93%	60.42%	57.38%	49.65%	<.01
Married	72.85%	68.38%	70.93%	75.60%	69.56%	<.01
Have any ADL limitations	6.16%	3.31%	4.43%	6.18%	11.01%	<.001
Cardiovascular risks						
Heart diseases	15.15%	9.93%	13.15%	14.97%	22.72%	<.001
Stroke	5.07%	6.25%	5.47%	4.36%	6.10%	n.s. <.05
Chronic conditions[b]						
None	39.32%	39.85%	37.47%	41.69%	34.04%	
One	45.12%	40.22%	46.48%	43.71%	50.70%	
Two	15.56%	19.93%	16.06%	14.59%	15.26%	
Ever smoked	30.06%	31.62%	27.86%	31.34%	28.57%	n.s.

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	Entire sample	Age of migration				
		18–34	35–49	50–64	65 or Later	
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	*p* value[a]
Depressive symptoms	2.50 (3.94)	2.22 (3.81)	2.40 (3.95)	2.48 (3.91)	2.94 (4.08)	<.01
Family-related migration	73.72%	61.03%	66.93%	75.91%	86.42%	<.001
	N = 2957	*n* = 272 (9.20%)	*n* = 768 (25.97%)	*n* = 1490 (50.39%)	*n* = 427 (14.44%)	

Note. n.s. = not significant; ADL = activities of daily Living; C-MMSE = Chinese version Mini-Mental State Examination.

[a]Chi-square tests for categorical variables and ANOVA for continuous variables were performed to compare group differences.

[b]Chronic conditions included hypertension and diabetes.

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Table 2.

Results of Quantile Regression on C-MMSE Scores Among the PINE Respondents.

	Model 1	Model 2	Model 3	Model 4
	β	*β*	*β*	*β*
Age at migration (ref: 18–34)				
35–49	−.035	−.184	−.180	−.523*
50–64	−.362*	−.470*	−.632*	−.848***
65 or older	−.922**	−1.084**	−1.26**	−1.408**
Socioeconomic status				
Years of education	.253***	.094**	.247***	.254***
Income	.171	.370***	.289**	.195
Social environment				
Social engagement	.068***	.063***	.013***	.063***
Social support	.004	−.002	−.003	.007
Neighborhood cohesion	.096	.046	.065	.093
Level of acculturation	.005	.006	.004	.060***
Control variables				
Age	−.076***	−.082***	−.076***	−.078***
Woman	−.691***	−.590***	−.640***	−.704***
Married	.620***	.676***	.676***	.630***
Have any ADL limitations	−.895	−.758	−.908	−.833
Cardiovascular risks				
Heart diseases	−.028	−.016	−.024	−.038
Stroke	−.546	−.490	−.425	−.321
Chronic conditions (ref: none)[a]				
One	.091	.148	.068	.070
Two	−.000	−072	.003	−.005
Ever smoked	−.394*	−.229	−.313	−.401**
Depressive symptoms	−.100***	−.100***	−.111***	−.108***

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	Model 1	Model 2	Model 3	Model 4
	β	*β*	*β*	*β*
Family-related migration	−.126	−.009	−.079	−.100
Interactions				
Age at migration × education				
30–49 × education		.118**		
50–64 × education		.193***		
65 or older × education		.210***		
Age at migration × social engagement				
30–49 × social engagement			.017	
50–64 × social engagement			.078***	
65 or older × social engagement			.056*	
Age at migration × acculturation				
30–49 × acculturation				.093***
50–64 × acculturation				.070***
65 or older × acculturation				.136***

Note.

*$p < .05$

**$p < .01$

***$p < .001$.

[a]Chronic conditions included hypertension and diabetes.

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Table 3.

Results of Linear Regression on Global Cognition Among the PINE Respondents.

	Model 1	Model 2	Model 3	Model 4
	β	*β*	*β*	*β*
Age at migration (ref: 18–34)				
35–49	.027	−.025	−.061	−.101*
50–64	.049	−.028	−.076	−109**
65 or older	.062	−.050	−.094	−.132**
Socioeconomic status				
Years of education	.062***	.029***	.061***	.061***
Income	.065**	.083***	.074**	.076**
Social environment				
Social engagement	.019***	.018***	.005	.018***
Social support	.004	.003	.003	.004
Neighborhood cohesion	−.001	−.004	−.003	−.002
Level of acculturation	.008**	.010**	.010**	.009*
Control variables				
Age	−.023***	.023***	−.023***	−.023***
Woman	−.076*	−.078*	−.077*	−.079*
Married	.046	.046	.045	.043
Have any ADL limitations	−.167***	−.162***	−.162***	−.167***
Cardiovascular risks				
Heart diseases	.046	.037	.044	.043
Stroke	−.188***	−.179***	−.186***	−.179***
Chronic conditions (ref: none)[a]				
One	−.014	−.012	−.013	−.011
Two	−.057	−057	−.057	−.048
Ever smoked	−.039	−.039	−.040	−.039
Depressive symptoms	−.011***	−.011***	−.011***	−.012***