Published in final edited form as:
Res Aging. 2020 August ; 42(7-8): 226–235. doi:10.1177/0164027520917064.

Importance of Activity Engagement and Neighborhood to Cognitive Function Among Older Chinese Americans

Fengyan Tang[1], **Wei Zhang**[2], **Iris Chi**[3], **Mengting Li**[4], **Xin Qi Dong**[4]

[1]School of Social Work, University of Pittsburgh, PA, USA

[2]Department of Sociology, University of Hawai'i at Mānoa, Honolulu, Hawai'i

[3]Suzanne Dworak-Peck School of Social Work, University of Southern California, Los Angeles, CA, USA

[4]Institute for Health, Health Care Policy and Aging Research, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA

Abstract

This study investigates the differential associations of activity engagement and perceived neighborhood characteristics (i.e., cohesion, disorder, sense of community) with cognitive measures. Using data of 2,713 Chinese older adults in Chicago, who completed two interviews between 2011 and 2015, we identified three activity domains: reading, social, and games. In general, engagement in more reading and social activities was associated with better baseline cognitive function, but the positive effects tapered off over time in some cases. Neighborhood cohesion had both direct and indirect effects on cognitive function. Engagement in social activities mediated the neighborhood cohesion effects, that is, living in a cohesive neighborhood promoted social activities and consequently benefited cognitive function. Findings speak to the importance of activity engagement and neighborhood cohesion for cognition among the U.S. Chinese older adults. Future research is needed to investigate the longitudinal relationships of activity engagement and environmental factors with cognitive change.

Keywords

cognitive function; activity engagement; neighborhood; Chinese older adults

---

Cognitive impairment and associated dementias have become major health and social issues due to the increasing prevalence and detrimental effects on quality of life in the rapidly increasing older population (Kuiper et al., 2015). Previous studies documented that activity engagement, especially in socially meaningful and cognitively stimulating activities, has protective effects against age-related cognitive decline and impairment throughout adulthood and later life (Bielak et al., 2012), although reverse causation may exist, that is, activity

---

Corresponding Author: Fengyan Tang, School of Social Work, University of Pittsburgh, 2217C Cathedral of Learning, 4200 Fifth Avenue, Pittsburgh, PA 15260, USA. fet7@pitt.edu.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

engagement is limited for those with prior cognitive decline (James et al., 2011). Indeed, the engagement hypothesis of cognitive aging suggests that active individuals likely have higher cognitive functioning and higher cognitive fitness allows them to be more active in older age (Bielak, 2010; Stine-Morrow et al., 2007).

Daily activity choices are often affected by environmental opportunities and constraints that either foster or hinder engagement in certain types of activities (Horgas et al., 1998). A growing body of literature has examined aspects of living environments that facilitate activity engagement and benefit cognitive function (e.g., Cassarino & Setti, 2015; Wu et al., 2015). One such important aspect is the perceived social environment, including social cohesion, interpersonal relationships, and place attachment, which is found to promote older adults' physical activity (Van Cauwenberg et al., 2014), and have an impact on cognition (Lee & Waite, 2018; Zhang et al., 2019), underscoring the importance of social environment and potential mediating role of activity engagement to cognitive function (Wu et al., 2015). Perceived social environment and a sense of community (SOC), or the feelings that members have in relation to their community and other members (McMillan & Chavis, 1986), may play an important role in providing social support and resources for activity engagement and cognitive enrichment. A strong SOC implies a healthy living environment with high social cohesiveness (Nowell & Boyd, 2010). Yet the associations of cognitive function with activity engagement and perceived neighborhood characteristics remain unknown in the rapidly increasing U.S. Chinese older population.

With around 4 million in total and 14% of them being 65 years or older, the Chinese is among the fastest growing aging populations in the United States (U.S. Census Bureau, 2016). To date, no studies have systematically examined cognitive function and associated factors in this population (Li et al., 2017). A few studies revealed that older Chinese Americans are at especially high risk for delayed diagnosis and deficient management of dementias due to the intense stigma associated with dementia in Chinese culture (Woo, 2017). The U.S. Chinese older adults, most of whom are first-generation immigrants, have rapidly increased in number, but their health care needs, especially for cognitive interventions, are largely neglected by the mainstream U.S. society (Li et al., 2017). Facing cultural, language, and systems barriers, older Chinese immigrants may be restricted to less resource-demanding activities, relying more on the neighborhood for engagement in active and healthy lifestyles than nonimmigrants. As documented in cross-sectional analyses of the Population Study of Chinese Elderly (PINE) data, older Chinese Americans reported relatively low levels of participation in cognitive and social activities (Tang, Chi, Zhang, & Dong, 2018). Residing in a socially cohesive neighborhood was related to better mental health, whereas disruptive living environments were associated with worse physical and mental health indicators (Tang et al., 2017).

Few studies have explored the role of activity engagement in conjunction with perceived neighborhood characteristics in preventing cognitive decline, especially among older immigrants who may heavily rely on their neighborhoods for social integration. Our study aims to fill the knowledge gap through examining differential impacts of activity engagement and neighborhood characteristics on cognitive function. We focused on the effects of leisure activities in which one prefers or enjoys engaging during free time.

These activities could be divided into relatively active, social leisure (e.g., attending events) and relatively passive, solitary leisure (e.g., reading; Bath & Deeg, 2005). Further, we explored whether the impact of neighborhood on cognition is mediated by social activity. Neighborhood cohesion that represents the person–environment fit may promote social activity engagement and reduce risks for cognitive decline.

Background

This study is guided by two conceptual frameworks. First, the engagement hypothesis of cognitive aging predicts that engagement in intellectual, social, and physical activities protests against age-related cognitive decline and reduces risks of dementia (Bielak, 2010; Stine-Morrow et al., 2007). According to Stine-Morrow and colleagues (2007), the environment creates opportunities for self-directed activity and promotes the allocation of mental resources toward intellectual activity, thereby expanding the repertoire of intellectual skills. Activity participation as one index of exposure to cognitively demanding social environments can induce neurogenesis (Stine-Morrow et al., 2007). Particularly, engagement in social activities presents rich opportunities for older adults to experience dynamic and engaging environments that benefit cognition (Bourassa et al., 2017). Overall, participation in social activities was associated with better function and slower declines in both memory and executive function (Bourassa et al., 2017). Older adults with less social participation and less frequent social contact have an increased risk of developing dementia (Kuiper et al., 2015).

Second, according to person–environment fit theories, individual competencies, preferences, and needs manifest differently across environments (Lawton, 1983; Wahl et al., 2012). A neighborhood can be either an asset or a hindrance based on its ability to meet personal needs and preferences (Lee & Waite, 2018). Perceptions of neighborhood such as social cohesion serve as the ratings of person–environment fit, which appear to have more direct effects on cognition than do objective indicators of neighborhood, such as violent crime and poverty (Lee & Waite, 2018). Using perceived neighborhood cohesion and city satisfaction as ratings of fit with the environment, Mejia et al. (2017) found that person–environment fit was associated with various successful aging outcomes, including global well-being, activity participation, positive and negative experienced well-being, and mortality. An analysis of the PINE baseline data showed that neighborhood cohesion was independently associated with episodic memory, perceptual speed, and global cognition among older Chinese Americans (Zhang et al., 2019). It is speculated that a socially cohesive neighborhood may offer opportunities to enhance social integration and encourage social engagement (Zhang et al., 2019). Perceived social environments, including social support, neighborliness, and safety, are important to engage in activities that occur outside the home, such as social activities (Vaughan et al., 2016). By contrast, living in neighborhoods with poor built environment and high levels of violent crime was associated with lower cognitive function (Lee & Waite, 2018). In addition, an SOC provided a positive identity for older adults and promoted their well-being (Mejia et al., 2017). SOC was associated with the social environmental characteristics of place, indicating the extent to which one feels part of a readily available, supportive, and dependable environment (Pretty et al., 2003). A strong SOC was related to better self-rated health and fewer depressive symptoms in older Chinese Americans

(Tang, Chi, Xu, & Dong, 2018). These studies indicate that the person–environment fit may contribute to differences in social activity engagement, which further affects cognitive function. Immigrants' experience of transitions in and out of places requires cognitive sense-making and reconnections with familiar and unfamiliar places in everyday life. Such cognitive processes may develop into a person–environment fit with familiar routines and relationships with neighbors, leading to a sense of belonging, place attachment, and consequently cognitive wellbeing (Wahl & Oswald, 2010).

It is noted that the associations between environmental factors and activity engagement are culture-specific (Cassarino & Setti, 2015). In Chinese culture, social embeddedness and interdependence are critical among individuals that comprise the community, and the members have a feeling of personal relatedness and a duty to others in the community (Brewer & Chen, 2007), pointing to the importance of social cohesion and an SOC for the well-being of older adults in the community. Using data from two waves of the PINE, the first population-based epidemiological study of Chinese older adults in the United States, this study aims to examine the effects of activity engagement and perceived neighborhood characteristics on multiple cognitive domains over time. A large portion of the PINE participants was from Chinatown in Chicago, the largest community of Chinese immigrants. Despite being segregated from other racial/ethnic groups, living in Chinatown may be cognitively beneficial through developing social networks and support, enhancing social cohesiveness and SOC, thus buffering the deleterious effects of environmental and individual disadvantages.

We first identified activity domains that encompass various types of leisure activities and examined their relationships with cognitive measures. Following prior work (Zhang et al., 2019), we investigated whether perceived neighborhood characteristics, including neighborhood social cohesion, neighborhood disorder, and SOC, are related to cognitive function independent of activity engagement. Due to the lack of evidence from previous studies, we took an exploratory approach to the mediating effects of activity engagement on the pathway from neighborhood characteristics to cognitive function. We examined whether living in a cohesive neighborhood enhances social activity engagement, which in turn positively impacts cognitive function. The person–environment fit, indicating social connection to residential place (Cagney et al., 2009), may positively influence participation in social activities. The clarification of differential impacts of neighborhood characteristics and activity engagement and the pathway to cognitive benefits will improve our understanding of the preventive effects of activity engagement and the associated contextual factors in the neighborhood. Building on theoretical and empirical evidence, we hypothesized that (1) higher levels of activity engagement and (2) positive neighborhood characteristics (i.e., more social cohesion, less neighborhood disorder, and more SOC) are related to better baseline cognitive performance and slower decline in cognitive domains over time. In response to the immigration-related challenges, older adults may rely on neighborhoods for social engagement, develop supportive relationships, and increase access to coping resources. Thus, we expected that a cohesive neighborhood is critical for engagement in social activities and hypothesized that (3) social activity engagement mediates the relationship between neighborhood characteristics and cognition, that is, after adding social activity engagement as a mediator in the model, the associations between neighborhood characteristics and cognitive function become statistically less significant or nonsignificant.

Method

Participants

Guided by community-based participatory research principles, the PINE study is the only longitudinal epidemiological study that has collected cognitive data and other important health indicators in a population-based sample of Chinese older adults in the United States (Dong et al., 2014; Li et al., 2017). The comparison between the PINE study and the 2010 Census data as well as the 2012 Random Block Census study indicated that the PINE study was representative of the Chicago Chinese aging population without significant differences in main sociodemographic characteristics (Dong et al., 2014).

Participation rate was greater than 91% at Wave 1 (2011–2013) with 3,157 respondents. Wave 2 data were collected between 2013 and 2015, with a follow-up rate of 89.4%. Among baseline 3,157 respondents, 270 did not respond to the second wave and 124 died between the waves. The final sample included 2,713 participants completing two surveys, with sample sizes ranging from 2,039 to 2,654 in various analyses due to missing data. Compared with those who participated in both waves, those who dropped out were older, $t(63.51) = -4.00$, $p < .001$, less likely to be married, $\chi^2(1, N = 3{,}137) = 13.39$, $p < .001$, with lower scores of episodic memory, $t(1050.2) = 5.95$, $p < .001$, perceptual speed, $t(144.87) = 5.65$, $p < .001$, and global cognition, $t(990.84) = 4.13$, $p < .001$, at baseline. There were no differences in working memory, general mental status, education, income, and gender distributions. We controlled for factors that predict cognitive function (e.g., age, education, self-rated health, baseline mental status); therefore, sample attrition is unlikely to produce biased estimation in mixed effects models with maximum likelihood estimation.

Cognitive Function

Participants were tested through a battery of five instruments. The 30-item Chinese Mini-Mental State Examination (C-MMSE) was used to measure *general mental status*, based on the MMSE which has been widely used in epidemiological studies (Chiu et al., 1994). *Episodic memory* was assessed using summary scores of two tests: the East Boston Memory Test-Immediate Recall and the East Boston Memory Test–Delayed Recall of brief stories. *Working memory* was assessed using the Digit Span backwards test, which was drawn from the Wechsler Memory Scale–Revised test. *Perceptual speed* was assessed using the oral version of the 11-item Symbol Digit Modalities Test (SDMT), which calls for rapid perceptual comparisons of numbers and symbols during the 90-s duration of the test. Based on five tests, a *global cognition* score was calculated by averaging standardized scores of the above tests to minimize floor and ceiling artifacts and other measurement errors (Li et al., 2017).

Activity Engagement

Participants reported the frequency of engagement in various leisure activities, including reading, playing games, watching TV, listening to radio, going out, visiting friends, and going on trips. Responses were scaled from *once a year or less* (0) to *everyday or almost* (4). One question about how much time spending on reading each day was scaled from *none* (0) to *2 or more hours each day* (4). Using the baseline data, we conducted factor analysis to identify activity domains underlying the discrete activities. We retained factors with an eigenvalue greater than one or Kaiser–Guttman criterion. An item was identified to load on a given factor if the factor loading was .40 or greater (Field, 2000). Results indicated three distinct factors or activity domains: *reading* (reading time, frequencies of reading books, reading magazines, and reading newspapers), *social activity* (frequencies of going out, visiting friends, and inviting guests), and *games* (frequencies of playing games and playing mahjong). Three observed items (i.e., going on trips, watching TV, listening to radio) were dropped due to low factor loadings. Table 1 presents description of each item grouped by activity domains, factor loadings, and frequency of the highest level response.

Neighborhood Characteristics

Neighborhood cohesion was composed of 6 items extracted from the Chicago Neighborhood and Disability Study (CNDS; Cagney et al., 2009). The items were designed to measure individual level of integration (e.g., how often in your neighborhood do you see neighbors talking outside in the yard or in the street?; response: 0 = *never* to 3 = *often*) and to evaluate the overall social cohesiveness that individuals perceived (e.g., how many neighbors do you know by name?; response: 0–21 or more; Cagney et al., 2009). The index had a high level of internal consistency (Cronbach's α = .86) in the PINE study. We used the standardized score of neighborhood cohesion due to different response sets across items (range: −1.07 to 2.80). *Neighborhood disorder* contained 8 items used in the CNDS to evaluate the neighborhood's physical and social disorders (Cagney et al., 2009), with a high level of internal consistency (Cronbach's α = .81). Respondents were asked whether they had observed the presence of potentially threatening or intimidating conditions, including strangers, speeding cars, vandalism, and safety of walking around the neighborhood (response: 0 = *never* to 3 = *often*). The summary score was used in the analyses (range: 0–22). *SOC* was measured by the 12-item Sense of Community Index (response: 0 = *never* to 3 = *often*; Perkins et al., 1990). Respondents were asked to rate statements such as "I feel at home at this neighborhood." The summary scores ranged from 19 to 58, with higher scores reflecting greater levels of SOC (Cronbach's α = .69).

Covariates

Time was the follow-up period for participants, ranging from 1.8 to 3.7 years. We controlled for demographic variables, including age (range: 59–103), education (range: 0–26 years in school), income (range:1 = $0–$4,999 to 10 = over $45,000), self-rated health (0 = *poor/fair*, 1 = *good/very good*), years living in the neighborhood (range: 0.1–63), years living in the United States (range: 0.1–90), gender (1 = *female*, 0 = *male*), and marital status (1 = *married*, 0 = *not married*). Baseline C-MMSE (range: 0–30) was controlled in the analyses of other cognitive measures. Descriptive information about cognitive tests, activity engagement, perceived neighborhood characteristics, and covariates is presented in Table 2.

Data Analysis

We applied mixed effects regression models to estimate changes in five cognitive measures and the associations with explanatory variables after controlling for sociodemographic and health variables. Baseline independent and control variables, and cognitive measures from both waves were used. The core of mixed models is the incorporation of both fixed and random effects. Fixed effect parameters show how the sample means differ between any value of predictors or how the average change in the outcome variable is associated with one-unit change in a predictor variable, while the random effect parameters represent the general variability among subjects (Seltman, 2018). The effect of time was entered as a fixed factor to capture potential differences in cognitive function between two waves. Neighborhood characteristics, activity engagement, and their interactions with time were entered as fixed effects to test their associations with baseline level of cognition and rate of change after adjusting for baseline individual differences. Since two data points do not sufficiently make a change trend, we specified random intercept models to allow for individual-specific mean varying around the sample mean intercept (Seltman, 2018). Particularly, we estimated six models to test Hypotheses 1 and 2: (1) the null model that only included time, (2) the model with time and covariates of sociodemographic and health variables, (3) the model with neighborhood variables after controlling for time and covariates, (4) the model with activity engagement factors after controlling for time and covariates, (5) the model with neighborhood variables and activity engagement factors after controlling for time and covariates, and (6) adding the interaction terms between time and explanatory variables based on Model 5.

To test Hypothesis 3, we examined mediation effects in mixed effects models. Three criteria are needed to indicate a mediation effect: (1) the predictor variable is significantly related to the outcome variable, (2) the predictor is significantly related to the mediator, and (3) the mediator is significantly associated with the outcome variable (Baron & Kenny, 1986). As a result, two types of mediation effects may be identified; that is, full mediation occurs when the inclusion of mediator variable drops the significant relationship between predictor and outcome variables, and partial mediation occurs if the inclusion of mediator reduces the effect of predictor variable on the outcome. Our analysis focused on the mediation effect of social activities since evidence showed that social engagement is conditional on environmental factors (Cassarino & Setti, 2015).

Results

Table 3 presents the results of mixed effects models that were used to estimate rates of change in cognitive measures from baseline to Time 2 and the associations with the explanatory variables. First, the null models (Model 1) showed that global cognition, working memory, and C-MMSE significantly declined over years, but changes in episodic memory and perceptual speed were not statistically significant. The fixed effects in Model 2 showed that younger age, more education, higher income, and better health status were associated with better cognitive function. Compared with men, women had worse working memory and mental status, but better episodic memory. In Model 3, a higher level of perceived neighborhood cohesion was related to better cognitive functioning except working memory, after controlling for covariates. Model 4 indicated the consistently positive effects of engagement in reading and social activities on cognitive measures. In addition, more frequent engagement in games was associated with better general mental status and perceptual speed. When examining activity engagement and neighborhood variables together in Model 5, we found that the effects of activity engagement remained similar with those in Model 4, while higher neighborhood cohesion was significantly related to better global cognition, episodic memory, and perceptual speed with smaller parameter estimates, indicating the possible mediation effects of activity engagement. Model 6 examined the time interactions with activity engagement and neighborhood characteristics. In general, activity engagement and neighborhood cohesion were not associated with cognitive change, while there is evidence of the negative time interaction. That is, higher neighborhood cohesion was associated with faster decline in perceptual speed, and more engagement in reading activities was associated with faster decline in global cognition, suggesting that the cognitive effects leveled off with time from strong positive associations at baseline. We also found that neighborhood disorder was related to slower decline in global cognition, working memory, and C-MMSE, implying that negative effects of neighborhood disorder on cognitive function may taper off over time. In addition, the random effects (not shown in Table 3) were similar across models. All cognitive measures exhibited significant evidence of individual-level variation in the intercept and residual variances.

Based on preliminary results that neighborhood cohesion was associated with social activity and cognitive performance and that social activity was related to cognitive measures except working memory, we tested the mediation effect of social activity on the association of neighborhood cohesion with four cognitive measures. Results showed that there were significant indirect effects of neighborhood cohesion on cognition through social activity engagement, which accounted for about 32%, 28%, 27%, and 28% of the total effects on global cognition, episodic memory, perceptual speed, and C-MMSE, respectively (Table 4). After adding social activity in the models, neighborhood cohesion was still significantly associated with cognitive measures but with smaller parameter estimates (compared with Model 3 in Table 3), indicating partial mediation effects of social activity engagement.

Discussion

This study investigated the relationship of neighborhood characteristics and activity engagement with cognitive function in the largest population-based epidemiological study of the U.S. Chinese older adults. Findings showed that more activity engagement was associated with better baseline cognitive functioning independent of neighborhood characteristics and covariates. Neighborhood cohesion had both direct and indirect effects on cognitive functioning through social activity or informal social interaction, that is, respondents living in cohesive neighborhoods were more frequently engaged in social activities and had better cognitive function than those living in less cohesive neighborhoods.

Inconsistent with previous studies in general older populations, which documented that higher levels of perceived neighborhood danger were associated with lower cognitive function (e.g., Lee & Waite, 2018), our findings showed that neighborhood disorder did not matter that much. This is probably due to the differences in how disorder was measured and, perhaps more importantly, due to the differences in perceptions about observable and unobservable neighborhood conditions. Older residents, especially recent immigrants, may have restricted activity selections and social interactions to the immediate environment due to language barriers, social isolation, and declined health. In the PINE study, most respondents lived in Chinatown, a neighborhood with high co-ethnic density, and they reported a low level of neighborhood disorder, implying that few people perceived their neighborhood physically threatening or stressful. Using the PINE data, Lai and associates (2019) found that perceiving more neighborhood disorder was associated with a higher level of social engagement. They suggested that a co-ethnic residential pattern might serve as a potential exogenous factor that had simultaneous effects on perception about neighborhood and activity engagement and that a reversed relationship might exist. In other words, residents participating in more social activities tended to observe more neighborhood disorders relative to those spending more time at home (Lai et al., 2019). In addition, our findings indicated that neighborhood disorder may not indicate the lack of person–environment fit, while the subjectively experienced match between personal and environmental attributes might be a more important indicator.

The nonsignificant effect of SOC suggested that older Chinese immigrants may not develop an SOC that captures the relationship between the individual and the social structure. Older immigrants may actually be spatially and socially isolated, and ethnic enclaves are often characterized by lower levels of social cohesion and civic participation (Osypuk et al., 2009). Recent older immigrants may especially feel the loss of SOC to their primary communities and subsequently psychological distress, and it is not easy to establish connection with the host community due to language or cultural barriers. Further, informal social or leisure activities that aim at social connection and self-entertainment may not necessarily rely on an SOC. Besides, there may be measurement errors in the SOC index, which result in the lack of adequate psychometric properties or cultural relevance, thus compromising the association with cognitive function.

Consistent with the engagement hypothesis and previous research, we found that engagement in reading and social activities was cognitively beneficial and that playing games was beneficial to general mental status and perceptual speed. Playing games involving brain exercise tends to improve individuals' ability to search, compare, and identify objects and figures. As decline in perceptual speed performance starts in young adulthood, it may be more susceptible to influence from various activities (Ghisletta et al., 2006). Moreover, social activity engagement mediated the effects of neighborhood cohesion on general mental status, episodic memory, and perceptual speed, except working memory. Living in a cohesive neighborhood may enhance social activity, which further affects episodic memory (or verbal memory) and perceptual speed (or information processing) through increased social interactions and mental simulations. By contrast, working memory, or short-term memory tested through memorizing backward a series of strings of digits, may not depend on the interactions with others and the environments. This may also explain why neither neighborhood characteristics nor engagement in social leisure activities was associated with working memory in our study. Although the recall limit in digits is important, the recalls of letters and words are often used in previous research, which are missing in our study. Besides, working memory involves both storage and processing, central to language comprehension, problem-solving, and planning (Cowan, 2010). The use of digit recall may limit our assessment of this mental capacity and the associated individual and contextual factors.

We did not find the time effect of neighborhood cohesion and activity engagement, that is, they were not associated with cognitive decline, with some findings opposite to our hypothesis. The positive effects on baseline cognition may taper off over time, probably because a short observation period makes it challenging to document a stable trend. Also, potential risk factors of cognitive decline, such as cardiovascular diseases and lifestyle variables, may confound both activity engagement and cognition. In addition, older Chinese Americans may have restricted access to the complex environments with intellectually demanding activities that help maintain cognitive functioning due to spatial and social isolation. We speculate that the effects of routine activity participation may last to a certain time point, after which it may have null effect on daily functioning. Conversely, perceived neighborhood disorder was not related to baseline cognitive measures but to a slower decline in working memory and overall status. It might be possible that for older Chinese immigrants with limited outdoor activity opportunities, perceived neighborhood disorder may even encourage engagement in solitary activity that one does alone at home, like reading, thus further preventing cognitive decline. Our findings also imply that the impacts of neighborhood characteristics and underlying racial or residential segregation may vary by ethnic and geographic contexts. Although Chicago’s Chinatown is fairly segregated from other racial/ethnic groups, it may provide opportunities for in-group integration and support to meet older adults’ needs, which may compensate for the negative effects of physical environments over time. Ethnic concentration of Chinese older adults living in Chicago, one of the most racially segregated cities, may either buffer or intensify the deleterious effects of disadvantaged physical and social environments across different health indicators. For older immigrants who face barriers and challenges to access social resources, it seems that engagement in everyday activity is more accessible and practicable than volunteering and community work that require special skills, knowledge, and competencies. Given the potential of activity engagement in maintaining cognitive function, practice and policy efforts are needed to provide and develop activity-based intervention programs with the aim to promote cognitive health. As documented in the literature, such activities as reading and traveling were associated with slower rate of cognitive decline and reduced risk of dementia, especially in Asian older populations (Dodge et al., 2008). Culturally specific activities, such as mahjong and tai chi, could preserve functioning and delay decline in certain cognitive domains even in those with significant cognitive impairment, as shown in a study conducted in Hong Kong (Cheng et al., 2014). For Chinese older adults whose activity engagement is limited and conditional on acculturation and individual resources, their neighborhoods may play a critical role in providing resources for social integration and health promotion. In addition to relying on individual capacities and resources, community centers located in Chinese immigrant neighborhoods are in a position to address the needs of engaging in various activities through providing opportunities for culturally specific activities or events that are appealing to older immigrants. At a societal level, efforts are needed to build aging-friendly, cohesive neighborhoods that may enable older adults to actively engage in activities and promote overall well-being.

Several limitations need to be considered. Due to the lack of experimental design, we cannot establish the causal links of activity engagement and neighborhood characteristics with cognitive function. A reversed or reciprocal relationship may exist, that is, cognitive abilities may affect the degree to which older adults are engaging in life, and those with better cognitive function tend to be involved in more activities. Further, the observation period in this study was relatively short for detecting cognitive change or estimating accelerated decline. Cognitive function measured at two time points imposes restrictions on the statistical inferences that can be drawn from the study sample. A longer follow-up period will allow for detecting cognitive change trajectories and shed light on the full impacts of neighborhood characteristics and activity engagement. In addition, cognitive measures may be susceptible to the test–retest effects due to repeated testing over a relatively short study period. Cognitive tests with varying difficulty levels may be insensitive to further deterioration. Houx and associates (2002) suggested that repetitive measurements in screening instruments for general cognitive deterioration should not be used to follow up nondemented persons.

Although the PINE study provides the largest population-based epidemiological data for studying cognitive function in older Chinese Americans, the study findings are limited to the greater Chicago area, and our results cannot be generalized to older Chinese populations in other geographic areas. In addition, attrition over time might be selective, leaving a relatively healthy sample of respondents; and exclusion of those with incomplete data may lead to biased findings and amplify the healthy participation effects. Besides, a couple of limitations on measurement need acknowledgment. The PINE study asked about a limited number of activities while ignoring another broad set of activities, that is, productive activities such as paid work, volunteering, and physical activity. What is also missing is the length of participation in each activity type. Through factor analysis, we identified several activity domains which may share similarities, for example, games may also be characterized as social leisure activities. The summary scores of activity items gave the same weight to all items included, with the assumption that all activities are equally cognitively demanding, yet there are differences in the amount of intellectual simulation needed for each type of activity engagement. Future research needs to apply more rigorous and person-centered approaches (e.g., latent class analysis) to examine the complex, multidimensional, and dynamic nature of activity participation (Morrow-Howell et al., 2014). Finally, we lacked the data on objective indicators of the immediate social and physical contexts, such as neighborhood socioeconomic status, residential homogeneity or proportion of foreign-born immigrants, and other minority groups. The person–environment fit measures need to include both objective and subjective perspectives and to compare individual’s physical and mental capacity against environmental characteristics or demands (Mejia et al., 2017).

Despite these limitations, our findings speak to the importance of engagement in daily leisure activities and neighborhood cohesion for cognitive maintenance among the U.S. Chinese older adults. Engagement in everyday activities, such as reading and spending time with friends, is essential to maintain cognitive function. Improving neighborhood cohesion may directly and indirectly influence cognitive health by facilitating activity engagement, especially informal social interactions among older adults. Active engagement with life and living in a cohesive environment are particularly important to older immigrants who have experienced acculturative stress and social isolation. Future research is needed to investigate the longitudinal, preventive effects of activity engagement patterns and contextual factors, the complex interplay between activity engagement and living environments, and the causal mechanisms underlying the link between environment and cognition.

Funding

The study was supported by National Institute on Aging Grants R01AG042318 and R01AG067548.

Author Biographies

Fengyan Tang is a professor in the School of Social Work at University of Pittsburgh. Her studies focus on social engagement and associated well-being outcomes in later life.

Wei Zhang is a professor in the Department of Sociology at the University of Hawai'i at Manoa. Her research focuses on medical sociology, aging, religion and health, and methodology.

Iris Chi is the Chinese-American Golden Age Association/Frances Wu chair for the Chinese Elderly at the University of Southern California, Suzanne Dworak-Peck School of Social Work and a senior scientist at the USC Edward R. Roybal Institute on Aging. An expert in health and gerontology. She has participated in more than 100 studies and published over 300 articles and book chapters.

Mengting Li is a visiting research associate in the School of Nursing Rutgers University at Rutgers University. Her research area includes intersection of culture, social relations and health, elder mistreatment, family caregiving, and intergenerational relations.

Xin Qi Dong is the director of the Institute for Health, Health Care Policy, and Aging Research (IFH) at Rutgers University and the inaugural Henry Rutgers distinguished professor of Population Health Sciences. He has published extensively on the topics of violence prevention with more than 220 peer-reviewed publications and is leading a longitudinal epidemiological study - The PINE Study.

References

Baron RM, & Kenny DA (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173. [PubMed: 3806354]

Bath PA, & Deeg D (2005). Social engagement and health outcomes among older people: Introduction to a special section. European Journal of Ageing, 2, 24–30. [PubMed: 28794713]

Bielak AA (2010). How can we not "lose it" if we still don't understand how to "use it"? Unanswered questions about the influence of activity participation on cognitive performance in older age—A mini-review. Gerontology, 56, 507–519. [PubMed: 19996570]

Bielak AA, Anstey KJ, Christensen H, & Windsor TD (2012). Activity engagement is related to level, but not change in cognitive ability across adulthood. Psychology and Aging, 27, 219. [PubMed: 21806303]

Bourassa KJ, Memel M, Woolverton C, & Sbarra DA (2017). Social participation predicts cognitive functioning in aging adults over time: Comparisons with physical health, depression, and physical activity. Aging and Mental Health, 21, 133–146. [PubMed: 26327492]

Brewer MB, & Chen YR (2007). Where (who) are collectives in collectivism? Toward conceptual clarification of individualism and collectivism. Psychological Review, 114, 133. [PubMed: 17227184]

Cagney KA, Glass TA, Skarupski KA, Barnes LL, Schwartz BS, & Mendes de Leon CF (2009). Neighborhood-level cohesion and disorder: Measurement and validation in two older adult urban populations. Journals of Gerontology: Social Sciences, 64, 415–424.

Cassarino M, & Setti A (2015). Environment as “brain training”: A review of geographical and physical environmental influences on cognitive ageing. Ageing Research Reviews, 23, 167–182. [PubMed: 26144974]

Cheng ST, Chow PK, Song YQ, Edwin CS, Chan AC, Lee TM, & Lam JH (2014). Mental and physical activities delay cognitive decline in older persons with dementia. The American Journal of Geriatric Psychiatry, 22, 63–74. [PubMed: 23582750]

Chiu HF, Lee HC, Chung WS, & Kwong PK (1994). Reliability and validity of the Cantonese version of mini-mental state examination—A preliminary study. Hong Kong Journal of Psychiatry, 4, 25.

Cowan N (2010). The magical mystery four: How is working memory capacity limited, and why? Current Directions in Psychological Science, 19, 51–57. [PubMed: 20445769]

Dodge HH, Kita Y, Takechi H, Hayakawa T, Ganguli M, & Ueshima H (2008). Healthy cognitive aging and leisure activities among the oldest old in Japan: Takashima study. The Journals of Gerontology: Medical Sciences, 63, 1193–1200.

Dong X, Wong E, & Simon MA (2014). Study design and implementation of the PINE study. Journal of Aging and Health, 26, 1085–1099. [PubMed: 24667107]

Field A (2000). Discovering statistics using SPSS for windows. SAGE.

Ghisletta P, Bickel J-F, & Lövdén M (2006). Does activity engagement protect against cognitive decline in old age? Methodological and analytical considerations. The Journals of Gerontology: Psychological Sciences, 61, P253–P261.

Horgas AL, Wilms HU, & Baltes MM (1998). Daily life in very old age: Everyday activities as expression of successful living. The Gerontologist, 38, 556–568. [PubMed: 9803644]

Houx PJ, Shepherd J, Blauw GJ, Murphy MB, Ford I, Bollen EL, Buckley B, Stott DJ, Jukema W, Hyland M, Gaw A, Norrie J, Kamper AM, Perry IJ, MacFarlane IJ, Edo Meinders A, Sweeney BJ, Packard CJ, Twomey C, Cobbe SM, Westendorp RG, & Gaw A (2002). Testing cognitive function in elderly populations: The PROSPER study. Journal of Neurology, Neurosurgery, and Psychiatry, 73, 385–389. [PubMed: 12235304]

James BD, Wilson RS, Barnes L, & Bennett DA (2011). Late-life social activity and cognitive decline in old age. Journal of the International Neuropsychological Society, 17, 998–1005. [PubMed: 22040898]

Kuiper JS, Zuidersma M, Voshaar RCO, Zuidema SU, van den Heuvel ER, Stolk RP, & Smidt N (2015). Social relationships and risk of dementia: A systematic review and meta-analysis of longitudinal cohort studies. Ageing Research Reviews, 22, 39–57. [PubMed: 25956016]

Lai D, Li J, Lee V, & Dong X (2019). Environmental factors associated with Chinese older immigrants’ social engagement. Journal of American Geriatrics Society, 67, S571–S576.

Lawton MP (1983). Environment and other determinants of wellbeing in older people. The Gerontologist, 23, 349–357. [PubMed: 6352420]

Lee H, & Waite LJ (2018). Cognition in context: The role of objective and subjective measures of neighborhood and household in cognitive functioning in later life. The Gerontologist, 58, 159–169. [PubMed: 28666359]

Li LW, Ding D, Wu B, & Dong X (2017). Change of cognitive function in U.S. Chinese older adults: A population-based study. Journals of Gerontology: Medical Sciences, 72, S5–S10.

McMillan DW, & Chavis DM (1986). Sense of community: A definition and theory. Journal of Community Psychology, 14, 6–23.

Mejía ST, Ryan LH, Gonzalez R, & Smith J (2017). Successful aging as the intersection of individual resources, age, environment, and experiences of well-being in daily activities. Journals of Gerontology: Social Sciences, 72, 279–289.

Morrow-Howell N, Putnam M, Lee YS, Greenfield JC, Inoue M, & Chen H (2014). An investigation of activity profiles of older adults. Journals of Gerontology: Social Sciences, 69, 809–821.

Nowell B, & Boyd N (2010). Viewing community as responsibility as well as resource: Deconstructing the theoretical roots of psychological sense of community. Journal of Community Psychology, 38, 828–841.

Osypuk TL, Roux AVD, Hadley C, & Kandula NR (2009). Are immigrant enclaves healthy places to live? The multi-ethnic study of atherosclerosis. Social Science & Medicine, 69, 110–120. [PubMed: 19427731]

Perkins DD, Florin P, Rich RC, Wandersman A, & Chavis DM (1990). Participation and the social and physical environment of residential blocks: Crime and community context. American Journal of Community Psychology, 18, 83–115.

Pretty GH, Chipuer HM, & Bramston P (2003). Sense of place amongst adolescents and adults in two rural Australian towns: The discriminating features of place attachment, sense of community and place dependence in relation to place identity. Journal of Environmental Psychology, 23, 273–287.

Seltman HJ (2018). Experimental design and analysis. https://www.stat.cmu.edu/~hseltman/309/Book/Book.pdf

Stine-Morrow EA, Parisi JM, Morrow DG, Greene J, & Park DC (2007). An engagement model of cognitive optimization through adulthood. The Journals of Gerontology: Social Sciences, 62, 62–69.

Tang F, Chi I, Xu L, & Dong X (2018). Exploring relationships of psychological sense of community with self-rated health and depressive symptoms among older Chinese Americans. Gerontology and Geriatric Medicine. 10.1177/2333721418778183

Tang F, Chi I, Zhang W, & Dong X (2018). Activity engagement and cognitive function: Findings from a community-dwelling U.S. Chinese aging population study. Gerontology and Geriatric Medicine. 10.1177/2333721418778180

Tang F, Xu L, Chi I, & Dong X (2017). Health in the neighborhood and household contexts among older Chinese Americans. Journal of Aging and Health, 29, 1388–1409. [PubMed: 27481932]

U.S. Census Bureau. (2016). Asian American data links. www.census.gov/about/partners/cic/resources/data-links/asian.html

Van Cauwenberg J, De Donder L, Clarys P, De Bourdeaudhuij I, Buffel T, De Witte N, Dury S, Verté D, & Deforche B (2014). Relationships between the perceived neighborhood social environment and walking for transportation among older adults. Social Science & Medicine, 104, 23–30. [PubMed: 24581058]

Vaughan M, LaValley MP, AlHeresh R, & Keysor JJ (2016). Which features of the environment impact community participation of older adults? A systematic review and meta-analysis. Journal of Aging and Health, 28, 957–978. [PubMed: 26578546]

Wahl HW, Iwarsson S, & Oswald F (2012). Aging well and the environment: Toward an integrative model and research agenda for the future. The Gerontologist, 52, 306–316. [PubMed: 22419248]

Wahl HW, & Oswald F (2010). Environmental perspectives on ageing. In Dannefer D (Ed.), The SAGE handbook of social gerontology (pp. 111–124). Sage Publications.

Woo BK (2017). Dementia health promotion for Chinese Americans. Cureus, 9, e1411. [PubMed: 28856076]

Wu YT, Prina AM, & Brayne C (2015). The association between community environment and cognitive function: A systematic review. Social Psychiatry and Psychiatric Epidemiology, 50, 351–362. [PubMed: 25087013]

Zhang W, Liu S, Sun F, & Dong X (2019). Neighborhood social cohesion and cognitive function in U.S. Chinese older adults—Findings from the PINE study. Aging and Mental Health, 23, 1113–1121. 10.1080/13607863.2018.1480705 [PubMed: 30518241]

Table 1.

Activity Items, Domains, and Factor Loadings at Baseline.

Activity Domain (Factor)	Activity Item	Factor Loading	Frequency (%) [a]
Reading	Time spent on reading each day	.87	428 (13.7)
	Frequency of reading newspaper	.83	1,436 (45.6)
	Frequency of reading magazines	.78	460 (14.6)
	Frequency of reading books	.72	589 (18.7)
Social activity	Frequency of having friends or relatives for a dinner or a party	.77	227 (7.2)
	Frequency of going out to a movie, restaurant, or sporting event	.69	83 (2.6)
	Frequency of visiting relatives, friends, or neighbors	.66	234 (7.4)
Games	Frequency of playing mahjong	.72	130 (4.1)
	Frequency of playing games (e.g., cards, checkers, crosswords)	.73	97 (3.1)

Note. N = 2,713.

[a]Frequency (%) was reported for the highest level choice, that is, everyday or almost everyday, 2 or more hours each day (times on reading).

Table 2.

Sample Descriptive of the PINE Study at Baseline.

Characteristics (Range)	**Mean ± *SD*/%**
Cognitive tests	
C-MMSE (0–30)	25.42 ± 4.53
EBMT (0–11)	7.47 ± 2.70
EBDR (0–11)	7.04 ± 2.99
SDMT (0–80)	29.71 ± 11.96
DB (0–12)	5.03 ± 2.38
Activity engagement	
Reading (0–17)	7.13 ± 5.10
Social (0–12)	4.44 ± 2.40
Games (0–8)	0.83 ± 1.54
Perceived neighborhood characteristics	
Neighborhood cohesion (−1.1 to 2.8)	.03 ± . 78
Neighborhood disorder (0–22)	4.08 + 4.09
SOC (19–58)	40.89 ± 5.36
Sociodemographics	
Age (59–103)	72.81 ± 8.30
Education (0–26)	8.71 ± 5.05
Income (1–10)	1.93 ± 1.11
Self-rated good, very good health (0–1)	38.74%
Years living in neighborhood (0.1–63)	12.05 ± 10.86
Years living in the United States (0.1–90)	20.02 ± 13.18
Female (0–1)	57.97%
Married (0–1)	70.93%

Note. N = 2,713. C-MMSE = Chinese Mini-Mental State Examination; EBDR = East Boston Memory Test–Delayed Recall; EBMT = East Boston Memory Test–Immediate Recall; SDMT = Symbol Digit Modalities Test; DB = Digit Span Backwards; PINE = Population Study of Chinese Elderly; SOC = sense of community. Global cognition was a summary of z-scored five cognitive tests. Episodic memory was a summary of EBMT and EBDR. Perceptual speed and working memory were from SDMT and DB, respectively.

Table 3.

Fixed Effects of Associations of Activity Engagement and Neighborhood Characteristics With Cognitive Measures.

Models	Global Cognition Estimate (*t*)	Episodic Memory Estimate (*t*)	Working Memory Estimate (*t*)	Perceptual Speed Estimate (*t*)	C-MMSE Estimate (*t*)
Model 1					
Intercept	−0.01 (−.87)	−0.02 (−1.01)	5.05 (109.4)***	19.88 (106.2)***	25.54 (279.1)***
Time	−0.04 (−6.68)***	−0.01 (−1.06)	−0.13 (−6.46)***	0.01 (0.08)	−0.42 (−11.92)***
Model 2					
Intercept	−1.06 (−23.78)***	−1.06 (−16.71)***	3.81 (23.22)***	21.14 (21.78)***	25.09 (103.3)****
Time	−0.02 (−4.07)***	0.01 (0.78)	−0.11 (−5.50)***	0.10 (0.82)	−0.42 (−20.26)***
Age	−0.02 (−18.05)***	−0.02 (−13.60)***	−0.03 (−5.96)***	−0.48 (−16.99)***	−0.19 (−20.26)***
Female	−0.01 (−0.71)	0.08 (3.04)**	−0.29 (−3.85)***	−0.65 (−1.57)	−0.53 (−3.64)***
Education	0.07 (34.18)***	0.06 (21.07)***	0.21 (28.29)***	1.06 (25.95)****	0.39 (28.26)***
Income	0.04 (3.87)***	0.02 (1.68)	0.11 (3.46)***	0.88 (4.77)***	0.05 (0.78)
Married	0.03 (1.38)	0.03 (0.79)	0.09 (0.99)	−0.09 (−0.18)	0.35 (2.08)*
Self-rated health	0.07 (3.63)***	0.10 (4.04)***	0.08 (1.11)	0.89 (2.26)*	0.35 (2.53)*
Years in neighborhood	−0.00 (−0.75)	−0.01 (−2.34)*	0.00 (0.04)	−0.02 (−0.77)	0.02 (2.04)*
Years in United States	0.00 (1.26)	0.00 (2.39)*	−0.00 (−0.75)	0.02 (0.81)	0.01 (1.26)
Previous C-MMSE	1.02 (33.31)***	0.98 (21.03)***	1.31 (11.51)***	7.76 (11.05)***	—
Model 3					
Intercept	−1.03 (−22.96)***	−1.03 (−16.02)***	3.86 (23.07)***	21.04 (21.53)***	25.17 (103.3)***
Time	−0.02 (−4.03)***	0.01 (0.85)	−0.11 (−5.72)***	0.12 (0.92)	−0.41 (−11.64)***
Neighborhood cohesion	0.06 (4.68)***	0.08 (4.48)***	0.04 (0.79)	1.25 (4.47)***	0.32 (3.22)**
Neighborhood disorder	−0.00 (−0.86)	−0.00 (−0.57)	−0.01 (−1.15)	−0.08 (−1.78)	0.03 (1.76)
SOC	−0.00 (−0.66)	−0.00 (−0.65)	−0.01 (−1.33)	−0.05 (−1.09)	0.03 (2.00)*
Model 4					
Intercept	−1.03 (−23.88)***	−1.03 (−16.32)***	3.88 (23.86)***	21.85 (22.92)***	24.88 (106.7)***
Time	−0.02 (−4.25)***	0.01 (0.66)	−0.12 (−5.69)***	0.08 (0.63)	−0.42 (−11.78)***
Reading	0.03 (13.07)***	0.03 (8.47)***	0.07 (8.66)***	0.40 (8.92)***	0.21 (14.02)***

Models	Global Cognition Estimate (*t*)	Episodic Memory Estimate (*t*)	Working Memory Estimate (*t*)	Perceptual Speed Estimate (*t*)	C-MMSE Estimate (*t*)
Social activity	0.02 (5.68)***	0.03 (5.26)***	0.02 (1.52)	0.31 (3.83)***	0.12 (4.43)***
Games	0.00 (0.99)	−0.01 (−1.21)	0.02 (0.98)	0.43 (3.39)***	0.12 (3.10)**
Model 5					
Intercept	−1.02 (23.14)***	−1.01 (−15.77)***	3.91 (23.63)***	21.63 (22.46)***	24.93 (106.2)***
Time	−0.02 (−4.18)***	0.01 (0.75)	−0.12 (−5.89)***	0.10 (0.74)	−0.41 (−11.62)***
Neighborhood cohesion	0.03 (1.99)*	0.05 (2.63)**	−0.04 (−0.83)	0.67 (2.37)*	0.04 (0.39)
Neighborhood disorder	−0.00 (−0.42)	−0.00 (−0.25)	−0.00 (−0.80)	−0.07 (−1.58)	0.04 (2.29)*
SOC	−0.00 (−1.04)	−0.00 (−0.88)	−0.01 (−1.53)	−0.06 (−1.41)	0.02 (0.39)
Reading	0.03 (12.61)***	0.02 (7.99)***	0.07 (8.73)***	0.38 (8.39)***	0.21 (13.39)***
Social activity	0.02 (5.12)***	0.03 (4.62)***	0.03 (1.94)	0.28 (3.34)**	0.10 (3.60)***
Games	0.00 (0.93)	−0.01 (−1.41)	0.03 (1.27)	0.44 (3.72)***	0.12 (2.78)**
Model 6					
Cohesion × Time	−0.02 (−1.83)	−0.05 (−0.86)	0.00 (0.06)	−0.51 (−2.65)**	−0.07 (1.34)
Disorder × Time	0.01 (4.42)***	−0.01 (−0.63)	0.02 (3.02)**	0.04 (1.29)	0.02 (2.59)**
SOC × Time	0.00 (1.71)	−0.01 (−0.63)	−0.00 (−0.27)	0.03 (0.92)	−0.01 (−1.51)
Reading × Time	−0.00 (−2.92)**	−0.00 (−1.16)	0.00 (0.21)	−0.01 (−0.44)	0.01 (1.45)
Social × Time	−0.00 (−1.41)	−0.03 (−0.179)	−0.01 (−1.09)	−0.04 (−0.74)	0.03 (1.87)
Games × Time	0.00 (0.01)	−0.02 (−0.77)	−0.00 (−0.26)	0.10 (1.18)	−0.03 (−1.23)

Note. Models 3–6 controlled for time, and associations of sociodemographic and health variables with the intercept. C-MMSE = Chinese Mini-Mental State Examination; SOC = sense of community.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4.

Mediation Models of Social Activity on Neighborhood Cohesion to Cognitive Measures.

Independent Variables	Mediator Variables	Dependent Variables	*B* (*SE*)	Indirect Effect	Total Effect	% of Total Effect That Is Mediated	Sobel Test
				.02	0.06	.32	5.61***
Cohesion→	Social activity		0.06 (.01)***				
Cohesion→		Global cognition	0.04 (.01)***				
	Social activity→	Global cognition	0.03 (.00)***	.02	0.08	.28	4.72***
Cohesion→	Social activity		0.08 (.02)***				
Cohesion→		Episodic memory	0.06 (.02)***				
	Social activity→	Episodic memory	0.03 (.01)***	.30	1.11	.27	4.37***
Cohesion→	Social activity		1.12 (.25)***				
Cohesion→		Perceptual speed	0.81 (.26)**				
	Social activity→	Perceptual speed	0.39 (.08)***	.12	0.44	.28	4.94***
Cohesion→	Social activity		0.43 (.09)***				
Cohesion→		C-MMSE	0.32 (.09)***				
	Social activity→	C-MMSE	0.16 (.03)***				

Note. C-MMSE = Chinese Mini-Mental State Examination.

* $p < .05$.

** $p < .01$.

*** $p < .001$.