

Association Between Social Participation and Cognitive Decline Among Middle-Aged and Older Chinese Community-Dwelling Adults: Insights from the China Health and Retirement Longitudinal Study (CHARLS)

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Abstract

Background

Cognitive impairment is a growing public health concern globally. Early identification of risk factors for cognitive decline is critical for delaying and preventing its onset. Alongside physical activity, social engagement represents a key component of healthy aging among middle-aged and older adults.

Methods

This study utilized data from the China Health and Retirement Longitudinal Study (CHARLS), including 12,171 participants. Baseline social participation was recorded, and cognitive function was assessed using z-scores calculated at baseline and follow-up. Cognitive decline was defined as a negative change in z-scores between the two time points. Statistical analyses were conducted using SPSS, with significance set at $p < 0.05$.

Results

Baseline cognition z-scores were significantly positively associated with social participation ($\beta = 0.119$, $p < 0.001$), and follow-up z-scores showed a similar positive association ($\beta = 0.060$, $p < 0.001$). Conversely, a decline in delta z-scores was negatively associated with social participation ($\beta = -0.067$, $p < 0.001$). Besides, a significant association was observed between overall social participation and cognitive decline (OR = 0.795, 95% CI: 0.728–0.869, $p < 0.001$). Additionally, interacting with friends also showed a significant relationship with cognitive decline (OR = 0.809, 95% CI: 0.739–0.886, $p < 0.001$).

Conclusion

This study highlights a significant relationship between social participation and cognitive decline among Chinese adults. Social participation appears to play a protective role in maintaining cognitive function and mitigating decline. Further research is warranted to confirm these findings and explore the mechanisms.

Introduction

With the rapid increase in population aging, cognitive impairment has emerged as a major public health concern worldwide(1). Studies report that in those aged ≥ 60 years, over 15% had mild cognitive impairment(2), and 6.0% and 3.9% had dementia and Alzheimer's disease, respectively(3, 4). Early mild cognitive impairment (MCI) often develops into more severe forms of cognitive decline, including dementia, which amplifies its impact on both individuals and society(5). Early identification of potential risk factors for cognitive decline is essential to delay and prevent the onset of cognitive impairment(6).

Currently, effective curative treatments for dementia or MCI remain limited, highlighting the importance of epidemiological research in identifying potential modifiable risk factors(7). Many evidence have shown that physical exercise positively affects brain plasticity, influencing cognition and overall wellbeing(8). Physical activity has been demonstrated to enhance cognitive function by promoting hippocampal plasticity through mechanisms involving neurotransmitters such as insulin-like growth factor and brain-derived neurotrophic factor, which in turn improve memory performance(9, 10).

In addition to physical activity, social engagement is a vital component of life in middle-aged and older adults. The relationship between social participation and cognitive function remains controversial, and a longitudinal study have found no positive effect of social participation on cognitive decline(11). Although studies on the link between social relationships and physical functioning in middle-aged and older adults have shown mixed results(12). There is limited research focusing on the role of social engagement in cognitive health. While previous studies have examined the relationship between social isolation and frailty(13). However, to the best of our knowledge, few studies have specifically explored the impact of social activities on cognitive decline, particularly within the context of longitudinal studies involving Chinese populations. This gap in the literature warrants further investigation to better understand the potential role of social engagement in mitigating cognitive decline.

Therefore, this study aims to establish a longitudinal cohort to investigate the relationship between social activities and cognitive decline in Chinese middle-aged and older adults. By identifying key risk factors for cognitive impairment, this research seeks to provide new strategies for preventing cognitive decline, ultimately contributing to more effective methods for delaying or preventing cognitive deterioration in the middle-aged and older adults

Methods

Study Participants

Data for this study were derived from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative longitudinal survey of Chinese individuals aged 45 years and older. The CHARLS aims to collect high-quality microdata representing households and individuals aged 45 and above across China to facilitate analysis of the aging population and support interdisciplinary research on aging, including assessments of the social, economic, and health status of community residents(14). The sample includes over 17,000 individuals from around 10,000 households across 450 villages, 150 counties, and 28 provinces. The datasets are available for download on the CHARLS homepage (<http://charls.pku.edu.cn/en>). The survey project was approved by the Biomedical Ethics Committee of Peking University, and all participants provided informed consent.

This study utilized data from the first (2011) and third (2015) waves of CHARLS. Participants were excluded based on the following criteria: (1) missing information on cognitive function at baseline or follow-up, (2) missing information on social participation, (3) self-reported cognitive impairment at

baseline, and (4) age below 45 years or missing age information. 12,171 participants in all were included in the final analysis following the application of these exclusion criteria (Fig. 1).

Social participation

In each survey wave, participants reported their engagement in various social activities over the past month, including whether they: (1) interacted with friends; (2) played Mahjong, chess, or cards, or attended a community club; (3) provided unpaid assistance to family, friends, or neighbors who did not live with them; (4) attended a sports, social, or other club; (5) participated in a community-related organization; (6) engaged in voluntary or charity work; (7) cared for a sick or disabled adult who did not live with them and did not pay for assistance; (8) attended an educational or training course; (9) invested in stocks; (10) used the Internet; and (11) engaged in other activities(15). Additionally, social participation was handled as a binary variable, where 0 denoted no activity and 1 denoted involvement in at least one activity(15, 16).

Assessment of Cognitive Decline

Cognitive function was evaluated in two dimensions: episodic memory and executive function. Episodic memory was assessed through immediate and delayed word recall, each scored from 0 to 10 points. Executive function, measured using the Telephone Interview of Cognitive Status (TICS) battery, comprised three components: orientation (0–5 points), requiring participants to state the current date (month, day, year, season) and day of the week; visuoconstruction (0–1 point), testing the ability to replicate a presented figure; and attention (0–5 points), assessed by repeated subtraction of 7 from 100. The total cognitive function score, ranging from 0 to 31, was calculated by summing the scores from these two dimensions, with higher scores reflecting better performance(17).

To facilitate comparisons across tests, raw cognitive scores were standardized to z-scores by subtracting the baseline mean and dividing by the baseline standard deviation (SD). Positive z-scores indicated performance above the population mean, while negative values suggested below-average performance. Cognitive decline was defined as a negative change in z-scores between baseline and follow-up(18). Standardized z-scores were used throughout the study as a continuous measure of cognitive function.

Covariates

Baseline data were collected by trained interviewers using standardized questionnaires. These included demographic variables such as age, sex, marital status, and education level, which was categorized into illiteracy, elementary school, middle school, high school and above(19). Standardized procedures were used to measure height and weight, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Health-related factors were assessed through self-reported

smoking and drinking behaviors, as well as physician-diagnosed medical conditions, including hypertension, diabetes, dyslipidemia, lung disease, heart disease, stroke, arthritis, and cancer.

Statistical analysis

The baseline characteristics of our sample were divided by gender, and further analyses were conducted to examine these characteristics in relation to cognitive decline at follow-up. Continuous variables were expressed as mean $\pm$ standard deviation; skewed continuous variables were expressed as median and quartile; and classified variables were expressed as a percentage (%). Comparisons between two different groups performed using the Chi-square test for categorical variables, Kruskal-Wallis test for skewed continuous variables and t test for normally distributed continuous variables.

Linear regression was used to assess the relationship between the number of social activities and cognitive decline, while logistic regression analyzed the associations between cognitive function and social participation. Covariates controlled for in the regression models included variables significantly different between groups and sociodemographic factors such as age, gender, BMI, education level, rural residence, marital status, smoking, drinking, and history of hypertension, diabetes, heart disease or stroke. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 29.0 (IBM Corp, Armonk, New York), with a significance level set at $P < 0.05$.

Results

Characteristics at Baseline

A total of 12,171 participants were included in the final analysis. As shown in Table 1, male participants were older ($p < 0.001$) and had a higher BMI compared to female participants ($p < 0.001$). Significant differences were observed in the living environment ($p = 0.031$) and education level between genders ($p < 0.001$). Male participants were also more likely to have smoking and drinking habits ($p < 0.001$). In contrast, male participants demonstrated higher cognitive function scores than female ($p < 0.001$). On the other hand, female participants were more likely to have hypertension ($p < 0.001$), diabetes ($p = 0.002$), hyperlipidemia ($p = 0.011$), heart disease ($p < 0.001$), arthritis ($p < 0.001$), and even cancer ($p = 0.016$). Additionally, male participants had a higher prevalence of chronic obstructive lung disease at baseline ($p < 0.001$).

Table 1
Baseline characteristic according to gender.

Characteristic	Male (5,732)	Female (6,439)	P value
Age (y)	58.75 ± 8.74	57.85 ± 8.87	< 0.001
BMI (kg/m ²)	22.93 ± 3.32	23.95 ± 3.77	< 0.001
Rural (%)	64.5(3695)	62.6(4029)	0.031
Education Level			< 0.001
Illiteracy (%)	11.4(656)	41.1(2644)	
Elementary school (%)	45.9(2633)	35.9(2311)	
Middle school (%)	26.9(1543)	15.7(1010)	
High school and high school above (%)	15.7(900)	7.4(474)	
Married (%)	91.6(5250)	85.9(5533)	< 0.001
Smoking (%)	59.2(3394)	5.8(375)	< 0.001
Drinking (%)	57.1(3274)	11.8(758)	< 0.001
Participant in social activities (%)	51.4(2947)	49.5(3190)	0.039
Cognitive score	14.33 ± 5.15	12.17 ± 5.95	< 0.001
Medical Conditions			
Hypertension (%)	23.0(1318)	26.6(1713)	< 0.001
Diabetes (%)	5.1(295)	6.6(425)	0.002
Dyslipidemia (%)	9.0(516)	10.4(668)	0.011
Lung disease (%)	11.3(645)	7.6(488)	< 0.001
Heart disease (%)	9.8(559)	13.3(857)	< 0.001
Stroke (%)	2.3(129)	1.9(122)	0.168
Arthritis (%)	28.5(1633)	38.7(2486)	< 0.001
Cancer (%)	0.6(36)	1.0(66)	0.016
BMI: Body mass index.			

Association between Covariates and Cognitive Decline

Participants were further categorized based on the presence of cognitive decline at follow-up (Table 2). The analysis revealed that older age was strongly associated with a higher risk of cognitive decline ($p <$

0.001). BMI also correlated significantly with cognitive decline ($p < 0.001$), while rural residency was linked to a greater susceptibility to adverse cognitive outcomes ($p < 0.001$). Additionally, lower educational attainment was associated with an increased risk of cognitive decline ($p < 0.001$). On the other hand, married participants were less likely to experience cognitive decline ($p < 0.001$). Conversely, participants with a history of heart disease or stroke at baseline were more likely to exhibit cognitive decline during follow-up ($p = 0.028$).

Table 2
Baseline characteristic according to whether cognitive decline at follow-up.

Characteristic	Normal (9,025)	Decline (3,146)	P
Age (y)	57.77 ± 8.63	59.71 ± 9.21	< 0.001
BMI (kg/m ²)	23.54 ± 3.61	23.25 ± 3.58	< 0.001
Female (%)	53.1(4795)	52.3(1644)	0.398
Rural (%)	62.4(5628)	66.6(2096)	< 0.001
Education Level			< 0.001
Illiteracy (%)	25.1(2263)	33.0(1037)	
Elementary school (%)	40.5(3658)	40.9(1286)	
Middle school (%)	22.1(1998)	17.6(555)	
High school and high school above (%)	12.3(1106)	8.5(268)	
Married (%)	89.3(8059)	86.6(2724)	< 0.001
Smoking (%)	30.7(2773)	31.7(996)	0.326
Drinking (%)	33.4(3014)	32.4(1018)	0.287
Participant in social activities (%)	49.5(4470)	53.0(1667)	< 0.001
Medical Conditions			
Hypertension (%)	24.6(2220)	25.8(811)	0.187
Diabetes (%)	5.8(520)	6.1(192)	0.483
Dyslipidemia (%)	10.0(905)	8.9(279)	0.059
Lung disease (%)	9.3(834)	9.5(299)	0.691
Heart disease (%)	12.0(1084)	10.6(332)	0.028
Stroke (%)	1.9(171)	2.5(80)	0.028
Arthritis (%)	34.0(3066)	33.5(1053)	0.596
Cancer (%)	0.8(72)	1.0(30)	0.409
BMI: Body mass index.			

Association of Social Participation and Cognition Decline

This study further explored the relationship between cognitive scores and social activity. Table 3 summarizes the results of linear regression analyses for baseline, follow-up, and cognitive decline variables in relation to cognitive function. In Model 1, baseline cognition z-scores were significantly

positively associated with social participation ($\beta = 0.177, p < 0.001$), and follow-up z-scores showed a similar positive association ($\beta = 0.134, p < 0.001$). Conversely, a decline in delta z-scores was negatively associated with social participation ($\beta = -0.049, p < 0.001$).

Table 3

Linear regression of social activity with baseline cognition, follow-up cognition, and cognitive decline.

	Model 1		Model 2	
	β	P	β	P
Baseline z	0.177	< 0.001	0.119	< 0.001
Follow-up z	0.134	< 0.001	0.06	< 0.001
Decline delta z	-0.049	< 0.001	-0.067	< 0.001
Model 1: no adjusted. Model 2: adjusted for age, gender, BMI, educational level, rural, married, smoking, drinking, hypertension, diabetes, heart disease, stroke.				

In Model 2, after adjusting for additional covariates, these trends remained consistent. Baseline z-scores maintained a positive association with social participation ($\beta = 0.119, p < 0.001$), as did follow-up z-scores ($\beta = 0.060, p < 0.001$). Similarly, the negative association between delta z-scores and social participation persisted ($\beta = -0.067, p < 0.001$). These findings indicate that cognitive scores at both baseline and follow-up were significantly associated with social activity participation.

Association Between Types of Social Participation and Cognitive Decline

We further conducted logistic regression analyses to examine the relationship between each type of social activity and cognitive decline (Fig. 2). After adjusting for multiple factors, a significant association was observed between overall social participation and cognitive decline (OR = 0.795, 95% CI: 0.728–0.869, $p < 0.001$). Additionally, interacting with friends also showed a significant relationship with cognitive decline (OR = 0.809, 95% CI: 0.739–0.886, $p < 0.001$).

Discussion

Our study explored the relationships between cognitive function and participation in social activities among Chinese middle-aged and older adults. By establishing a longitudinal cohort, we identified significant associations between baseline and follow-up cognitive decline and engagement in social activities. These results suggest that, in addition to physical activity, participation in social activities may serve as a crucial strategy to prevent cognitive decline in middle-aged and older adults.

Consistent with existing research, our findings demonstrate that social participation plays a vital role in maintaining cognitive health. Similar to physical activity, social engagement provides cognitive stimulation, emotional support, and access to health-related information, all of which help slow cognitive

decline. Participating in diverse social groups offers individuals opportunities to access various material resources or health-related information, which further supports cognitive health(20, 21). According to a comprehensive study, there is early evidence that physical activity may enhance Chinese older individuals' cognitive performance(22). Being active may therefore support the maintenance of normal cognitive function in older individuals. Engaging with others can help older people retain or grow their social network. According to studies, having a large social network appears to help against dementia(23). Older adults with extensive social connections are more likely to gain access to diverse material resources or information regarding their health(21), potentially encouraging healthier behaviors and reducing the risk of cognitive decline. Furthermore, regular contact with friends can enhance emotional well-being and provide a stronger sense of purpose, both of which are associated with neurohormonal benefits that directly support brain health(24). Recent research examining the causal relationship between cognition and social participation reinforces our findings. The study demonstrated that social participation and cognitive function exert positive autoregressive effects over time, with social participation having a cross-lagged effect on cognitive function(25). Interestingly, the reverse—cognitive function influencing future social participation—was not statistically significant, suggesting a stronger influence of social participation on cognitive health. Based on our results, it is recommended that communities consider fostering an environment conducive to social activities for older adults, such as establishing hobby rooms, to facilitate meaningful interactions that help maintain social networks and support healthy cognitive function among older adults(26).

While the majority of previous research supported our conclusions, a few studies contradicted each other. Notably, a few studies did not establish a clear link between social participation, cognitive impairment, and dementia(27, 28). These disparities may result from various cognitive tests, demographic factors, or research methodologies. Cognitive impairment and dementia are complex phenomena, and their relationship with social participation may be influenced by factors such as the frequency, type, and intensity of social activities, as well as individual differences in cognitive reserve. Additionally, while most studies emphasize the positive effects of social activities on cognitive and overall health, some have highlighted potential negative effects. For instance, certain types of social activities may increase stress or emotional strain, which could offset some of the cognitive benefits(29). This underscores the importance of considering the quality and context of social participation when evaluating its impact on health.

Global or combined assessments of cognitive performance across several study designs consistently demonstrated a high correlation between social activity and better global cognition(30). In addition to these cognitive benefits, social participation is closely linked to complex daily activities that require both cognitive and physical abilities. Impairment in these areas often correlates with declining cognitive function, suggesting that social participation may not only directly influence cognitive health but also promote independence in daily life(20). Other research findings indicated that social engagement moderately contributed to verbal fluency and memory, even after accounting for intellectual activity and other factors. Furthermore, social activities had statistically significant but less pronounced effects on numeracy and temporal orientation compared to other variables. These results suggest a positive

correlation between social activity and cognitive function in older adults, though the strength of this relationship varies across different cognitive domains(31). Regardless of the nature or frequency, participation in social activities of any type may contribute to the prevention of memory impairment(32). Further research is needed to investigate the varying impacts of social activity on specific aspects of executive function and to assess whether interventions targeting social engagement could enhance cognitive performance or mitigate its decline(30).

Several potential mechanisms may explain the association between social activities and cognitive function. First, the cognitive reserve theory posits that external cognitive stimulation can mitigate the adverse effects of aging and neurodegeneration associated with disease, thereby preserving and enhancing cognitive health(33, 34). Engaging in social activities has been found to activate brain networks, facilitating the development of cognitive reserves and improving resilience against cognitive decline(35, 36). Second, the vascular hypothesis proposes that the brain's vascular system exhibits plasticity, allowing it to respond to environmental stimuli and adapt to challenges, which may help delay or slow cognitive deterioration(37). Studies have demonstrated that regular daily activities, especially those involving physical movement, improve cerebral blood flow, promote angiogenesis, and reduce oxidative damage caused by free radicals, thereby supporting cognitive function(38). Third, the stress hypothesis highlights the role of chronic stress in triggering excessive corticosterone production, which disrupts the feedback regulation of the hypothalamic-pituitary-adrenal axis and damages hippocampal neurons(34). Participation in social activities provides opportunities for older adults to build meaningful connections, reducing stress through shared experiences and emotional support. This stress-buffering effect not only enhances self-efficacy but also promotes better cognitive outcomes(34, 39). Finally, another possible explanation for the differential effects of social activities on specific cognitive domains lies in the nature of these activities. Social interactions may not typically involve tasks that require temporal orientation or numeracy. Based on the cognitive enrichment hypothesis, social activities tend to involve cognitively demanding contexts that challenge other domains, such as verbal fluency and memory, more directly(31).

It is important to consider the role of social isolation and loneliness, which have been linked to negative health behaviors through reduced social support(40). Our study emphasizes the importance of fostering social environments that encourage middle-aged and older adults to engage in a variety of social activities, as these interactions appear to have a protective effect on cognitive health. This supports the need for community-level interventions, to enhance social participation among the middle-aged and older adults.

Limitation

This study has several limitations. Firstly, due to the design of the questionnaire and the constraints in accessing detailed information, there may be recall bias in the data regarding social participation, potentially leading to measurement errors. Secondly, the cognitive function assessment scale used in this study does not provide a precise cutoff value to distinguish between normal cognitive function and

cognitive impairment. As a result, we are unable to determine the threshold score below which an individual can be classified as cognitively impaired. Lastly, future research should further evaluate how the frequency of social activities may influence cognitive outcomes, as this study did not specifically assess the impact of different levels of engagement. Understanding the role of activity frequency could provide deeper insights into the relationship between social participation and cognitive health.

Conclusion

Our study examined the relationship between cognitive decline and social participation among middle-aged and older Chinese adults. Through the establishment of a longitudinal cohort, we identified significant associations between social engagement and cognitive decline at both baseline and follow-up. These findings indicate that, alongside physical activity, social participation may play a key role in preventing cognitive decline in middle-aged and older adults. To confirm these results and thoroughly examine the underlying processes, more investigation is needed.

Declarations

Conflict of interests

The authors report no conflicts of interest in this work.

Author Contributions Statement

Xinze Wu and Jinlong Guo drafted the main manuscript and performed the statistical analyses. Aobo Ma prepared all figures and assisted in manuscript writing. Xiyao Sun reviewed the initial manuscript and provided valuable suggestions. Junhui Guo designed and supervised the study.

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Ethics Approval and Consent to Participate

All participants provided written informed consent, and the protocol was approved by the Ethical Review Committee of Peking University (Approval Number: IRB00001052–11015). This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Data availability

The data that support the findings of this study are available from the China Health and Retirement Longitudinal Study (CHARLS), but restrictions apply to the availability of these data, which were used

under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of CHARLS.

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Figures

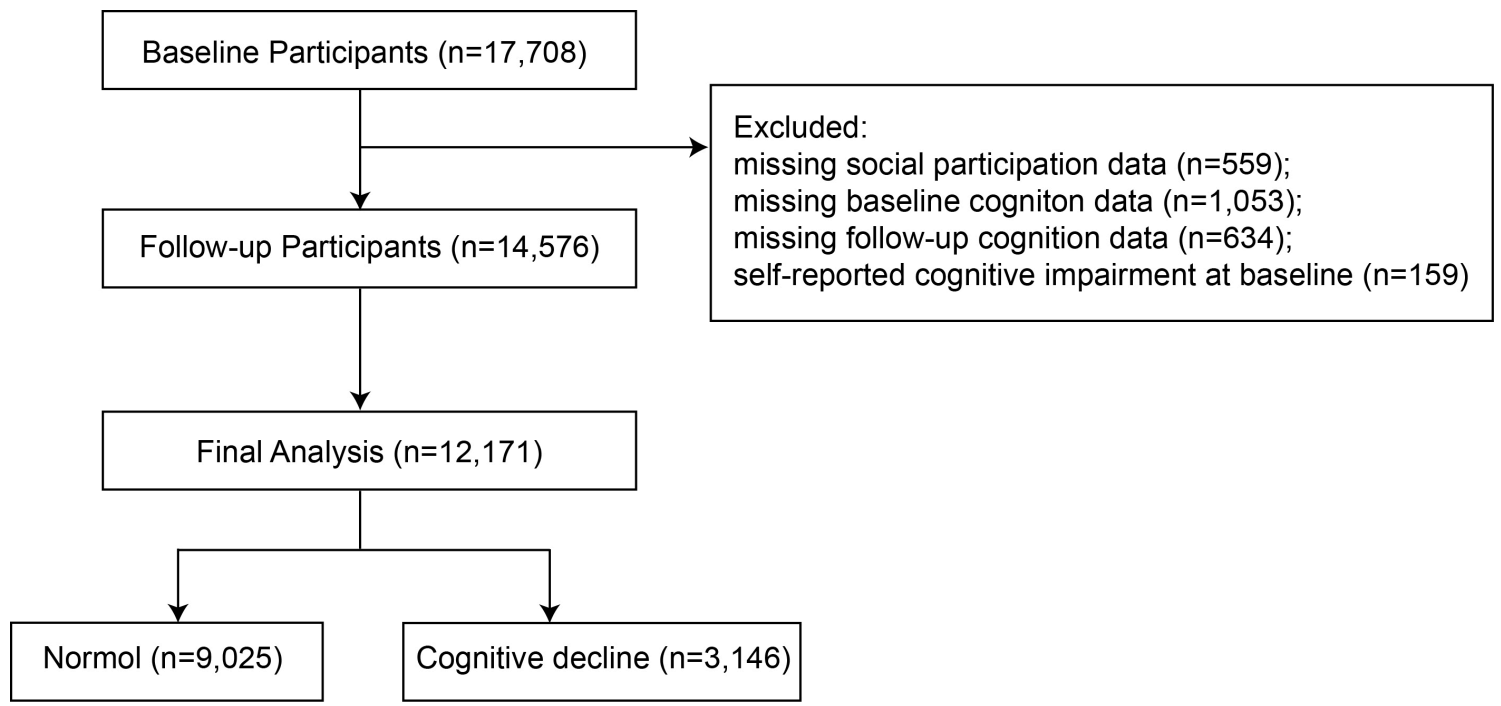


Figure 1

Flow chart of this study.

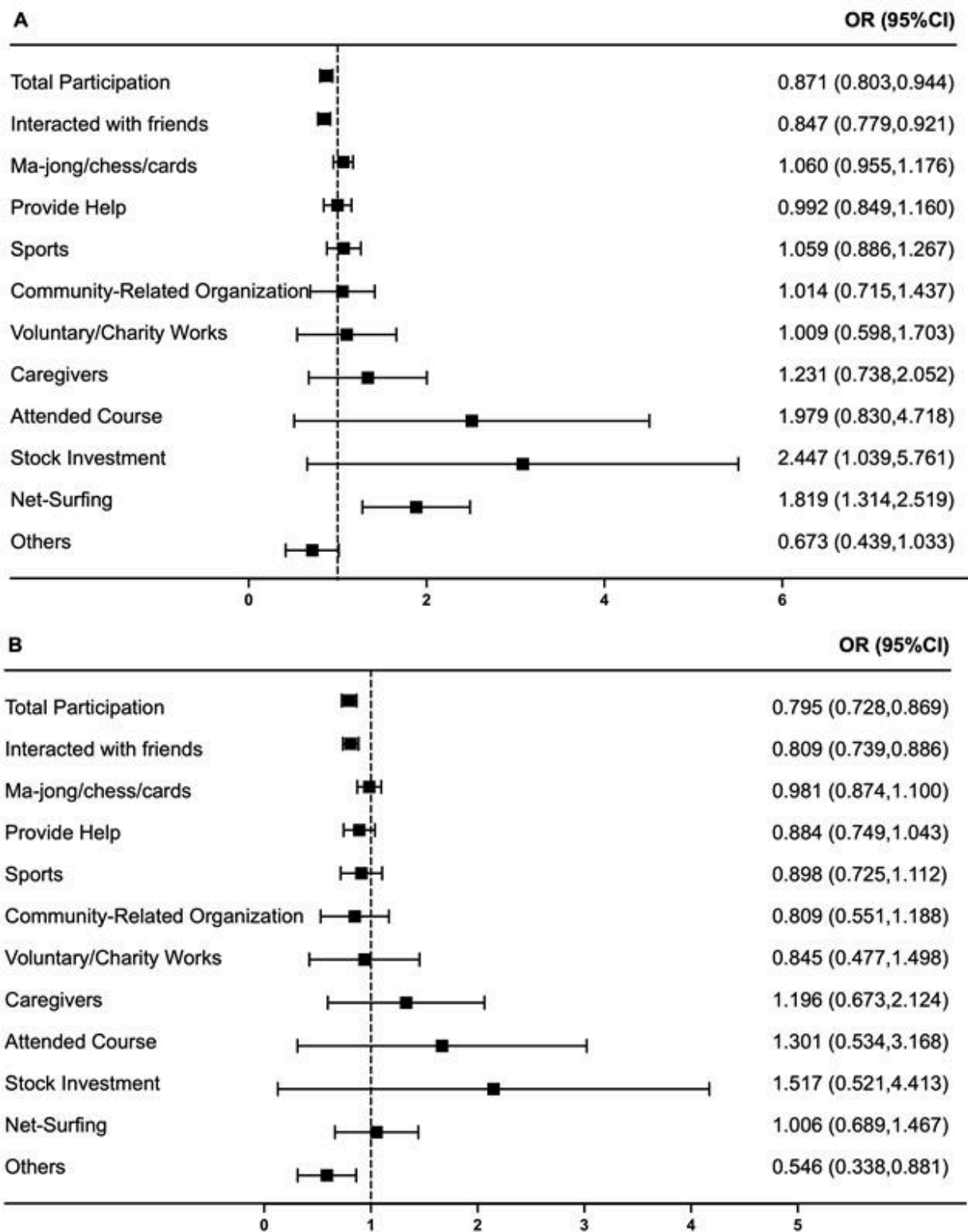


Figure 2

Logistic regression of baseline social activity and cognitive decline

(A: model 1 no adjusted; B: model 2 adjusted for age, gender, BMI, educational level, rural, married, smoking, drinking, hypertension, diabetes, heart disease, stroke.)