



Association of social interaction with dementia among Chinese adults aged 65 years and older: A multicenter cross-sectional study

Abstract

Objective: The number of people developing dementia is expected to rapidly increase given the aging population. Effective treatments are lacking necessitating the development of intervention strategies to target modifiable risk factors. This study aimed to examine the association between social interaction and dementia.

Methods: Social interaction was integrated into marital status, social activities, and living with others. The quartile method was used to grade social interactions. Multivariate analysis was used to analyze the association between each indicator and social interaction with dementia.

Results: Among 7,406 participants, there has 886 had dementia. Married and divorced or widowed participants and having richer social activities were associated with a lower risk of developing dementia. Living alone or with others was associated with a lower risk of developing dementia than living with a housekeeper in all models; Living with others. As the degree of social interaction increased, the risk of developing dementia decreased.

Conclusion: Social interaction positively correlated with cognitive function. In the specific analysis, we found that being married, being socially active, and living alone or with family members were associated with a lower risk of dementia.

Introduction

With a rapidly aging world population, including 50 million people currently living with dementia and 82 million expected by 2023 (World Health 1), the number of patients with dementia in China reached 10.427 million in 2016, accounting for approximately 1/4 of the world's dementia population, making it the country with the largest and fastest growing population (GBD 2016 Dementia 2). Although experts have researched to attempt to understand dementia for decades, no effective treatment options are currently available. In the absence of therapeutic interventions for dementia, successful intervention strategies that target modifiable risk factors to promote disease prevention are currently the only available approaches that can affect the projected rates of dementia [3]. Several studies have

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Received: Apr 28, 2026; Accepted: May 15, 2026;

Published: May 22, 2026

Journal of Neurology and Neurological Sciences

Volume 2 Issue 1 - 2026

www.jnans.org

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Citation: Chen H, Li D, Zhou C, Cao Y, Liu S, et al. Association of social interaction with dementia among Chinese adults aged 65 years and older: A multicenter cross-sectional study. *J Neurol Neuro Sci.* 2026; 2(1): 1025.

Keywords: Dementia; Social interaction; Marital status; Social activities; Living arrangements.

demonstrated the influence of modifiable lifestyle factors on cognition [4-6]. A healthier lifestyle is beneficial for cognition [7]. However, most previous studies examined healthier lifestyles characterized in terms of smoking, alcohol consumption, diet, physical activity, and body weight [4,8-10]. To our knowledge, few studies have focused on the impact of social interaction on cognitive function. Cognition is the process by which the human brain receives external information, processes it, and transforms it into internal psychological activities to acquire or apply knowledge. Cognitive function is also a form of advanced thinking that is an important result of human socialization from birth. Social interaction is an important behavior in the socialization process. Among modifiable factors, social interaction is more important in cognitive development or decline when material abundance is present.

To address gaps in the literature, we aimed to examine social interactions including marital status, living with others, and social activities with cognitive function in older people in China to identify potential intervention targets to optimize social interaction and decrease the incidence of dementia.

Methods

Study population: This multicenter, cross-sectional epidemiological survey was conducted from April to October 2019 on dementia in Chinese participants aged 65 years or older. The detailed multistage, stratified cluster-sampling procedure was described in our previous study [11]. The study began in 2019 with the enrollment of 8,018 individuals from 86 study sites; we excluded 592 participants with missing questionnaire data and 21 individuals aged <65 years. Of the 7,046 participants, 886 had dementia, and 6520 did not have cognitive impairment. This study was approved by the Ethics Committee of Medical Research Ethics at Tianjin Huanghua Hospital, the Institutional Review Board approval number is 2019-40. Written informed consent was obtained from all the participants.

Ascertainment of dementia: Dementia was diagnosed based on combining two scales: Mini Mental State Evaluation (MMSE) and Activities of Daily Living (ADL). The MMSE ranges from 0 to 30, and the diagnostic criteria vary according to the level of education [12]. For ADL, the lower the score, the better the ability to perform daily activities. A total score of 22 or less was considered completely normal, and a score greater than 22 was classified as significant dysfunction [13].

According to the criteria of the U.S. Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM -IV-R) (American Psychiatric14), participants who had an MMSE score of ≤ 17 for illiterate, ≤ 20 for those with primary school education, and ≤ 24 for participants with junior high school education or above [12], and total ADL score >22 points were considered positive for dementia [13].

Social interaction: Social interaction includes social networks, support, participation, and other factors (15, 16). Three indicators were selected to observe the influence of social interactions on dementia: marital status, social activities, and living with others.

Marital status

Marital status was obtained from the participants' files and divided into three categories: (1) unmarried, (2) divorced or widowed, and (3) married. Participants reviewed how often they had participated in social activities during the previous 12 months; social activities were divided into four categories based on the frequency of activities judged by the participants themselves: (1) None or too little: once a year or less; (2) Poor: several times a year (3); Moderate: several times a month (3); Rich: several times a week or almost every day [17]. The living situation was divided into three categories: (1) living with a housekeeper, (2) living alone, and (3) living with a spouse or immediate family members.

Other variables: Information regarding sociodemographic factors (age, sex, handedness, and education), vascular risk factors (smoking and alcohol consumption), and other diseases (cerebral infarction, cerebral hemorrhage, cephalalgia, diabetes, heart disease, epilepsy, and hypertension) was collected using a structured questionnaire. The Body Mass

Index (BMI) was calculated by measuring the height and weight of the participants in the field.

Statistical analyses: All analyses were performed with SPSS version 25.0 (SPSS, Inc., Chicago, IL, USA). Descriptive analyses are presented as number (proportion, %) for qualitative variables and mean [\pm Standard Deviation (SD)] for quantitative variables. After collecting the data, a univariate logistic regression analysis was conducted to determine the factors affecting cognitive function.

We used multivariate regression to analyze the relationship between the three indicators and dementia separately, and then social interaction was calculated based on the β coefficient of the three indicators in the logistic regression. The standardized value of social interaction was obtained by adding the β values of the corresponding grades of the three indicators and dividing by the sum of the β values of each grade. Social interaction was grouped according to quartiles, and multivariate regression analysis was used for analysis. We further analyzed the participants in the subgroups according to whether they had cerebral hemorrhage or infarction. We examined social interaction concerning dementia among participants who had neither cerebral hemorrhage nor cerebral infarction, cerebral infarction alone, cerebral hemorrhage alone, or both.

In Model 1, we adjusted for age, sex, and educational level. In Model 2, additional adjustments were made for BMI, smoking, alcohol consumption, cerebral infarction, cerebral hemorrhage, cephalalgia, and heart disease.

Results

The background characteristics of the study population are listed in (Table 1); the mean age of the 7,406 participants was 72.6 [6.2] years, and 886 (12%) had dementia. The mean MMSE score was 22.3 [5.9]. There were significant differences in age, sex, education, marital status, social activities, living with others, BMI, smoking, alcohol consumption, cerebral infarction, cerebral hemorrhage, cephalalgia, heart disease, MMSE scores, and ADL scores.

Association between social interactions and dementia

Marital status: Among the 7,406 participants, 76.2% were married, 22.9% were divorced or widowed, and 0.9% were single. As shown in (Table 2), Model 2 was adjusted for age, sex, education level, BMI, smoking, alcohol consumption, cerebral infarction, cerebral hemorrhage, cephalalgia, and heart disease. Married (Odds Ratio [OR], 0.45; 95% confidence interval, 0.22-0.91) and divorced or widowed (OR, 0.49; 95% CI, 0.24-1.0) participants had a lower risk of developing dementia compared to unmarried participants.

Social activities: As shown in (Table 2), having richer social activity was associated with a lower risk of developing dementia, regardless of adjustment for sociodemographic characteristics. (Model 2: Poor: OR, 0.73; 95% CI, 0.60-0.90; Moderate: OR, 0.54; 95% CI, 0.45-0.66; Rich: OR, 0.28; 95% CI, 0.21-0.39).

Living with others and dementia: As shown in (Table 2), living alone or with a spouse or immediate family members was associated with a lower risk of developing dementia than living with a housekeeper in all models (living alone: OR, 0.29; 95% CI, 0.17-0.50; Living with others: OR, 0.38; 95% CI, 0.23-0.64).

Social interaction: As shown in (Table 3), as the degree of social interaction increased, the risk of developing dementia

decreased (second quartile: OR, 0.65; 95% CI, 0.54-0.80; third quartile: OR, 0.55; 95% CI, 0.45-0.66; fourth quartile: OR, 0.30; 95% CI, 0.23-0.38, p for trend < 0.05).

Subgroup analysis: As shown in (Table 4), we analyzed the association between social interaction and dementia in partici-

pants with or without cerebral infarction and cerebral hemorrhage. For participants without cerebral infarction or cerebral hemorrhage, the risk for dementia decreased with greater social interaction (second quartile: OR, 0.62; 95% CI, 0.50-0.77; third quartile: OR, 0.54; 95% CI, 0.44-0.67; fourth quartile: OR, 0.29; 95% CI, 0.21-0.38, p for trend < 0.05).

Table 1: Characteristics of the study population.

Characteristics	All participants (N=7406)	Without dementia (n=6520)	With dementia (n=886)	P
Age, y (mean± SD)	72.58±6.19	75.77±7.55	72.15±5.85	0.000
Sex, Female, n (%)	4197 (56.7)	3544 (54.4)	653 (73.7)	0.000
Handedness, Right, n (%)	6822	6015 (92.3)	807 (91.1)	0.225
Education, y (Median [interquartile range])	6 (2, 9)	6 (3, 9)	3 (3, 6)	0.000
Marital status				
Unmarried	67 (0.9)	55 (0.8)	12 (1.4)	0.000
Divorce or Widow	1696 (22.9)	1387 (21.3)	309 (34.9)	
Married	5643 (76.2)	5078 (77.9)	565 (63.8)	
Social activities				
None or too less	1399 (18.9)	1122 (17.2)	277 (31.3)	0.000
Poor	1546 (20.9)	1308 (20.1)	238 (26.9)	
Moderate	3181 (43.0)	2868 (44.0)	313 (35.3)	
Rich	1280 (17.3)	1222 (18.7)	58 (6.5)	
Living with others				
Living with housekeeper	100 (1.4)	71 (1.1)	29 (3.3)	0.000
Living Alone	813 (11.0)	714 (11.0)	99 (11.2)	
Living with others	6493 (87.7)	5735 (88.0)	758 (85.6)	
BMI, (mean± SD)	24.84±3.74	24.80±3.69	25.14±4.05	0.011
Smoking, yes, n (%)	1845 (24.9)	1700 (26.1)	145 (16.4)	0.000
Alcohol, yes, n (%)	1584 (21.4)	1475 (22.6)	109 (12.3)	0.000
Cerebral infarction, yes, n (%)	740	589	159	0.000
Cerebral hemorrhage, yes, n (%)	116	79	37	0.000
Cephalalgia, yes, n (%)	408	343	65	0.011
Diabetes, yes, n (%)	1130	978	152	0.094
Heart diseases, yes, n (%)	1194	1004	190	0.000
Epilepsy, yes, n (%)	7	6	1	0.590
Hypertension, yes, n (%)	2945	2576	369	0.222
MMSE, (mean± SD)	22.33±5.85	23.51±4.84	13.68±5.39	0.000
ADL (Median [interquartile range])	20 (20, 22)	20 (20, 21)	38 (28, 50)	0.000

Values are presented as n (%), mean ± SD, or median (interquartile ranges).

MMSE: Mini Mental Status Examination; BMI: body mass index; ADL: Activities of Daily Living.

Table 2: Association between marital status, social activities, and living with others or not with dementia.

	Univariable model			Multivariable model 1			Multivariable model 2		
	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend
Marital status									
Unmarried	Reference	NA	0.000	Reference	NA	0.020	Reference	NA	0.014
Divorce/Widow	1.021 (0.540, 1.930)	0.949		0.421 (0.211, 0.838)	0.014		0.489 (0.240, 0.995)	0.048	
Married	0.510 (0.271, 0.958)	0.036		0.415 (0.211, 0.816)	0.011		0.448 (0.220, 0.912)	0.027	
Social activities									
None or too less	Reference	NA	0.000	Reference	NA	0.000	Reference	NA	0.000
Poor	0.737 (0.609, 0.892)	0.002		0.730 (0.597, 0.893)	0.002		0.733 (0.597, 0.899)	0.003	
Moderate	0.442 (0.371, 0.527)	0.000		0.512 (0.426, 0.616)	0.000		0.543 (0.450, 0.655)	0.000	
Rich	0.192 (0.143, 0.258)	0.000		0.273 (0.202, 0.370)	0.000		0.284 (0.209, 0.386)	0.000	

Living with others									
Living with housekeeper	Reference	NA	0.000	Reference	NA	0.000	Reference	NA	0.000
Living alone	0.339 (0.210, 0.549)	0.000		0.268 (0.159, 0.452)	0.000		0.291 (0.170, 0.498)	0.000	
Living with spouses or immediate family members.	0.324 (0.209, 0.502)	0.000		0.342 (0.211, 0.553)	0.000		0.384 (0.231, 0.640)	0.000	

Model 1 adjusted for age, sex, and education levels.

Model 2 adjusted for age, sex, education levels, BMI, smoking, alcohol, cerebral infarction, cerebral hemorrhage, cephalalgia, and heart diseases.

Table 3: Association between social interaction and dementia.

Social interaction	Univariable model			Multivariable model 1			Multivariable model 2		
	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend
First quartile	Reference	NA	0.000	Reference	NA	0.000	Reference	NA	0.000
Second quartile	0.618 (0.515, 0.741)	0.000		0.651 (0.538, 0.787)	0.000		0.651 (0.537, 0.790)	0.000	
Third quartile	0.365 (0.304, 0.439)	0.000		0.527 (0.434, 0.639)	0.000		0.545 (0.449, 0.663)	0.000	
Fourth quartile	0.214 (0.167, 0.274)	0.000		0.290 (0.224, 0.374)	0.000		0.294 (0.227, 0.380)	0.000	

Model 1 adjusted for age, sex, and education levels

Model 2 adjusted for age, sex, education levels, BMI, alcohol, cerebral infarction, cerebral hemorrhage

Table 4: Association between social interaction and dementia in patients with or without cerebral infarction and cerebral hemorrhage.

Social interaction	Cerebral infarction or cerebral hemorrhage free (n=6573)			Only cerebral infarction (n=717)			Only cerebral hemorrhage (n=93)			Cerebral infarction and cerebral hemorrhage (n=23)		
	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend	OR (95%CI)	P value	P value for trend
First quartile	Reference	NA	0.000	Reference	NA	0.004	Reference	NA	0.029	Reference	NA	0.041
Second quartile	0.616 (0.497, 0.765)	0.000		0.743 (0.455, 1.212)	0.234		1.491 (0.397, 5.605)	0.554		0.135 (0.002, 7.647)	0.331	
Third quartile	0.543 (0.437, 0.673)	0.000		0.600 (0.362, 0.994)	0.047		0.543 (0.130, 2.274)	0.403		0.026 (0.000, 2.261)	0.109	
Fourth quartile	0.286 (0.214, 0.381)	0.000		0.427 (0.231, 0.789)	0.007		0.105 (0.011, 0.982)	0.048		0.000 (0.000, ---)	0.999	

OR adjusted for age, sex, education levels, BMI, and alcohol. IQR: interquartile range.

Discussion

We found that social interaction, represented by a combination of the three indicators, positively correlates with cognitive function. In the specific analysis of the three indicators, we found that being married, being socially active, and living alone or with family members were associated with a lower risk of dementia.

Unmarried people have a higher risk of dementia than those who have been married: Compared to people who were not married, married and divorced or widowed participants had a lower risk of developing dementia. Marital status showed a protective effect on individual cognition, and previous studies have also shown the same conclusion. A nationwide population-based study encompassing approximately two million individuals in Sweden showed that nonmarried individuals may be at risk for early- and late-onset dementia [18]. As older adults face declining health and caregiving responsibilities, attention may focus more on close relationships such as spouses. Through

increased daily interactions, marriage can generate emotional connections and support for individuals [19,20], stimulate cognition, and provide members with more health resources and social control, thereby being linked to the hypothesis of cognitive reserve [18].

Social participation was associated with a lower risk of dementia: Our study found that an increased frequency of social participation was associated with a reduced risk of dementia. Other studies have also shown that social activities lead to slower cognitive decline or lower dementia risk at follow-up [21,22]. One explanation for this is that rich social activities can release stress, regulate mood, stimulate the brain to increase synaptic activity and facilitate brain repair [23].

Living with family was associated with a lower risk of dementia: Our study suggests that living with family members is associated with a lower risk of dementia than living with a caregiver such as a housekeeper. Close and meaningful emotional relationships, which provide high-quality emotional

value, are important for older adults to cope with the decline in health and cognitive changes that occur with aging [24]. We determined that people who lived with housekeepers were better at cognition, and those who lived alone were better at all aspects of ability, including cognition.

Social interaction improves cognitive function by increasing cognitive reserve: Whether in marriage, living with relatives, or social activities, we are all socialized to receive different information and emotions through ourselves or others. In the process of completing complex communication and activities through social participation, cognition will be stimulated, and the human brain will receive external information and process and transform it to obtain or apply knowledge. This process affects the changes in the trajectory of cognitive aging, increases cognitive ability, and accumulates cognitive ability to compensate for the damage caused by pathology. This is the cognitive reserve theory hypothesis [17,25,26]. The theory is that life experiences, combined with genetic factors, provide a buffer against pathological changes in the brain, leading to cognitive resilience and better coping with brain degeneration [27-29]. Maintaining rich social activities can help build cognitive reserves and improve cognitive function.

No significant association between social interaction and dementia after stroke: The association in our study was not significant, but another study reported an increased risk of dementia after stroke [30]. We consider that due to the large differences in individual cognitive ability before the stroke, when the stroke occurs, the degree of brain lesions is different, and the impact on cognition varies from person to person. Thus, a single measure of social participation may not be sufficient to draw any conclusions.

We benefited from a large sample size, which led to a valid dataset, but our study was a cross-sectional study and did not have a definitive age at the onset of dementia or at the time of change in marital status. In addition, the risk factors are not comprehensive, in further study, we should add more risk factors (such as genetics, depression, hearing loss, untreated vision loss, and LDL cholesterol) according to the latest Lancet 2024 Dementia Commission. The current study did not examine social support or loneliness. Social participation was subjectively judged by the participants, which may have caused errors.

Our study found that social interaction is positively correlated with cognitive function. As social interaction increases, the risk of dementia decreases. In the specific analysis of the three indicators, we found that having been married, being more socially active, and living alone or with family members led to a lower risk of dementia. In our study, there was no significant association between social interaction and dementia after stroke. Social participation requires a more precise classification and frequency setting for activities, such as intellectual and social participation types. In the future, we will analyze the relationship between social interaction and dementia in greater detail.

Declarations

Statement of ethics: This cross-sectional study was approved by the Institutional Review Board of The Medical Ethics Committee of Tianjin Huanghua Hospital (Approval No.: [2024-242], Date: [November 18, 2024]). All participants provided informed consent.

Declaration of competing interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding: This study was supported by the National Natural Science Foundation of China [grant number 82171182], and Tianjin Scientific Research Projects in Key Areas of Traditional Chinese Medicine [grant number 2015017].

Author contributions: Hui Chen: Conception, Duan Li: Planning, Chaohui Zhou: Data Collection, Yu Cao: Experimentation, Zhu Meng: Analysis, Jiahui Xiang: Writing, Yuan Li: Reviewing, Yong Ji: Supervision, Shuai Liu: Funding.

Data availability statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to the sensitive nature of the data, access will be granted only after approval from the Medical Ethics Committee of Tianjin Huanghua Hospital and the Huanghua Hospital. Requests for data access should be directed to snchenhui@tmu.edu.cn.

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