

Association between playing cards/mahjong and risk of incident dementia among the Chinese older adults: A prospective cohort study

Gang Tian

Central South University

Rui Li

Central South University

Tong Zhou

Central South University

Yan Shi

Central South University

Gang Cheng

Central South University

Yan Yan (✉ yanyan802394@126.com)

Central South University

Article

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Abstract

Studies have shown that late-life frequent participation in cognitively stimulating activities are associated with decreased risk of developing dementia, but prospective evidences regarding an association are limited. We used the prospective cohort study of the Chinese Longitudinal Healthy Longevity Survey (CLHLS), and included 11821 community-living Chinese individuals age 65 years or older at 2008 baseline who were free of dementia, and were followed up every 2–3 years until 2018. A total of 821 participants developed incident dementia during the 10-year follow-up. The mean age of the participants was 89 and 90 years old in dementia and non-dementia older adults, respectively. Compared to participants with rarely or never playing cards/mahjong, those who almost every day playing cards/mahjong had a significant lower risk of dementia (HR = 0.63; 95%CI, 0.42–0.95) after multivariable-adjusted model. Similar results were observed in subgroup analyses based on sex (male:HR = 0.52, 0.28–0.96; female:HR = 0.62, 0.36–0.98), age(< 85years:HR = 0.55, 0.32–0.89), regularly exercise (yes: HR = 0.44, 0.28–0.87) and MMSE score [above median (25): HR = 0.66, 0.41–0.92]. Active participation in playing cards/mahjong may contribute to a reduction of risk of dementia in Chinese older persons over 65 years old.

Introduction

Dementia, as a central nervous degenerative disease in middle-aged and older adults, can cause progressive cognitive impairment and behavioral damage, and often causes great suffering in people older than 65 years worldwide, including China ^[1–3]. With the considerable rise in life expectancy and the aggravation of the aging process, the number of individuals with dementia is increasing. In 2016, about over 46 million people were reported to be living with dementia all over the world. The number is expected to exceed 130 million by 2050 ^[3], the number of individuals with dementia in China will account for approximately 25% of the entire population with dementia worldwide ^[4]. Because dementia can't be cured, this will put a huge burden on the country, health-care professionals, and family members. Therefore, it is necessary to explore some effective methods for the primary prevention of dementia and delay disease onset in the older adults.

It is generally known that mahjong and cards are extremely popular in every corner of China, and it is also the favorite leisure and recreational activities of Chinese older adults, both men and women. Previous studies ^[5–9] in North America and Europe suggested that active participation in leisure and recreational activities, especially intellectual activities, such as reading books and playing chess or cards, can be conducive to reduce the risk of dementia among the older adults, possibly through improving cognitive reserve, protecting and restoring cognitive functions ^[10–13]. However, in China, the researches on this aspect are still scarce ^[14], and the related problems are worth exploring. Those people who often actively participate in intellectual activities are usually more health-conscious and have healthier lifestyles such as exercising regularly, eating a balanced diet, and smoking fewer cigarettes. However, these have been proved to be protective factors against dementia ^[15–18]. Whether participation in intellectual activities, particularly mahjong/cards in China, can prevent and delay the onset of dementia independent of these unfavorable lifestyles has yet to be determined. Hence, we used a 10-year follow-up cohort of individuals aged 65 years and older from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) ^[19] to investigate the associations between frequency of playing cards/mahjong and dementia, the longer interval between frequency of playing cards/mahjong assessment and dementia diagnosis might allow us to be more confident in the timeliness and causality of this association ^[20].

Our study objectives were to estimate the odds ratio (OR) for dementia from the different frequencies of playing cards/mahjong, using never playing cards/mahjong as a reference; estimated dementia risk across age, sex, regular exercise status, and the Mini-Mental State Examination (MMSE) score stratifications; in order to ensure the stability and reliability of our results, we conducted sensitivity analysis by excluding participants who were MMSE scores < 18 at baseline, further excluding participants suffering from epilepsy or stroke at baseline, and participants suffering from dementia during the first year of follow-up in turn.

Results

Participant characteristics

A total of 11821 participants were included in our study (Figure.1). As shown in Table 1, at baseline, compared with other groups, those participants who rarely or never played cards/mahjong were older, with a median (IQR) age of 90 (81–98) years, more female (60.1%), lower married rate (26.3%), and lower MMSE score (24 points). With the increasing frequency of playing cards/mahjong (divided into four groups), the proportion of educated (34.0%, 42.9%, 46.2% and 49.2%, respectively) smokers (34.0%, 42.9%, 46.2% and 49.2%, respectively), drinkers (34.0%, 42.9%, 46.2% and 49.2%, respectively) and regular exercisers (34.0%, 42.9%, 46.2% and 49.2%, respectively) also increased among participants (shown in Table 1). There was no significant difference in the proportion of living with family members, and suffering from hypertension and diabetes among the groups. A total of 821 participants developed incident dementia during the 10-year follow-up. As summarized in Table 1, those who developed incident dementia were older [age:median (IQR), 90 (82–96)] than those who remained free of dementia [age:median (IQR), 89 (79–97)], and were predominantly female [530 (64.6%) vs 6248 (56.8%)]; with a significantly higher percentage of uneducated [629 (76.6%) vs 8013 (72.9%)], married, smokers, drinkers and less MMSE score, with a higher prevalence of hypertension, diabetes.

Table 1

Characteristics of the study participants according to frequency of playing cards/mahjong and dementia status at end of follow-up at baseline.

Characteristics	Frequency of playing cards/mahjong				P value for difference	dementia status at end of follow-up		P value for difference
	Rarely or never	Sometimes, at least once for a month	Regularly, at least once for a week	almost everyday		No dementia	Dementia	
Participant (n)	10280	579	405	557		11000	821	
Age (year), median (IQR)	90 (81–98)	81 (71–89)	88 (80–94)	80 (71–88)	< 0.001	89 (79–97)	90 (82–96)	0.0052
Sex, Female (n,%)	6175 (60.1)	217 (37.5)	158 (39.0)	228 (41.0)	< 0.001	6248 (56.8)	530 (64.6)	< 0.001
No schooling received (n,%)	7810 (76.0)	331 (57.1)	218 (53.8)	283 (50.8)	< 0.001	8013 (72.9)	629 (76.6)	0.0188
Married (n,%)	2706 (26.3)	280 (48.3)	187 (46.1)	267 (48.0)	< 0.001	3249 (29.5)	191 (23.3)	< 0.001
Household income (RMB)					< 0.001			0.4584
Low (\leq 10000)	4666 (45.4)	190 (32.8)	142 (35.1)	214 (38.4)		4836 (44.0)	376 (45.8)	
Middle (10000 ~ 30000)	3851 (37.5)	256 (44.2)	183 (45.2)	253 (45.4)		4244 (38.6)	299 (36.4)	
High (\geq 30000)	1763 (17.2)	133 (23.0)	80 (19.7)	90 (16.1)		1920 (17.5)	146 (17.8)	
Current smoker (n,%)	1619 (15.8)	144 (24.9)	136 (33.6)	188 (33.8)	< 0.001	1967 (17.9)	120 (14.6)	0.0179
Current drinker (n,%)	1679 (16.3)	152 (26.2)	113 (28.0)	178 (32.0)	< 0.001	1996 (18.2)	126 (15.4)	0.0439
Regular exercise (n,%)	2322 (22.5)	215 (37.1)	171 (42.2)	278 (59.9)	< 0.001	2782 (25.3)	193 (23.5)	0.2561
Living with family members, (n,%)	8596 (83.6)	488 (84.3)	336 (83.0)	452 (81.2)	0.4432	9204 (83.7)	668 (81.4)	0.0855
BMI (kg/m ²) group (n,%)					< 0.001			0.8329
Underweight (< 18.5)	3892 (37.9)	128 (22.1)	90 (22.2)	135 (24.2)		3959 (36.0)	286 (34.9)	
Normal (18.5–23.9)	5164 (50.2)	351 (60.6)	242 (59.8)	322 (57.8)		5653 (51.4)	426 (51.9)	
Overweight (24–27.9)	953 (9.3)	84 (14.5)	58 (14.3)	84 (15.1)		1091 (9.9)	88 (10.7)	

Data are n, median (IQR), or n (%).

Characteristics	Frequency of playing cards/mahjong				P value for difference	dementia status at end of follow-up		P value for difference
	Rarely or never	Sometimes, at least once for a month	Regularly, at least once for a week	almost everyday		No dementia	Dementia	
Obese (≥ 28)	271 (2.6)	16 (2.8)	15 (3.7)	16 (2.9)		297 (2.7)	21 (2.6)	
MMSE score, median (IQR)	24 (13–29)	29 (26–30)	29 (26–30)	27 (24–29)	< 0.001	25 (16–29)	23 (11–28)	< 0.001
MMES < 18 (n,%)	3255 (31.7)	34 (5.9)	25 (6.2)	19 (3.4)	< 0.001	3037 (27.6)	296 (36.1)	< 0.001
MMES ≥ 18 (n,%)	7025 (68.3)	545 (94.1)	380 (93.8)	538 (96.6)		7963 (72.4)	525 (63.9)	
Hypertension (n,%)	1873 (18.2)	108 (18.7)	89 (22.0)	119 (21.3)	0.0781	2010 (18.3)	179 (21.8)	0.0120
Type 2 diabetes (n,%)	192 (1.9)	15 (2.6)	9 (2.2)	19 (3.4)	0.0516	216 (2.0)	19 (2.3)	0.4875

Data are n, median (IQR), or n (%).

Association of playing cards/mahjong with risk of dementia

Overall, with the increase of playing cards/mahjong frequency, the crude rate of dementia events decreased gradually. The incidence rate (95%CI) per 1000 person-year in rarely or never group, sometimes, at least once for a month group, regularly, at least once for a weekly group and the almost everyday group were 16.4 (15.3–17.6), 8.8 (6.2–12.4), 8.2 (5.4–12.5) and 6.7 (4.5–9.9), respectively (Table 2).

Table 2
Associations between frequency of playing card/mahjong and dementia for Chinese older adults

frequency of playing card/mahjong	N cases/N total	ID(95%CI) per 1000 persons-years	Unadjusted model HR(95% CI)	Age-and sex-adjusted model HR(95% CI)	Multivariable -adjusted model ^a HR (95% CI)
Rarely or never	744/10280	16.4 (15.3–17.6)	Ref	Ref	Ref
Sometimes, at least once for a month	32/579	8.8 (6.2–12.4)	0.52 (0.36–0.73)	0.77 (0.54–1.10)	0.84 (0.59–1.21)
Regularly, at least once for a week	21/405	8.2 (5.4–12.5)	0.47 (0.31–0.74)	0.66 (0.42–1.02)	0.75 (0.50–1.16)
almost everyday	24/557	6.7 (4.5–9.9)	0.38 (0.25–0.57)	0.55 (0.36–0.82)	0.63 (0.42–0.95)

ID: Incidence density, HR: hazard ratio, CI: Confidence interval

^a Multivariable-adjusted model including age, sex, education, household income, marital status, smoking status, drinking status, exercise, BMI, living with family members, hypertension, diabetes and MMSE score.

In Cox proportional hazards models reported in Table 2, the corresponding unadjusted HR (95%CI) for incident dementia was significantly lower in those who almost every day playing cards/mahjong (HR = 0.38; 95%CI,0.25–0.57) than those who rarely or never played cards/mahjong. It was associated with incident dementia after adjusting for sex and age (HR = 0.55; 95%CI,0.36–0.82). It remained significant after further adjust additional education, household income, marital status, smoking status, drinking status, regular exercise, BMI, living with family members, hypertension, diabetes, and MMSE score (HR = 0.63; 95%CI,0.42–0.95). There was no clear evidence of an association in the other two groups.

subgroup analysis

We performed subgroup analysis by sex, age, regular exercise, and MMSE score median. In sex-stratified analysis, the risk of dementia in almost everyday playing cards/mahjong group (male:HR = 0.52, 0.28–0.96; female:HR = 0.62, 0.36–0.98) was lower than that in other the frequency of playing cards/mahjong groups. In age-stratified analysis, the risk of dementia of almost everyday playing cards/mahjong group in less than 85 years (HR = 0.55, 0.32–0.89) was lower than more than 85 years (HR = 0.87, 0.45–1.28). Similar pattern was observed in regular exercise-stratified analysis (yes: HR = 0.44, 0.28–0.87), and MMSE score-stratified analysis [above median (25): HR = 0.66, 0.41–0.92] (Fig. 2).

Sensitivity analysis

The results of the sensitivity analyses are presented in Table 3. We still used three models (unadjusted, age- and sex-adjusted, multivariable-adjusted) to analyze the association of the frequency of playing cards/mahjong with the incidence of dementia. Through the unadjusted, age- and sex-adjusted, and multivariable-adjusted models excluded participants who were MMSE scores < 18 at baseline, further excluding participants who suffer from epilepsy or stroke at baseline, or additionally excluding dementia that occurred during the first year of follow-up didn't make a big difference to the original results.

Table 3
Association of frequency of playing cards/mahjong with dementia after further exclusions

frequency of playing cards/mahjong	Incidence density per 1000 persons-years	Unadjusted model HR(95% CI)	Age-and sex-adjusted model HR(95% CI)	Multivariable-adjusted model* HR (95% CI)
Excluding participants who were MMSE scores < 18 at baseline				
Rarely or never	12.4 (11.3–13.6)	Ref	Ref	Ref
Sometimes ^a	8.4 (5.7–12.2)	0.60 (0.42–0.87)	0.83 (0.57–1.20)	0.72 (0.41–1.27)
Regularly ^b	7.7 (4.8–12.0)	0.58 (0.38–0.90)	0.75 (0.49–1.16)	0.61(0.34–1.11)
almost everyday	6.6 (4.3–10.1)	0.47 (0.31–0.71)	0.62 (0.41–0.94)	0.54 (0.36–0.97)
Further excluding participants suffer from epilepsy or stroke at baseline				
Rarely or never	12.0 (10.8–13.1)	Ref	Ref	Ref
Sometimes ^a	7.8 (5.3–11.4)	0.57 (0.39–0.84)	0.80 (0.54–1.19)	0.73 (0.40–1.32)
Regularly ^b	7.6 (4.8–11.9)	0.59 (0.0.38–0.92)	0.77 (0.49–1.21)	0.69 (0.38–1.26)
almost everyday	6.7 (4.4–10.1)	0.48 (0.32–0.74)	0.65 (0.43–0.98)	0.60 (0.29–1.22)
Excluding dementia that occurred during the first year of follow-up				
Rarely or never	12.0 (11.0-13.1)	Ref	Ref	Ref
Sometimes ^a	7.9 (5.5–11.4)	0.74 (0.50–1.10)	1.05 (0.70–1.56)	0.90 (0.48–1.68)
Regularly ^b	7.1 (4.5–11.2)	0.68 (0.42–1.10)	0.89 (0.55–1.45)	0.69 (0.32–1.50)
almost everyday	5.1 (3.2-8.0)	0.48 (0.30–0.79)	0.65 (0.40–1.05)	0.63 (0.31–1.31)
HR:hazard ratio, CI: Confidence interval; Sometimes ^a : at least once for a month; Regularly ^b : at least once for a week				
Multivariable-adjusted model* including age, sex, education, household income, marital status, smoking status, drinking status, exercise, BMI, living with family members, hypertension, diabetes and MMSE score.				

Discussion

This extensive community-based, prospective cohort study showed that more frequency of playing cards/mahjong was associated with a significant reduction in the risk of dementia among older adults individuals aged 65 and older. Furthermore, we found that the protective association was stronger for older adults who reported playing cards/mahjong almost every day with regular exercise than those without regular exercise. We did not find any significant difference in age, sex, and MMSE score median, and that further sensitivity analysis yielded no substantial changes in our findings after adjusting confounding factors.

The present findings align with several previous studies that active participation in stimulating intellectual activities (such as playing cards or checkers), especially among the older adults, is associated with better cognitive functioning [6, 21]. In addition, some studies had also found that more frequently playing stimulating intellectual games (such as cards, bingo, chess, mahjong, crossword puzzle) were associated with a decreased risk of dementia [22–24]. The reasons why these stimulating intellectual games can reduce the risk of dementia may be explained by the fact that playing cards or mahjong (game activities welcomed by Chinese circle) is a strong and comprehensive stimulating activity in cognitive domains (involving attention, reasoning, memory, and initiative capacity) [24] and interpersonal social communication, which is also proved to be help to reduce the risk of dementia or cognitive impairment [25, 26]. However, as we know, many previous studies did not fully consider other confounding factors (such as education level and whether live with family members) and baseline cognitive status, both of which can lead to potentially biased results. Moreover, our finding was consistent with a recent prospective study result that active participation in playing cards/mahjong might be in favor of decreasing the risk of dementia in older adults [14]. However, the study was followed-up for only three years, and relevant evidence showed that dementia was considered to develop slowly over many years [27], so the causality of this study conclusion was still controversial. Additionally, most studies had incorporated various types of stimulating intellectual activities as independent variables, while our study included playing cards/mahjong as the only factor to explore the independent impact on the risk of dementia in the older adults through adjusted as many confounding factors as possible.

A few prospective studies also had investigated the relationship of other types of leisure activities (such as social, recreational, physical) to cognitive decline or dementia, and their results did not identify that frequency of participation in social or recreational or physical activities was associated with lower risk of cognitive decline or dementia [6, 14, 28]. These results were contrary to the relationship between stimulating intellectual activities and cognitive decline or dementia, but these findings were significant because they showed that the association of cognitive decline or dementia risk reflected mental stimulation rather than nonspecific results of other types of leisure activities. Compared with stimulating intellectual activities, these activities are usually more passive and have less cognitive involvement, so we deduce that stimulating intellectual activities might be more effective than engaging in various nonintellectual leisure activities (such as recreational, social, and physical) in preventing dementia.

The potential mechanisms involved for the association of stimulating intellectual activities with incident dementia are no consensus. One hypothesis is that frequent participation in cognitively stimulating activities can protect the cognitive function of the older adults from decline [29], because repeating some cognitive skills can make neurons more active and less vulnerable to disruption by dementia pathology [30]. Another similar view points out that frequent cognitive stimulating activity may strengthen thought processing skills, such as ratiocination, calculation, and perceptual speed, which may be conducive to compensate and resist for age-related decline in other cognitive systems [31]. Some studies had explored possible biological mechanisms for the association of cognitively stimulating activities with cognitive function [32, 33]. These findings manifested that being mentally active may delay the onset of clinical dementia by improving cognitive reserve. According to cognitive reserve theory in neuroscience, people with a higher level of the cognitive reserve can more buffer the effects of neuropathology in brain anatomical substrate and function, and also have greater dynamic neural network compensation such that the larger cognitive reserve, the more serious the pathological damage needed to cause functional impairment [33, 34]. A recent study showed that cognitive stimulating can improve functional connectivity between the hippocampus and superior frontal cortex to resist cognitive function decline [35]. The above findings show that cognitive training may improve cognition, possibly through different neural regulation mechanisms, which can explain our findings that more frequency of playing mahjong/cards lowers the risk of dementia.

Regarding the strengths of this study, it is a community-based, national-wide prospective design, the large sample of the over 65 older adults, a relatively long follow-up period with about three years evenly spaced observations per individual, adjustment for established and potential confounders. Of course, our study also has some limitations. First, our findings only apply to the older adults in China. Due to the cognitive function effects of playing cards/mahjong may be different

between young and older adults individuals, this effect should be carefully extended to young people. Second, information on covariates and dementia status is collected through self-reported in the form of a questionnaire; thus, recall bias and information bias are possible. Third, we do not control other types of leisure activities. Although this is also important, it does not alter the main results in that frequent playing cards/mahjong is associated with a significantly decreased risk of dementia.

In conclusion, our study provides evidence that frequently playing cards/mahjong may decrease the risk of dementia among Chinese older adults over 65 years old. Given China's huge population base and increasing aging, promoting more frequent participation in this activity could protect against the onset of dementia, and also solve problems in aging societies.

Methods

Study design and participants

The CLHLS study is an ongoing, population-based, prospective cohort study that was conducted initially in 1998 and randomly selected half of the counties or cities in 22 of 31 provinces in China. These areas include approximately 85% of the total Chinese population ^[36]. Our study analysis selects data from 2008 to 2018 waves and mainly collects information on the health status and quality of life of older adults individuals aged 65 and older. Details of the study design and methods have been described elsewhere ^[37].

The CLHLS data were collected by trained staff through face-to-face interviews with the older adults themselves or their relatives or caregivers. After evaluation, the data quality and the report information reliability of the CLHLS is reasonably good ^[38]. A total of 16,954 older adults Chinese over 65 years old participated in the 2008 baseline survey, which contained rich information on playing cards/mahjong and dementia of the respondents. After excluding cases with missing information on key variables, with dementia at baseline and lost to follow-up, the final 11821 participants available were included for the analysis of the association of frequency of playing cards/mahjong and dementia. The full screening process of research participants is presented in Fig. 1.

Assessment of frequency of playing cards/mahjong

To obtain the data of playing mahjong/cards status at the baseline, we invited participants themselves or a close relative of the interviewee to answer some questions, such as "do you now perform the following activities regularly?", with options of "almost every day", "not every day, but at least once a week", "not every week, but at least once a month", "not every month, but sometimes", and "rarely or never". Based on the frequency of playing mahjong/ cards in the 2008 baseline survey, Finally, we classified four types of mahjong/cards players. Those who "not every month, but sometimes" or "never" played mahjong/cards at the baseline were classified as "rarely or never players", which was the reference category in the regression analyses.

Identification of dementia

The outcome of this study was incident dementia in the following up to 10 years. The identification of individuals with dementia came from reports through family members or caregivers, diagnosed by qualified medical institutions or taking dementia treatment drugs. For those participants who were dead during follow-up, we asked their family members or caregivers whether they had dementia before death.

Evaluation of other variables

To control the potential confoundings, covariates, such as socio-demographic information, lifestyles factors, and health status, were included in our analyses. Socio-demographic variables included age (continuous), sex, education (no schooling

received/1 year or more), household income [low(< 10000 RMB);middle(10000–30000 RMB):high(> 30000 RMB)], marital status (married/unmarried), living with household members(yes/no). Lifestyles factors included smoking status (current smoker/current non-smoker), drinking status (current drinker/current non-drinker), regular exercise (yes/no). Health status information included body mass index (BMI) (underweight (< 18.5), normal (18.5–23.9), overweight (24–27.9), obese (\geq 28)) [39]. The identification of individuals with hypertension or diabetes came from reports through family members or caregivers, diagnosed by qualified medical institutions or taking hypertension or diabetes treatment drugs. Because of the close relationship between cognitive function and dementia [40], we carefully analyzed the role of cognitive function in dementia. Cognitive function was measured by the Chinese version of the Mini-Mental State Examination (MMSE) in the CLHLS. The validity and reliability of the Chinese MMSE have been verified [41]. The MMSE score ranged from 0 to 30, and a higher score indicated better cognitive function [42, 43]. A score below 18 was considered to be the cognitive impairment among the older adults in China [44, 45].

Statistical analysis

Baseline characteristics were described as medians and interquartile ranges (IQR) for continuous variables (not normally distributed), the count and percentage for categorical variables according to different groups of playing mahjong/cards frequency and with and without incident dementia. The χ^2 test was used for comparing differences among groups in categorical variables and the Kruskal-Wallis H test or the Mann-Whitney test in continuous variables. We calculated crude incidence rates (IR) (per 1000 person-years) of dementia across categories of playing cards/mahjong frequency. The person-years were calculated by summing each participant's contribution of follow-up time (from baseline to the year of assessment when the participant was found to have dementia, or to the year of the last assessment if the participant remained free of dementia). All analyses were performed using R version 4.0.5 (R Foundation for Statistical Computing), and all reported $P < 0.05$ (2-tailed) were considered statistically significant.

Cox proportional hazards models were applied to generate the hazard ratios (HRs) and 95% confidence intervals (CIs) for analyzing the associations of frequency of playing cards/mahjong and the incidence of dementia. Initially, we constructed models without any adjusted covariates (unadjusted model), additionally adjusted only for age and sex (age and sex-adjusted model) and further adjusted for education, household income, marital status, smoking status, drinking status, regular exercise, BMI, living with family members, history of hypertension and diabetes and MMSE score (multivariable-adjusted model).

To further explore the influence of sex, age, regular exercise, and MMSE score (median) on the associated frequency of playing cards/mahjong with the incidence of dementia, we conducted subgroup analyses. In order to ensure the stability and reliability of our study results and exclude more interference, we carried out sensitivity analysis, first excluding participants who were MMSE scores < 18 at baseline, then further excluding participants suffer from epilepsy or stroke at baseline, and finally excluding dementia that occurred during the first year of follow-up.

Declarations

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Author contributions

TG participated in the design, data analysis and writing for the this study. YY provided supervision and guidance at all stages including the analyses. LR and ZT assisted with drafting the paper. SY and GC prepared the manuscript for

publication. All authors reviewed and commented on drafts of the manuscript. All authors read and approved the final manuscript.

Competing interests

The author(s) declare no competing interests.

Data availability statement

The dataset is publicly available at <https://sites.duke.edu/centerforaging/programs/chinese-longitudinal-healthy-longevity-survey-clhls/>

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Ethics declarations

The CLHLS study was approved by the Research Ethics Committee of Peking University (IRB00001052-13074). All authors confirm that all methods were carried out in accordance with relevant guidelines and regulations. All study participants or their legal proxy respondents must obtain and sign written informed consent before completing each study questionnaire.

Footnotes

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Figures

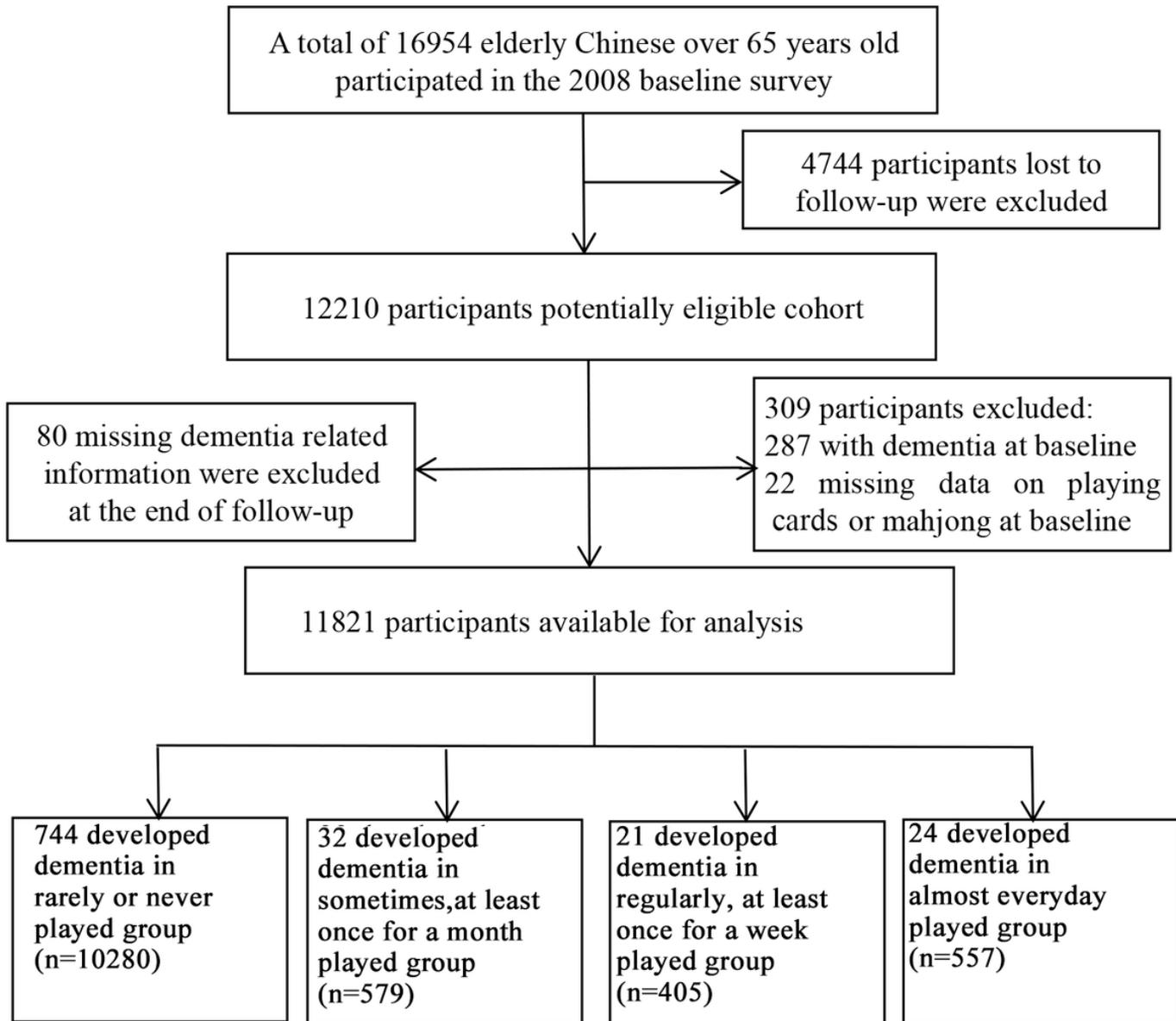


Fig. 1 Flow chart of the study population

Figure 1

Flow chart of the study population

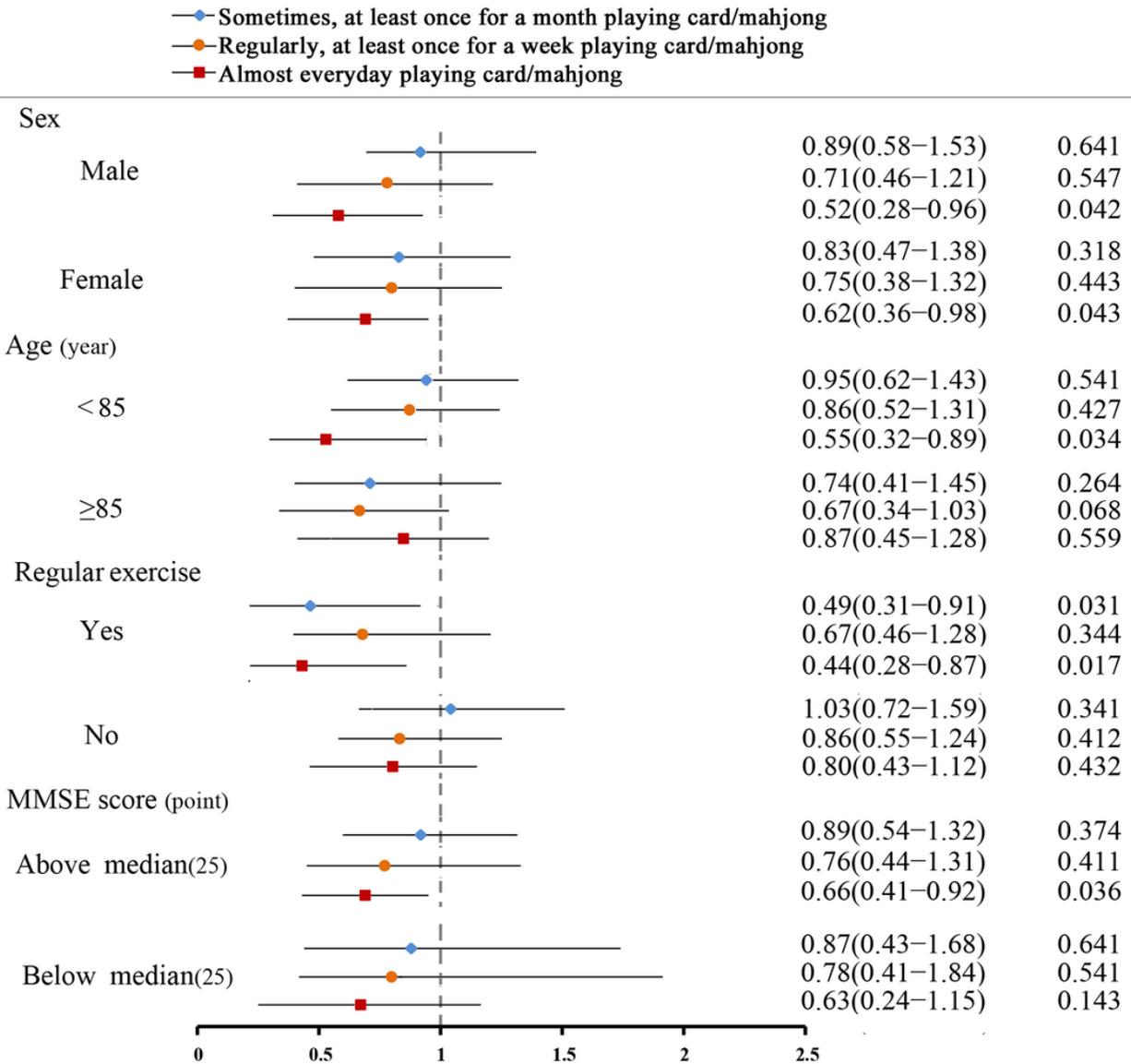


Fig 2 Hazard ratio(HR)and 95% confidence intervals(CIs) for the association between frequency of playing card/mahjong and dementia, with rarely or never playing card/mahjong as a reference group,by baseline sex,age,regular exercise and MMSE score,adjuing for baseline age,sex,education,household income, marital status,smoking status,drinking status, BMI,living with family members, hypertension,diabetes and MMSE score

Figure 2

Hazard ratios (HRs) and confidence intervals (CIs) for the association between frequency of playing cards/mahjong and dementia, with rarely or never playing cards/mahjong as a reference group, by baseline sex, age, regular exercise and MMSE score, adjusting for baseline age, sex, education, household income, marital status, smoking status, drinking status, exercise, BMI, living with family members, hypertension, diabetes and MMSE score.