THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Medical Sciences
cite as: *J Gerontol A Biol Sci Med Sci*, 2020, Vol. 75, No. 4, 739–746
doi:10.1093/gerona/glz086
Advance Access publication April 4, 2019

OXFORD

Research Article

Specific Leisure Activities and Cognitive Functions Among the Oldest-Old: The Chinese Longitudinal Healthy Longevity Survey

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Received: November 13, 2018; Editorial Decision Date: March 16, 2019

Decision Editor: Anne Newman, MD, MPH

Abstract

Background: Little is known about the role of specific leisure activities in affecting cognitive functions. We aim to examine the associations of specific leisure activities with the risk of cognitive impairment among oldest-old people in China. Methods: This community-based prospective cohort study included 10,741 cognitively normal Chinese individuals aged 80 years or older (median age 88 years) from the Chinese Longitudinal Healthy Longevity Survey. Cognitive function was assessed using the Mini-Mental State Examination (MMSE). Cox proportional hazards models were utilized to estimate the effects of specific leisure activities on cognitive impairment outcome. Results: During a median follow-up time of 3.4 years (41,760 person-years), 2,894 participants developed cognitive impairment. Compared to those who "never" engaged in watching TV or listening to radio, reading books or newspapers, and playing cards or mah-jong, those who engaged in such activities "almost every day" reduced their risk of cognitive impairment, the fully-adjusted hazard ratios were 0.56 (0.51–0.61), 0.64 (0.53–0.78), and 0.70 (0.56–0.86), respectively. The association between the risk of cognitive impairment and watching TV and listening to the radio, playing cards or mah-jong, and reading books or newspapers were stronger among those who had two or more years of education. Moreover, the association between risk of cognitive impairment and watching TV and listening to radio was stronger in men than in women. Conclusions: In conclusion, a greater frequency of TV watching or radio listening, reading books or newspapers, and playing cards or mah-jong may decrease the risk of cognitive impairment among the oldest-old.

Keywords: Cognitive impairment, Leisure activity, Oldest-old, Cohort study

Cognitive impairment is an increasing major public health concern globally. According to the World Alzheimer Report 2016 (1), 47 million people worldwide were diagnosed with dementia and this number is estimated to rise to 132 million by 2050. To date, there is

no known effective treatment for dementia or cognitive impairment. It is therefore essential to identify protective and risk factors, particularly those that are modifiable, in order to provide early interventions to prevent or delay the onset of cognitive impairment or dementia (2).

Emerging evidence indicates that active participation in leisure activities (eg, intellectual activity, cognitive activity, and social activity) is associated with a lower risk of cognitive impairment in older adults (65+ years) (3–9), although specific type of leisure activities remains uncertain. For instance, available studies have generated conflicting findings: Whereas data from the English Longitudinal Study on Aging showed that watching TV is associated with an increased risk of cognitive impairment (10), several other studies (11,12) reported a negative effect of watching TV on cognitive impairment. In contrast, other two published studies indicated that watching TV likely protects against cognitive impairment (3,13).

Individuals aged 80 years or above constitute the fastest growing segment of the elderly population (14). Despite the high prevalence of cognitive impairment among this segment (15), very few studies have prospectively investigated the association of cognition and specific leisure activities among the oldest-old. In addition, different levels of education may influence engagement in leisure activities and/or the specific type of activities. For instance, people with a low education level may exhibit lower engagement in reading books (6). However, much of the evidence regarding the potential role of leisure activities in cognitive impairment comes from developed countries or areas (eg, Sweden, the United States, and Hong Kong) (4,6), while research investigating the potential effect of specific leisure activities on cognitive impairment for people with lower education levels in developing countries is very limited.

In the current study, using longitudinal data collected from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) study, we examined specific leisure activities and the risk of cognitive impairment among the Chinese oldest-old (80 years or older).

Methods

Study Setting and Participants

The data used in the present study were derived from the CLHLS. Details of the CLHLS have been described previously (16,17). Briefly, from 1998 to 2014, the CLHLS was conducted by randomly selecting 631 counties or cities in 22 of the 31 provinces in mainland China, constituting about 85% of the total Chinese population. The initial surveys were 1998 and then implemented and recruitment of new participants in the years 2000, 2002, 2005, 2008, and 2011, with an estimated 90% response rate during each wave. All centenarians (aged 100 and older) in selected counties or cities were interviewed along with one nearby octogenarian (aged 80–89 years) and nonagenarian (aged 90–99 years) matched by geographical unit and sex. This selection process was designed to ensure comparable numbers of randomly chosen men and women octogenarians, nonagenarians, and centenarians. Ethical approval for the CLHLS study was obtained from the Ethics Committee of Peking University (IRB00001052-13074) and all participants provided written informed consent.

We included oldest-old people (80 years or older) from the 1998 survey and the new participants from the follow-up surveys. We included free cognitive impairment oldest-old people, which was defined as having Mini-Mental State Examination (MMSE) scores ≥18 at baseline. Participants without baseline data regarding leisure activities were excluded. In addition, participants without follow-up MMSE measure were excluded as in previous studies (17,18), because these individuals could not contribute to the assessment of risk. A flowchart of the participant enrollment in this study is shown in Supplementary Figure 1. The final sample that met inclusion criteria for this study was 10,741 participants. Specifically, 6,188 octogenarians, 3,261 nonagenarians, and 1,292 centenarians were included. All information was collected through in-home interviews. All interviews were conducted by a well-trained local doctor/nurse, census enumerator, or the CLHLS research team member. The information was obtained from proxy respondents, usually a spouse or close family member, if respondents were unable to answer questions.

Assessment of Leisure Activities

Self-reported information on leisure activity data was collected through in-home interviews. At baseline, the participants were interviewed regarding their engagement in six leisure activities, including watching TV or listening to radio, playing cards or mah-jong, reading newspapers or books, keeping domestic animals or pets, gardening, and attending religious activities. The participants reported their frequency of participation as "almost every day," "sometimes," or "never" for each individual activity.

Ascertainment of Cognitive Impairment

Global cognitive function at baseline was evaluated using the Chinese version of the MMSE, an assessment tool widely used for testing cognitive status (19,20). The MMSE tests consist of 30 items within six dimensions: orientation, registration, attention, language, memory, and visual construction skills. The total MMSE score ranges from 0 to 30 points, with higher scores reflecting better cognitive function. As previously reported, we used a cutoff MMSE score below 18 points to define cognitive impairment (21–24). This cutoff score has been reported to be 80–100% specific and 80–90% sensitive to a diagnosis of cognitive impairment among older Chinese adults (19,24). Because a reliable decline in MMSE should be at least two to four points (25), we performed an additional restriction of MMSE decline ≥4 points to definition of the cognitive impairment. We considered the time to first known cognitive impairment as the length of time for the survival analysis. For participants who did not develop cognitive impairment, the censoring time for the purposes of statistical analysis was the time of the last MMSE assessment.

Assessment of Covariates

Several potential confounders and effect modifiers were measured and defined as follows: sociodemographic information including age (year), sex (men and women), education level (year), body mass index (BMI, <18.5, 18.5–24.0, or ≥24.0 kg/m^2), living pattern (living alone or with others), residence (urban or rural), and current marital status (married or not); lifestyle behaviors such as smoking status (current smoker, former smoker, or nonsmoker), alcohol consumption (current drinker, former drinker, or nondrinker), regular exercise (yes or no), regular fresh fruit consumption (yes or no), and vegetable consumption (yes or no); prevalence of diabetes mellitus (yes or no), cerebrovascular disease (yes or no), and heart disease (yes or no), activities of daily living (ADL) (26) (restricted or normal), and housework (almost every day, sometimes or never). Hypertension was defined as systolic blood pressure of 140 mmHg or higher and/or diastolic blood pressure of 90 mmHg or higher, or self-report of a diagnosis of hypertension by a physician. Depressive symptoms were measured with two

self-assessment questions: (i) Have you felt sad, blue or depressed for 2 weeks or more? (ii) Have you lost interest in things, like hobbies, work, or activities that usually give you pleasure? Respondents who had at least one positive answer were defined to have depressive symptom. All covariate information was obtained using a standardized and structured questionnaire in the baseline survey (27).

Statistical Analysis

All statistical analyses were performed using R version 3.4.3 (R Development Core Team, 2018); $p < .05$ (two-sided) was considered statistically significant. On the whole, less than 4% of the data for the study covariates were missing, and the multiple imputation method was used to correct for missing values and reduce the potential for inferential bias (28). The median and interquartile range (IQR) (continuous variables) or number and percentage (categorical variables) were used to describe the participants' characteristics at baseline.

Cox proportional hazards models were applied to estimate the hazard ratio (HR) and 95% confidence intervals (95% CI) for leisure activities associated with the risk of developing cognitive impairment. Moreover, the Cox proportional hazards assumption was evaluated with Schoenfeld residual plots, and no evidence of a violation of the assumption was observed in our analyses. Three sets of models were used. In model 1, the baseline ADL and participation in other leisure activities were adjusted, and in model 2, additional variables were adjusted to: the baseline age, sex, education level, marital status, living pattern, and residence; in model 3 (fully-adjusted model), additional variables were controlled for: smoking status, alcohol consumption, frequent vegetable consumption, frequent fruit consumption, regular exercise, BMI, hypertension, diabetes mellitus, heart disease, cerebrovascular disease, housework, and baseline MMSE scores.

The interaction analyses were performed according to sex (men or women), education level (<2 or ≥2 years), residence (urban or rural), smoking status (current smoker, or nonsmoker), alcohol consumption (current drinker or nondrinker), regular exercise (yes or no), BMI (normal weight: 18.5–24.0 kg/m^2, or abnormal weight: <18.5 or ≥24.0 kg/m^2) (29), and current marital status (married or unmarried). The Wald test for the interaction term was performed.

We conducted several sensitivity analyses to determine the robustness of our primary findings by (i) additionally adjusting for depressive symptoms at baseline; (ii) adjusting for self-reported bronchitis, emphysema, asthma, and pneumonia; (iii) adjusting for the year of recruitment; (iv) restricting analyses to participants with two or more follow-up MMSE assessments; and (v) restricting analyses to participants without missing covariate data.

Results

Baseline Characteristics

The participant characteristics at baseline are summarized in Table 1. Of the 10,741 participants (median age of 88.0 years),

Table 1. Baseline Characteristics of the Study Participants

Variables	Values[a]	Variables	Values
Number of participants	10,741	Baseline MMSE score, median (IQR)	27 (24.0, 29.0)
Age, years, median (IQR)	88.0 (83.0–93.0)	Education level, years, median (IQR)	0.0 (0.0–3.0)
Men	4,896 (45.6)	Impaired activity of daily living	1,654 (15.4)
Marital status		Watching TV or listening to radio	
Married	2,659 (24.8)	Never	3,520 (32.8)
Unmarried	8,082 (75.2)	Sometimes	2,936 (27.3)
Living pattern		Almost everyday	4,285 (39.9)
Live alone	2,345 (15.4)	Religious activities	
Living with others	9,088 (84.6)	Never	9,075 (84.5)
Residence		Sometimes	1,267 (11.8)
Urban	4,685 (43.6)	Almost everyday	399 (3.7)
Rural	6,056 (56.4)	Keeping domestic animals or pets	
BMI, kg/m^2		Never	9,169 (85.4)
<18.5	4,474 (41.7)	Sometimes	707 (6.6)
18.5–24.0	4,759 (44.3)	Almost everyday	865 (8.1)
≥24.0	1,508 (14.0)	Reading books or newspapers	
Smoking status		Never	8,622 (80.3)
Nonsmoker	7,067 (65.8)	Sometimes	897 (8.4)
Current smoker	2,050 (19.1)	Almost everyday	1,222 (11.4)
Former smoke	1,624 (15.1)	Gardening	
Alcohol consumption		Never	7,952 (74.0)
Nondrinker	7,187 (66.9)	Sometimes	1,205 (11.2)
Current drinker	2,464 (22.9)	Almost everyday	1,584 (14.7)
Former drinker	1,090 (10.1)	Playing cards or mah-jong	
Regular exercise	5,288 (49.2)	Never	8,906 (82.9)
Frequent fruit consumption	9,233 (86.0)	Sometimes	1,202 (11.2)
Frequent vegetable consumption	3,320 (30.9)	Almost everyday	633 (5.9)
Hypertension	4,243 (39.5)	Housework	
Heart disease	740 (6.9)	Never	4,642 (43.2)
Diabetes mellitus	124 (1.2)	Sometimes	2,035 (18.9)
Cerebrovascular disease	304 (2.8)	Almost everyday	4,064 (37.8)

Note: BMI = Body mass index; IQR = Interquartile range; MMSE = Mini-Mental State Examination.
[a]Values are *n* (%) unless otherwise noted.

45.6% were men, 56.4% lived in rural areas, and 43.6% resided in urban areas. The median (IQR) education level was 0.0 (0.0–3.0) years. Nearly one-quarter (23.9%) consumed alcohol, 19.1% were current smokers, and 49.2% reported regular engaging in exercise. Most (86.0%) participants frequently consumed fruit, whereas 30.9% of the participants were frequent vegetable consumers. The self-reported chronic diseases included hypertension (39.5%), diabetes mellitus (1.2%), heart disease (6.9%), and cerebrovascular disease (2.8%). The proportions of participants who never watch TV or listening to radio, engage in religious activities, keep domestic animals or pets, read books or newspapers, engage in gardening, and play cards or mah-jong at baseline were 32.8%, 84.5%, 85.4%, 80.3%, 74.0%, and 82.9%, respectively.

Association Between Specific Leisure Activities and Cognitive Impairment

During a median follow-up time of 3.4 years (41,760 person-years), we documented 2,894 participants with cognitive impairment. Table 2 presents specific leisure activities and their associations with the risk of cognitive impairment. In the fully-adjusted model (model 3), compared with the participants who "never" engaging in watching TV or listening to radio, "almost every day" (HR: 0.56, 95% CI: 0.51–0.61) was more strongly associated with a reduced risk of cognitive impairment versus "sometimes" (HR: 0.67, 95% CI: 0.61–0.73); compared with the participants who "never" engaging in reading books or newspapers, "almost every day" (HR: 0.64, 95% CI: 0.53–0.78) was more strongly associated with a lower risk of cognitive impairment versus "sometimes" (HR: 0.82, 95% CI: 0.69–0.98); moreover, compared with "never" engaging in playing cards or mah-jong, "almost every day" (HR: 0.70, 95% CI: 0.56–0.86) was similarly associated with a reduced risk of cognitive impairment versus "sometimes" (HR: 0.69, 95% CI: 0.60–0.81). However, the frequencies of engagement in gardening ("almost every day" vs never, or "sometimes" vs "never") was not associated with the risk of cognitive impairment during the follow-up period.

We conducted a stratified analysis by age group (octogenarians, nonagenarians, and centenarians) using the fully-adjusted models (Table 3). Compared with those who "never" engaged in watching TV or listened to the radio, the estimated effects of engaging in this activity "sometimes" or "almost every day" were similar among the different age groups. Compared with those who "never" engaged in playing cards or mah-jong, the estimated effects of engaging in these activities "sometimes" or "almost every day" showed a significantly reduced risk of cognitive impairment in the octogenarians and nonagenarians, but not in the centenarians.

Table 2. Association Between Leisure Activities and Cognitive Impairment

	HR (95% CI) for cognitive impairment		
	Model 1[a]	Model 2[b]	Model 3[c]
Number of participants	10,741		
Number of events	2,894		
Number of person-years	41,760		
Watching TV or listening to radio			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.62 (0.57–0.68)***	0.65 (0.59–0.71)***	0.67 (0.61–0.73)***
Almost everyday	0.49 (0.45–0.54)***	0.53 (0.49–0.59)***	0.56 (0.51–0.61)***
Playing cards or mah-jong			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.60 (0.52–0.70)***	0.66 (0.57–0.77)***	0.69 (0.60–0.80)***
Almost every day	0.60 (0.49–0.74)***	0.66 (0.54–0.82)***	0.70 (0.57–0.86)***
Reading books or newspapers			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.66 (0.55–0.78)***	0.77 (0.64–0.91)***	0.82 (0.69–0.98)*
Almost every day	0.53 (0.44–0.63)***	0.61 (0.51–0.73)***	0.64 (0.53–0.78)***
Religious activities			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.90 (0.80–1.02)	0.97 (0.86–1.10)	1.00 (0.88–1.13)
Almost every day	1.13 (0.93–1.37)	1.11 (0.92–1.34)	1.13 (0.93–1.37)
Gardening			
Nerve	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.88 (0.78–0.99)*	0.93 (0.83–1.05)*	0.97 (0.86–1.10)
Almost every day	0.74 (0.67–0.83)**	0.85 (0.76–0.95)**	1.04 (0.92–1.17)
Keeping domestic animals or pets			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.88 (0.75–1.04)	0.95 (0.80–1.12)	0.99 (0.84–1.17)
Almost every day	0.58 (0.48–0.71)***	0.65 (0.53–0.79)***	0.69 (0.57–0.84)***

Note: CI = Confidence interval; HR = Hazard ratio.

[a]Model 1: adjusted for ADL and participation in other leisure activities. [b]Model 2: further adjusted for age, sex, education level, marital status, living pattern, and residence. [c]Model 3 (fully-adjusted model): further adjusted for smoking status, alcohol consumption, frequent vegetable consumption, frequent fruit consumption, regular exercise, BMI, hypertension, diabetes mellitus, heart disease, cerebrovascular disease, housework, and baseline MMSE scores.

*$p \le .05$, **$p \le .01$, ***$p \le .001$.

Table 3. Association Between Leisure Activities and Cognitive Impairment According to Age Groups

	HR (95% CI) for Cognitive Impairment[a]		
	Octogenarians	Nonagenarians	Centenarians
Number of participants	6,188	3,261	1,292
Number of events	1,270	1,047	587
Number of person-years	26,843	11,117	3,800
Watching TV or listening to radio			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.63 (0.55–0.73)***	0.70 (0.60–0.81)***	0.64 (0.52–0.80)***
Almost every day	0.56 (0.49–0.65)***	0.56 (0.48–0.67)***	0.50 (0.39–0.63)***
Playing cards or mah-jong			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.63 (0.51–0.78)***	0.73 (0.57–0.93)*	0.92 (0.61–1.39)
Almost every day	0.76 (0.58–0.99)*	0.65 (0.44–0.96)*	0.63 (0.32–1.24)
Reading books or newspapers			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.84 (0.65–1.08)	1.02 (0.76–1.36)	0.51 (0.28–0.91)*
Almost every day	0.69 (0.53–0.90)**	0.56 (0.40–0.78)***	0.81 (0.50–1.34)
Religious activities			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.98 (0.83–1.17)	1.11 (0.90–1.37)	0.96 (0.69–1.33)
Almost every day	1.13 (0.84–1.51)	1.12 (0.81–1.55)	1.16 (0.75–1.79)
Gardening			
Nerve	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.90 (0.75–1.08)	1.02 (0.82–1.25)	1.15 (0.84–1.57)
Almost every day	1.01 (0.86–1.18)	1.03 (0.84–1.28)	1.16 (0.83–1.61)
Keeping domestic animals or pets			
Never	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sometimes	0.90 (0.70–1.15)	1.06 (0.80–1.39)	1.41 (0.92–2.18)
Almost every day	0.76 (0.66–0.91)*	0.61 (0.42–0.89)*	0.58 (0.55–0.93)*

Note: CI = Confidence interval; HR = Hazard ratio.

[a]Adjusted for age, sex, education level, marital status, living pattern and residence, smoking status, alcohol consumption, frequent vegetable consumption, frequent fruit consumption, regular exercise, BMI, hypertension, diabetes mellitus, heart disease, cerebrovascular disease, housework, ADL, participation in other leisure activities, and baseline MMSE scores.

*$p \le .05$, **$p \le .01$, ***$p \le .001$.

Subgroup Analysis

Figure 1 presents the subgroup analyses of specific leisure activities and risk of cognitive impairment. After fully adjusting for the covariates, we observed statistical interactions between education level (>2 or ≤2 years) and the following: watching TV and listening to radio ("almost every day" vs "never," *p*-interaction < .001); playing cards or mah-jong ("sometime" vs "never," *p*-interaction = .003); and reading books or newspaper ("almost every day" vs "never," *p*-interaction = .006). The aforementioned leisure activities decreased the risk of cognitive impairment more strongly in participants with 2 years or more years of education. Moreover, there is a significant (*p*-interaction = .019) watching TV and listening to radio interaction ("almost every day" vs "never") with sex; the association was stronger in men than in women. We found no consistently significant effects of the interactions among residence, smoking status, drinking status, and BMI on the associations between leisure activities and cognitive impairment risk (Figure 1).

Sensitivity Analysis

Our sensitivity analyses yielded no material changes in the results after additionally adjusting for depression symptoms (Supplementary Table 1), self-reported bronchitis, emphysema, asthma, and pneumonia (Supplementary Table 2), time of recruitment (Supplementary Table 3), after we exclude participants with missing data covariate (Supplementary Table 4). Likewise, restricting the analyses to subjects with at least 2 years of follow-up in order to further reduce the effect of reverse causality did not materially change the observed associations (Supplementary Table 5).

Discussion

This large community-based cohort study suggests that more frequent engagement in leisure activities including watching TV or listening to radio, reading books or newspapers, and playing cards or mah-jong, is associated with a significant reduction in the risk of cognitive impairment among the oldest-old, even when we adjust for important potential confounders. Furthermore, the protective association between the risk of cognitive impairment and activities including watching TV and listening to the radio, playing cards or mah-jong, and reading books or newspapers was stronger for participants with two or more years of education than for those with less education.

In contrast to our results, previous studies have shown that more frequent TV watching is associated with an increased risk of cognitive impairment or dementia (11,30). The difference between those findings and our results might be due to the differences in participant characteristics. The participants in the current study had very low levels of education (median education level: 0 years, IQR: 0–3 years), compared with the education levels of participants in previous studies (11,31). Watching TV and listening to the radio might

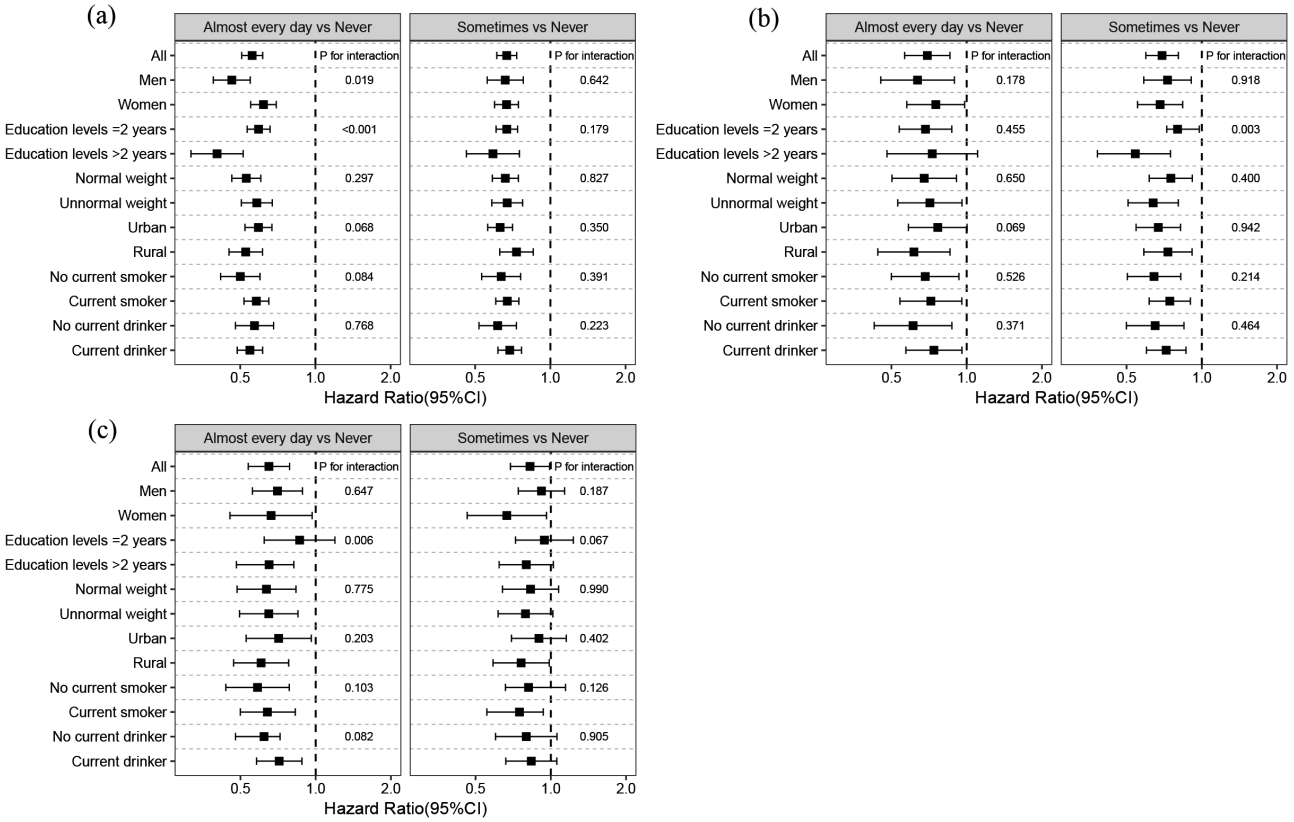

Figure 1. Forest plot of the subgroup analysis of the association between leisure activities and risk of cognitive impairment. The HR (95% CI) of the risk of cognitive impairment per subgroup is provided. The *P*-value of each interaction is provided. (**a**) Watching TV or listening to radio. (**b**) Playing cards or mah-jong. (**c**) Reading books or newspapers. CI = Confidence interval; HR = Hazard ratio.

serve as a major source of cognitive stimulation helping to maintain cognitive function, as participation in other cognitive activities (eg, reading a book or newspaper) might be restricted by low level of education. Moreover, using data from 2002, 2005, and 2008–2009 wave of the CLHLS, Zhu and colleagues (3) showed a protective effect of watching TV and listening to the radio in reducing cognitive impairment risk in older adults (65 years or older).

Our results are consistent with several previous studies (11,32) showing that more frequently playing cards or mah-jong is associated with a decreased risk of cognitive impairment. This finding may be explained by the fact that playing cards or mah-jong (a Chinese tile-based game) is a strong cognition-stimulating activity involving comprehensive cognitive domains (including attention, memory, calculation, and initiative capacity) (11) and interpersonal social contact, which is also known to be associated with a decreased risk of cognitive impairment (6,33). Kåreholt and colleagues conducted a prospective cohort study indicated that engage in mental activities (eg, reading books) in midlife were associated with reducing risk of cognitive impairment in later life (34). Moreover, a recent longitudinal observational study found that active participation in intellectual activities, such as playing mah-jong and reading books, might help delay or prevent dementia in older adults (4). Our study is consistent with the finding of that study, as we found that more frequent reading of books or newspapers was associated with a lower risk of cognitive impairment in the oldest-old people. Reduced participation in those leisure activities might reflect neurological disease that affects both leisure activities and cognitive outcomes.

This study also indicated that the associations between the risk of cognitive impairment and watching TV and listening to the radio, playing cards or mah-jong, and reading books or newspapers vary by education levels (≤2 or >2 years). The possible explanation for this phenomenon is the participants with higher education level may develop higher mental complexity, for the same leisure activity they will participate in a greater extent when compared with participants with lower education level, and finally they will get more benefit for their cognitive function (35). Furthermore, the skills developed from early-life educational experiences may enable these individuals to participate in activities throughout adulthood in a more productive and active way. Moreover, the motivational states achieved during these specific leisure activities, which may contribute to the advantages gained from these activities, might also vary according to differing education levels among the oldest-old (3). This finding suggests that investment in education, especially in developing countries with very low education levels, should be viewed as a public health intervention to address cognitive impairment benefiting.

The present study is the largest prospective cohort study to investigate the association between leisure activities and the risk of developing cognitive impairment in Asian oldest-old persons (80 years or older). The strengths of this study are its community-based, prospective design, the large sample of the oldest-old, adjustment for established and potential confounders, and robust results of sensitivity analyses. The current study has several limitations. First, this study is limited by its observational design. Hence, a causal relationship cannot be concluded. Second, although we carefully controlled for several identified and potential confounders,

such as sociodemographic information, lifestyle factors, and self-reported medical histories, there was still the potential for residual confounding by other unmeasured or unknown variables (eg, sleep quality). Third, the measures did not include information about the frequency, duration, intensity, or energy expenditure of the activities, possibly leading to imprecise measurements.

In conclusion, our study provides evidence that more frequently watching TV or listening to the radio, playing cards or mah-jong, and reading books or newspapers may decrease the risk of cognitive impairment among the oldest-old. Given the increasing elderly population worldwide, promoting more frequent engagement in these activities could protect against cognitive impairment.

Supplementary Material

Supplementary data is available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

Funding

The Chinese Longitudinal Healthy Longevity Study (CLHLS), which provided the data analyzed in this paper, is jointly supported by the National Natural Sciences Foundation of China (71233001, 71490732, and 81573247), and the U.S. National Institute of Aging (2P01AG031719 and 3P01AG031719-07S1). This work was supported by the National Key Research and Development Program of China (2018YFC2000400), the Construction of High-level University of Guangdong (C1050008 and C1051007), and the National Institutes of Health (NIH/NIA P30-AG028716). The funders played no role in study design or implementation; data collection, management, analysis, and interpretation; manuscript preparation, review, or approval; or the decision to submit the manuscript for publication.

Author Contributions

C.M., Z.H.L., and Y.B.L. designed the research and developed the analytical plan. X.M.S., Y.Z., and X.B.W. directed the study. C.M. and Z.H.L. performed the statistical analyses and had primary responsibility for writing the manuscript. J.H.Z. and W.Y.S. contributed to data cleaning. X.G., V.B.K., F.R.L., S.M.L, Z.X.Y., and X.M.S. contributed to the acquisition, analysis, or interpretation of the data. All authors critically reviewed the manuscript for important intellectual content.

Conflict of Interest

All authors have no conflicts of interest to report in relation to the current article.

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