



Leisure activities and cognitive function in elderly community-dwelling individuals in Japan: A 5-year prospective cohort study

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ABSTRACT

Objective: This study aimed to clarify the longitudinal relationship between leisure activities and cognitive decline among Japanese community-dwelling older adults, using a 5-year prospective cohort study design.

Methods: A total of 567 men and women, aged 70 years and over, participated in the study. The Mini-Mental State Examination was used in baseline and follow-up surveys to assess cognitive function. The change in cognitive function from baseline to follow-up was determined, and cognitive decline over 5 years was used as the outcome variable. Leisure activities (hobby, social activity, and physical activity) were assessed at baseline and used as independent variables. Age, gender, number of years of education, presence of chronic diseases, instrumental activities of daily living, depressive symptoms, smoking, hearing deficits, and level of cognitive function at baseline were used as covariates.

Results: Multivariate logistic regression analysis, adjusted for potential confounders, showed that non-participation in a hobby was significantly and independently associated with cognitive decline (odds ratio: 1.87, 95% confidence interval: 1.16–3.02, $p < 0.01$). There were no significant relationships between social activity, physical activity and cognitive decline.

Conclusions: Our study found a longitudinal inverse relationship between hobby participation and cognitive decline among elderly Japanese community-dwelling individuals, suggesting that engaging in a hobby in later life can contribute to preserving cognitive function.

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Introduction

Along with the aging of populations worldwide, the prevalence of dementia in later life will increase rapidly. In Japan, it has been estimated that the number of people with dementia will peak in 2036 at around 3,550,000 people, that is, 10.8% of subjects aged 65 years and older [1]. These predicted changes offer complex and intriguing challenges for geriatricians and gerontologists who endeavor to prevent older people from developing dementia and becoming bedridden.

It has been reported that frequently engaging in leisure activities is associated with a lower risk of dementia and deterioration in cognitive function among community-dwelling older adults [2–4]. The Japan Ministry of Health, Labour and Welfare has introduced a Dementia Prevention Program [5], which encourages community-dwelling elderly subjects to engage in various leisure activities that help to stimulate their cognitive function in daily life (e.g., reading books, watching TV

shows, gardening, playing challenging board games such as go or shogi, walking, and light exercise). We focus on the Dementia Prevention Program developed by the Japan Ministry of Health, Labour and Welfare because it is appropriate for the very elderly living in a community setting, who have various everyday physical impediments and whose physical function gradually deteriorates.

The Dementia Prevention Program was developed on the basis of findings from European and American longitudinal studies [2–4], which found an association between participation in leisure activities and a reduction in the incidence of dementia. However, since lifestyles and preferred activities among elderly individuals in Western countries may be different from those of elderly Japanese, it is questionable whether the findings from Western countries are applicable to dementia prevention strategies for older Japanese adults. The Cabinet Office of the Japanese Government reported that elderly individuals in Japan frequently engaged in various leisure activities, including gardening (34.3%), watching TV (31.4%), traveling (27.9%), walking (20.8%), knitting or Japanese-style pursuits (tea ceremonies, Japanese dancing, flower arrangement) (17.5%), reading books (16.4%), drawing (15.9%), sports (14.8%), Karaoke (10.5%), theater (6.8%), and playing challenging board games such as go or shogi (4.7%) [6]. Some of these activities were particular to Japan, thus the association between leisure

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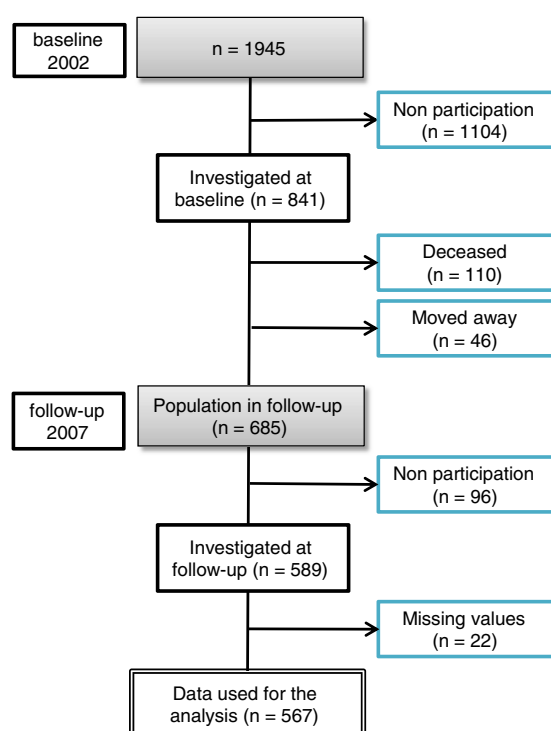


Fig. 1. Study sample in the analysis.

activity and cognitive decline should be re-examined among elderly Japanese subjects.

This study aimed to clarify a longitudinal relationship between leisure activities and cognitive decline among community-dwelling elderly Japanese, using a 5-year prospective cohort study design. Confirmation of a longitudinal relationship between leisure activities and cognitive decline could facilitate the development of specific strategies to prevent cognitive decline and dementia in older adults in Japan.

Methods

Participants

The data for the present study was acquired from the mass health checkups for community-dwelling older adults ("Otasha-Kenshin") [7,8], conducted by the Tokyo Metropolitan Institute of Gerontology. "Otasha-Kenshin" means "health checkups for accomplishing successful aging" in Japanese. The study was administered in Itabashi

ward in northern Tokyo, and we were granted access to the municipal resident registration files by the Itabashi ward authorities. Participants took part in a face-to-face interview at baseline and at 5-year follow-up with trained research assistants. The study was approved by the Ethics Committee of the Tokyo Metropolitan Institute of Gerontology. The study was explained to all participants, who were advised that: 1) their participation would be entirely voluntary; 2) they could withdraw from the study at any time; and 3) if they chose not to participate or to withdraw, then they would not be disadvantaged in any way. As of 2002, a sample of 1945 residents (aged 70–84 years) was obtained systematically from the municipal resident registration files. We acquired 841 completed sets of data (43.2% participation) in the baseline survey.

Of those who participated in the baseline survey, 589 participated in the follow-up survey 5 years later in 2007. Of the remaining 252 subjects, 110 had died during the 5-year follow-up period, 46 had moved to a different part of Japan, and 96 declined to participate. Of the 589 people who did participate in the follow-up survey, 22 were excluded from the analysis because they had missing cognitive performance data. In total, 567 participants (285 male, 282 female; mean age: 75.8 ± 3.5 , age range: 70–84 at baseline) with a complete set of data were included in this analysis (see Fig. 1).

Those subjects who died or moved away during the follow-up period had a lower proportion of women (30.8% vs. 49.7%, $p < 0.01$), were older (77.1 vs. 75.8 years, $p < 0.01$) and had a similar number of years of education (10.8 vs. 10.7 years, $p = 0.83$), an identical rate of depression (3.2% vs. 1.6%, $p = 0.19$), a higher rate of chronic disease (48.7% vs. 35.9%, $p < 0.01$), an identical rate of hearing deficits (9.6% vs. 7.8%, $p = 0.45$), an identical rate of smoking (21.9% vs. 16.9%, $p = 0.15$), lower instrumental activities of daily living score (IADL) [9], measured according to the Tokyo Metropolitan Institute of Gerontology Index of Competence (4.6 vs. 4.8 points, $p < 0.01$), lower Mini-Mental State Examination [10] (MMSE) score (26.9 vs. 28.3 points, $p < 0.01$) at baseline, exhibited a lower rate of engaging in hobbies (34.6 vs. 45.7, $p < 0.01$), and similar rates of engagement in social activity (30.1 vs. 37.2, $p = 0.11$) and physical activity (69.9 vs. 69.7, $p = 0.96$) compared with subjects used in the analysis (Table 1).

Those subjects who were excluded or declined to participate in the follow-up survey had an almost identical proportion of women (47.5 vs. 49.7, $p = 0.65$), similar age (76.4 vs. 75.8 years, $p = 0.15$), fewer years of education (10.1 vs. 10.7 years, $p < 0.05$), a higher rate of depression (5.1% vs. 1.6%, $p < 0.05$), an identical rate of chronic disease (37.3% vs. 35.9%, $p = 0.79$), an identical rate of hearing deficits (11.9% vs. 7.8%, $p = 0.15$), an identical rate of smoking (22.0% vs. 16.9%, $p = 0.19$), a lower IADL score (4.6 vs. 4.8 points, $p < 0.01$), a lower MMSE score (27.3 vs. 28.3 points, $p < 0.01$) at baseline, exhibited a lower rate of engaging in hobbies (33.1 vs. 45.7, $p < 0.01$), and

Table 1
Characteristics of subjects.

	Participants (n = 576)	Deceased/moved away (n = 156)	Non-participants at follow-up (n = 118)	Participants vs. deceased/moved away	Participants vs. non-participants
Gender (% women)	282 (49.7)	48 (30.8)	56 (47.5)	<0.01	0.65
Age (year)	75.8 ± 3.5	77.1 ± 3.7	76.4 ± 3.9	<0.01	0.15
Education (year)	10.7 ± 3.0	10.8 ± 3.5	10.1 ± 2.9	0.83	0.04
Depression (%)	9 (1.6)	5 (3.2)	6 (5.1)	0.19	0.02
Chronic disease (%)	204 (35.9)	76 (48.7)	44 (37.3)	<0.01	0.79
Hearing deficit (%)	44 (7.8)	15 (9.6)	14 (11.9)	0.45	0.15
Smoking (%)	96 (16.9)	34 (21.9)	26 (22.0)	0.15	0.19
IADL (points)	4.8 ± 0.6	4.6 ± 0.93	4.6 ± 0.9	<0.01	<0.01
MMSE (points)	28.3 ± 2.1	26.9 ± 3.2	27.3 ± 2.7	<0.01	<0.01
Hobby (yes %)	259 (45.7)	54 (34.6)	39 (33.1)	0.01	0.01
Social activity (yes %)	211 (37.2)	47 (30.1)	44 (37.3)	0.11	0.99
Physical activity (yes %)	395 (69.7)	109 (69.9)	74 (62.7)	0.96	0.14

Note: t tests for continuous measures and chi-square tests for categorical measures were used to clarify the significance of differences in these characteristics between the two groups (participants vs. deceased/moving away, participants vs. non-participants).

exhibited almost the same rates of engagement in social activity (37.3 vs. 37.2, $p=0.99$) and physical activity (62.7 vs. 69.7, $p=0.14$) compared with subjects used in the analysis (Table 1).

Outcome measure

MMSE was used to assess cognitive function at baseline and follow-up. The change in cognitive function during the 5 years (calculated by subtracting baseline MMSE score from follow-up MMSE score: a negative value signifying a decrease in MMSE score) was an outcome variable. In addition, we used a cutoff score of -3 (meaning that scores of -3 and below were classified as “cognitive decline”) to judge whether participants had meaningful deteriorations in cognitive function over 5 years. Previous studies have pointed out that a change in MMSE score may reflect not only true improvement or decline with aging, but also may be a result of measurement error, regression to the mean, and a practice effect of the test [11,12], and showed that a change in MMSE score of at least 2 to 4 points was necessary to reliably measure a change in scores [12,13].

Independent variables (leisure activities)

Data collected at baseline were used as independent variables. Participants were interviewed regarding leisure activities: hobby, social activity, and physical activity. Subjects were asked whether they engaged in any hobbies (e.g., gardening, watching TV, traveling, knitting, reading books, Karaoke, and playing board games such as go or shogi) “never”, “occasionally”, or “frequently”. In the analysis, these responses were dichotomized into two categories: “never/occasionally” and “frequently”, the former being defined as “no” and the latter as “yes”. Question regarding engagement in social activities (e.g., volunteering and group activities for the elderly) was answered “yes” or “no”. The question regarding regular physical activities (e.g., jogging, walking, Japanese croquet, hiking, dance, swimming, and gymnastics) was answered with a “yes” or “no” response.

Covariates

Data collected at baseline were used as covariates in the analysis of an independent association between leisure activities and cognitive decline. Data for age, gender, number of years of education, presence of chronic diseases, IADL, depressive symptoms (measured according to Mini-International Psychiatric Interview (MINI) [14]), smoking, hearing deficit, and baseline MMSE score, were included. The presence of chronic diseases was defined as at least one disease among diabetes, heart disease, and stroke.

Statistical analyses

Chi-square tests were performed to test the univariate associations between leisure activities and cognitive decline according to each leisure activity (i.e., hobby, social activity, and physical activity). Logistic regression analyses were performed to test the multivariate associations between leisure activities and cognitive decline according to each leisure activity. Adjusted odds ratio estimates and confidence intervals for engagement in the leisure activities, controlled for the above-mentioned covariates, were calculated. All statistical procedures were performed using SAS version 9.1 software (SAS Institute Inc., Cary, NC, USA).

Results

Fig. 2 shows distributions of change in MMSE score between the baseline and follow-up survey. The mean change in MMSE score was -0.94 ± 2.61 (range: -16 to 7). The number (proportion) of participants with cognitive decline was 109 (19.2%).

Table 2 shows the associations between leisure activities and cognitive decline, as assessed by chi-square tests. Those who did not engage in a hobby were more likely to

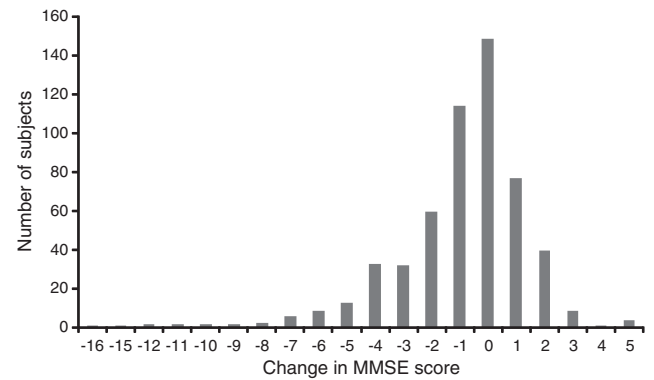


Fig. 2. Change in MMSE score over 5 years ($n=567$). Note: Change in cognitive function was calculated by subtracting baseline MMSE score from follow-up MMSE score: a negative value means a decrease in MMSE during the 5-year period.

experience cognitive decline over 5 years, compared with participants who did (23.4% vs. 14.3%, $p<0.01$). Those who did not engage in social activities and physical activities had an almost identical proportion experiencing cognitive decline, compared with participants who did (20.5% vs. 17.1%, $p=0.31$; 19.8% vs. 18.9%, $p=0.83$, respectively).

Multiple logistic regression analyses were carried out to examine the independent relationships between participation in leisure activities and cognitive decline. There was a significant relationship between lack of participation in a hobby and cognitive decline (odds ratio: 1.87, 95% confidence interval: 1.16–3.02, $p<0.01$) during the 5-year period. There were no significant relationships between participation in social and physical activities and cognitive decline (Table 3).

To examine whether the relationships between participation in leisure activities and cognitive decline were affected by cognitive impairment at baseline, we repeatedly performed the above analysis in subjects with no cognitive impairment according to MMSE scores at baseline. We used a cutoff MMSE score of 24, meaning that scores of 24 and above were classified as no cognitive impairment [15] ($n=541$). The results revealed that, in participants with a score of 24 or above, the association between hobby engagement and cognitive decline remained significant (odds ratio: 1.65, 95% confidence interval: 1.02–2.68, $p<0.05$), while the associations between social and physical activity and cognitive decline remained non-significant.

Discussion

This study aimed to clarify the longitudinal relationship between leisure activities (hobby, social activity, and physical activity) and cognitive decline among Japanese community-dwelling older adults, and found a significant and independent inverse relationship between hobby participation and cognitive decline, even when adjusting for potential confounding factors such as age, gender, number of years of education, presence of chronic diseases, IADL, depressive symptoms, smoking, hearing deficit, and level of cognitive function at baseline, indicating that older individuals who did not enjoy hobbies were more likely to experience cognitive decline during the 5-year period, compared to those who did. There were no significant

Table 2

The number (rate) of participants with cognitive decline over 5 years corresponding to engaging in leisure activities ($n=567$).

	Change in cognitive function		p^a
	Decline	Stable/improved	
Hobby			
Yes	37 (14.3)	222 (85.7)	<0.01
No	72 (23.4)	236 (76.6)	
Social activity			
Yes	36 (17.1)	175 (82.9)	0.31
No	73 (20.5)	283 (79.5)	
Physical activity			
Yes	75 (18.9)	320 (81.1)	0.83
No	34 (19.8)	138 (80.2)	

^a Chi-square test. A cut-off score of -3 (meaning that scores of -3 and below were classified as “cognitive decline”) was used to judge whether participants had significant deterioration over 5 years with respect to cognitive function.

Table 3
Longitudinal relationship between leisure activity and cognitive decline ($n = 567$).

	Odds ratio	95% Confidence interval	p^a
Hobby (no participation)	1.87	1.16–3.02	<0.01
Social activity (no participation)	1.45	0.89–2.34	0.14
Physical activity (no participation)	1.06	0.65–1.74	0.81

^a Multiple logistic regression analyses adjusted for age, gender, number of years of education, presence of chronic disease, IADL (measured according to the Tokyo Metropolitan Institute of Gerontology Index of Competence [9]), depressive symptoms (measured according to MINI [14]), smoking, hearing deficit, and baseline MMSE score.

relationships between participation in social activities and cognitive decline, nor participation in physical activities and cognitive decline.

Our findings were similar to the results of previous studies. Wilson [2] reported that regular engagement in cognitive-stimulating activities (including viewing television, listening to radio, reading newspapers, reading magazines, reading books, playing games such as cards, checkers, crosswords, or other puzzles, and going to museums) was associated with a reduced risk of Alzheimer disease (AD) during a mean follow-up of 4.5 years. Verghese [4] found that regular engagement in cognitive activities (including reading books or newspapers, writing for pleasure, doing crossword puzzles, playing board games or cards, participating in organized group discussions, and playing musical instruments) was associated with a reduced risk of dementia during a mean follow-up of 5.1 years. The previous studies suggested that engaging in activities that demand relatively substantive cognitive resources may be effective in preserving cognitive function in the elderly. The previous studies also showed a significant relationship only between cognitive activities and incidence of dementia, but not a significant relationship between physical activity and incidence of dementia [2,4]. Thus, previous studies and ours suggest that enjoying a hobby (which is a cognitive stimulating activity) may have a protective effect in helping to preserve cognitive function in later life.

Meanwhile, the longitudinal relationship could be explained by “reverse causality”, with which a loss of hobby participation would occur after an early stage of cognitive deficit developed owing to pre-clinical dementia. Quitting a hobby may constitute an early sign of dementia incidence [4], and such potential dementia cases are more likely to experience cognitive decline eventually. Because the current study did not conduct dementia discrimination at baseline, we cannot exclude the possibility that such potential dementia cases may have been included into the study cohort. However, the likelihood of this possibility occurring in the current study may be weakened, for two reasons. First, the multivariate analysis controlled for baseline cognitive function levels. Second, the association between hobby participation and cognitive decline remained significant when the analysis was restricted to subjects with no cognitive impairment [15] (defined by a cutoff MMSE score of 24 or above). Because, in the present findings, it is difficult to decide whether the longitudinal relationship ought to be explained by the protective effect or by reverse causality, further investigations with longer follow-up periods are needed in the future.

We speculate that there could be three mechanisms underlying the relationship between hobby participation and cognitive decline in the elderly. The first pathway may be related to the “use it or lose it” hypothesis [16], from a famous saying in English. Older individuals tend to experience deterioration in their cognitive and physical function if they physically and mentally receive little stimulus in everyday life (i.e., “disuse syndrome”) [17]. Thus, since some hobbies demand use of cognitive resources and stimulate cognitive function, engagement in a hobby may have a beneficial effect in preventing older individuals from failing into the disuse syndrome, and consequently reduce the deterioration in cognitive function.

The second pathway underlying the relationship between hobby participation and cognitive decline may be related to the “cognitive

reserve hypothesis” [18–20]. Previous studies have suggested that there are individual differences in tolerance to dementia pathology. Price [21] examined a relationship between neuropathological diagnosis at autopsy and clinical diagnosis of AD before death, and demonstrated that around 40% of non-demented individuals met at least some level of criteria for neuropathological AD, suggesting that there may be a lag between neuropathological states and manifestation of dementia symptoms (e.g., behavior disorders and cognitive decline), and that some non-demented older individuals may also have the potential for progression of cognitive dysfunction. Similarly, according to the Nun study [22], the lag may vary among individuals. The study found that those who showed a neuropathological state of AD at autopsy included not only individuals with dementia clinically manifest before death but also cognitively intact individuals. The findings indicate that there may be individual differences in cognitive reserve, which is an ability to tolerate dementia pathology. Previous studies assumed that cognitive reserve varied according to characteristics such as education and occupational attainment. Hence, those with higher education and career progression in earlier life are likely to have enhanced cognitive reserve in later life [18,19]. Previous studies demonstrated that older adults with higher education [23,24] and occupation attainment [23] were less likely to develop dementia. The results might be related to frequent engagement in cognitively challenging activities and consequent enhanced cognitive reserve. Thus, regularly engaging in a hobby may have a beneficial effect in preventing cognitive decline in later life by enhancing cognitive reserve.

The third pathway underlying the relationship between hobby participation and cognitive decline may be related to “the positive affect hypothesis”. Engaging in a hobby brings a “positive affect” (including happiness, joy, enthusiasm, contentment, subjective well-being, self-esteem, and congenial mood) to older adults. A previous study [25] reviewed the relationships between these positive affects and health outcomes, including mortality, morbidity, physical functioning, and others (cardiovascular, endocrine, and immunological diseases), and suggested that a positive affect regulated the central nervous system and hypothalamic–pituitary–adrenal axis activity. Hyperactivity in the axis may be detrimental to health because it causes a loss of hippocampal neurons and hippocampus atrophy [3,26–28], and an increase in cardiovascular risk factors (e.g., elevated blood pressure, cardiac dysrhythmia, and elevated platelet activation) [3,25,29], which increase the risk of dementia. Hence, engaging in a hobby may preserve cognitive function by providing a positive affect.

The relationship between hobby participation and cognitive decline may be confounded by depressive symptoms. It is well known that quitting a hobby is an early sign of depressive symptoms. In fact, the Geriatric Depression Scale, which is widely used to assess depressive symptoms among older individuals, includes an item related to having quit their hobby (i.e., “Have you dropped many of your activities and interests?” [30]). Also, a previous study reported that older individuals with depressive symptoms tend to experience cognitive decline [31]. Thus, the presence of depressive symptoms can be a confounding factor that affects the association between engaging in hobbies and cognitive decline. Nevertheless, our study controlled for the confounding effect of depressive symptoms (assessed by the MINI [14]) and found an independent inverse relationship between participation in a hobby and cognitive decline.

Our findings were inconsistent with the results of previous studies, which showed a longitudinal relationship between social engagement and preserving cognitive function among older adults [32,33]. Wang [32] found a relationship between participation in social activities (including traveling, playing card games, group activities, and volunteer activities) and reduced risk of dementia. Ertel [33] found a relationship between participation in social activities (including marital status, volunteering, frequency of contact with children, parents, and neighbors) and preservation of cognitive function using a

large, representative sample of American citizens. Meanwhile, Fabrigoule [34] did not find a significant association between participation in golden age clubs, which is one of the social activities of the elderly, and incidence of dementia, using a 3-year longitudinal study design in older individuals dwelling in Gironde (France). Further detailed explorations of the relationship are required to resolve the contradictions.

Our findings were inconsistent with the results of previous studies, which showed a longitudinal relationship between regular physical activity and preservation of cognitive function among older adults by observational study [35,36,37]. Larson [35] reported that older individuals who engaged in regular exercise (three or more times per week) were less likely to develop dementia during a mean follow-up of 6.2 years. Lindsay [37] reported that regular exercise (“regular” was not explicitly defined in the study) was associated with a reduced risk of AD in a 5-year prospective cohort study. According to the previous studies, regular physical activity brings biological benefits related to improved cerebral blood circulation [38] and oxygen delivery to regions of the brain [39], thus preserving cognitive function in later life. However, Wang [32] did not find any significant associations between physical activity (including swimming, walking, and gymnastics) and risk of dementia, in a 6.4-year longitudinal study among very old individuals living in Stockholm, Sweden. Wilson [2] also conducted a 4.5-year longitudinal study among older Catholic clergy in the USA and did not find a significant association. Further detailed examinations of the relationship are needed to resolve the contradictory results.

Generalization of our findings is limited in two ways. First, we did not assess which kinds of activities the participants engaged in as a hobby because of restricted procedures in this survey. Various kinds of activities are included in the hobbies that Japanese older individuals enjoy [6], and the extent of effectiveness of hobbies in preserving cognitive function, may vary with type of hobby. For example, hobbies such as the board games of go and shogi would demand relatively more cognitive resources than watching TV. Fishing and sports may demand few cognitive resources because these activities mostly use physical resources (e.g., physical fitness). Thus, which kinds of activities are most effective in preserving cognitive function should be examined in future studies. Second, the representativeness of the sample in this study may have been restricted. The participation rate at baseline was relatively low (43.2% participation) because we acquired the data by administering mass health checkups. In addition, those who were deceased/moved away differed in terms of the proportion of women, age, rate of chronic disease, IADL, cognitive functioning, and rate of engaging in hobbies compared with participants whose data were used in this study (Table 1). Also, those without follow-up data differed in terms of years of education, rate of depression, IADL, cognitive functioning, and rate of engaging in hobbies, compared with participants whose data were used in this study (Table 1), suggesting that a selection bias may have occurred. Therefore, we cannot exclude the possibility that the extent to which our findings are generalized may be limited because of the two reasons.

In conclusion, this study found an independent inverse relationship between hobby participation and longitudinal decline in cognitive function among community-dwelling older adults in Japan, suggesting that engaging in hobbies in later life can contribute to preserving cognitive function. Our results may help to facilitate the development of efficient strategies to prevent cognitive decline and reduce the incidence of dementia in older individuals in Japan.

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