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Original Article

Title:

Hobby engagement and risk of disabling dementia

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Abstract

Background: The association between hobby engagement and risk of dementia reported from a short-term follow-up study for individuals aged ≥65 years may be liable to reverse causation. We examined the association between hobby engagement in age of 40-69 years and risk of dementia in a long-term follow-up study among Japanese including individuals in mid-life, when the majority of individuals have normal cognitive function.

Methods: A total of 22,377 individuals aged 40–69 years completed a self-administered questionnaire in 1993–1994. The participants answered whether they had hobbies according to the three following responses: having no hobbies, having a hobby, and having many hobbies. Follow-up for incident disabling dementia was conducted with long-term care insurance data from 2006 to 2016.

Results: During 11.0 years of median follow-up, 3,095 participants developed disabling dementia. Adjusting for the demographic, behavioral, and psychosocial factors, the multivariable hazard ratios (95% confidence intervals) of incident disabling dementia compared with “having no hobbies” were 0.82 (0.75–0.89) for “having a hobby” and 0.78 (0.67–0.91) for “having many hobbies”. The inverse association was similarly observed in both middle (40-64 years) and older ages (65-69 years). For disabling dementia subtypes, hobby engagement was inversely associated with the risk of dementia without a history of stroke (probably non-vascular

type dementia), but not with that of post-stroke dementia (probably vascular type dementia).

Conclusions: Hobby engagement in both mid-life and late-life was associated with a lower risk of disabling dementia without a history of stroke.

Key word: hobby engagement; disabling dementia; follow-up study; epidemiology

Introduction

A hobby is defined as an enjoyable leisure activity in which individuals actively engage at their own initiative in their free time from work or other responsibilities [1]. A hobby includes cognitive and physical leisure activities, and engagement in these activities was associated with a lower risk of dementia [2-13]. Enjoyable leisure activities were also correlated with a higher level of life engagement (purpose in life) [1], probably lowering dementia risk [14]. However, evidence on the relationship between hobby engagement and the risk of dementia is limited [6,8]. Furthermore, previous studies examining the association between hobby engagement and risk of dementia recruited individuals aged ≥65 years and followed up their participants for less than 7 years at mean [6,8], probably resulting in reverse causation because a cognitive decline may restrict the engagement in hobbies. To minimize the impact of reverse causation, it is necessary to evaluate hobby engagement in mid-life, when the majority of individuals have normal cognitive function, and/or conduct a long-term follow-up survey.

Therefore, we aimed to examine the association between hobby engagement in age of 40-69 years and the long-term risk of dementia in the Japan Public Health Center-based prospective (JPHC) Study Cohort II. We hypothesized that having hobbies was associated with a lower risk of dementia.

Methods

Study population

The JPHC Study Cohort II was a population-based cohort study that started in 1993, enrolling residents aged 40–69 years from six PHC areas: Nagaoka, Niigata Prefecture; Mito, Ibaraki Prefecture; Suita, Osaka Prefecture; Chuo-higashi, Kochi Prefecture; Kamigoto, Nagasaki Prefecture; and Miyako, Okinawa Prefecture. A detailed description of the JPHC study protocol has been published elsewhere [15]. Briefly, the participants were provided with a self-administered questionnaire about demographic characteristics, medical history, physical activity, smoking, drinking, socioeconomic status, and dietary habits in 1993–1994, and thereafter, were followed up on their health outcomes of disabling dementia ascertained from the long-term care insurance (LTCI) data. Under the Japanese LTCI system starting in 2000, the long-term care service was provided with co-payment to persons aged ≥65 years who need support or care for their activities of daily living (ADL), and those aged 40–64 years who need care due to having specified aging-related diseases including dementia [16,17]. In four towns (Iwase district in Sakuragawa city and Tomobe district in Kasama city in Ibaraki Prefecture; and Kagami and Noichi districts in Konan city in Kochi Prefecture), the LTCI data were available from January 1, 2006, to December 31, 2016, through the approval of local municipalities for the provision of the LTCI data. A total of 13,251 men and 13,976 women were included in the study.

In the current study, we excluded participants with ineligible criteria (non-Japanese nationality, late report of migration occurring before the self-administered questionnaire survey, duplicate registration or refusal to follow-up survey (n=26), and those who died, moved out of the study area, or were lost to follow-up before January 1, 2006 (n=4,129). Participants who had a history of stroke in the self-administered questionnaire survey in 1993–1994 (n=146) and/or missing information about their hobbies (n=549) were also excluded. Finally, a total of 10,405 men and 11,972 women were included in the current analysis (Figure 1).

The participants were informed of the objectives of the study, and the completion of the survey questionnaire in 1993–1994 was regarded as providing consent for participation. This study was approved by the Institutional Review Boards of the National Cancer Center, Japan, and Osaka University.

The self-administered questionnaire Survey

The participants were queried about their hobby engagement as follows: “Do you have any hobbies?” with three possible responses: having no hobbies, having a hobby, and having many hobbies. The body mass index was calculated as the weight (kg) divided by height squared (m^2). We calculated the total physical activity by summing all the products of daily engagement time and metabolic equivalents (METs) per hour in METs/day for each activity (strenuous exercise,

sitting, standing or walking, and sleep or others) [18]. Our study using the 5-year follow-up questionnaire of the JPHC study, which included the same items of physical activity in this study, showed that the Spearman's rank correlation coefficient between the total METs/day score and physical activity record was 0.46 [18]. We also asked the participants, "How many friends do you meet at least once per week?" with three possible responses: no friends, 1–3 friends, and ≥4 friends. Type A characteristics were assessed based on four items representing the aspects of competitive drive, speed and impatience, aggressiveness, and irritability. We calculated the type A behavior pattern index by summing the scores of four items (0 to 2 for each) and divided the participants into four categories: low (score of 0 to 3), medium (score of 4), high (score of 5), and very high (score of 6 or more) [19]. The participants answered about perceived mental stress from "How much stress do you have in your daily life?" with three responses; low, moderate, and high. We further asked for the participant, "Are you living someone" with any of 5 possible responses: alone, spouse, child(ren), parent(s), and others. The status of hypertension, diabetes, and hypercholesterolemia were determined from the responses to the baseline questions regarding the use of medication and the medical history of the respective diseases.

Definition of disabling dementia

In the Japanese LTCI system, when the certification of care level was applied, the preliminary care level of applicants was computed based on a structured interview survey. Subsequently, the committee of long-term care requirement certification in the local government, which is composed of experts in medical, health, and welfare areas, finalized the care level for the applicant after reviewing all the documents, including the result of the computerized preliminary care level and the statement of the primary doctor's examination [16,17]. We defined disabling dementia as individuals who were certified regarding their care level (excluding support levels) and ranked in IIa or worse grade of ADL in older adults with dementia by attending physician. The first certified date of the care level meeting with our dementia criteria was used as the date of the incident disabling dementia. These criteria were previously verified in comparison with neuropsychiatrists' diagnoses of disabling dementia, and the sensitivity and specificity were 73% and 96%, respectively [20].

To investigate whether the association between hobby engagement and disabling dementia differed with dementia subtypes, we divided disabling dementia cases into disabling dementia without a history of stroke (possibly non-vascular type dementia) and post-stroke disabling dementia (possibly vascular-type dementia) according to the presence or absence of a history of stroke before the onset of disabling dementia. A history of stroke was obtained from 5- and 10-year follow-up questionnaires, and stroke registration. The details of stroke

registration have been published elsewhere [21].

Statistical Analysis

Person-years were calculated for each individual as the duration from January 1, 2006, when the outcome data started to be available, to the date of identification of disabling dementia, the date of death, lost to follow-up, or the end of follow-up (December 31, 2016), whichever occurred first. When we used the dementia subtypes as the outcomes, the follow-up ended on December 31, 2012, instead of December 31, 2016, owing to the unavailability of the stroke registry data.

Differences in mean value or proportions of the baseline characteristics were tested using the chi-square test and the analysis of variance. The hazard ratios (HRs) and 95% confidence intervals (CIs) of incident disabling dementia were calculated according to the hobby engagement categories using the Cox proportional hazards model. The proportional hazard assumption was confirmed visually by looking at the log-log plots using LIFETEST procedure and was not rejected by assessing the weighted Schoenfeld residuals using PHREG procedures with zph-options. We tested the interaction of hobby engagement with other variables for incident disabling dementia using cross-product terms in the Cox proportional hazards model. As there was no interaction between having hobbies and sex in relation to the incident disabling dementia (*P* for interaction: 0.28 for having a hobby and 0.60 for having

many hobbies), we did not conduct sex-specific analyses. The HRs and 95% CIs of the disabling dementia subtypes were calculated using a cause-specific Cox proportional hazard model. In model 1, we stratified jointly by area (four towns) and adjusted for age (years) at the questionnaire survey in 1993–1994 and sex. In model 2, we adjusted further for body mass index (<18.5, 18.5–<25.0, 25.0–<30, ≥30 kg/m^2, and missing), smoking status (never, former, 1–19 cigarettes/day, ≥20 cigarettes/day, and missing), alcohol intake (non-drinkers, former drinker, occasional drinkers, 1–<150 g/week, 150–<300 g/week, ≥300 g/week, and missing), total physical activity (tertiles of METs/day, and missing), and histories of hypertension, diabetes, and hypercholesterolemia (yes, no, and missing, for each). In model 3, we adjusted further for living alone (yes, no, and missing), job status (yes, no, and missing), perceived mental stress (low, moderate, high, and missing), type A characteristics (low, medium, high, very high, and missing), and the number of friends (no friends, 1–3 friends, ≥4 friends, and missing). We used the category of missing data for these confounding variables in the statistical model. For sensitivity analysis, we excluded the participants with missing data. We also conducted stratified analysis by age categories at the questionnaire survey in 1993–1994 (40–64 years and 65-69 years old).

All statistical analyses were performed using the SAS (version 9.4 SAS Institute, Cary, NC, USA) in a two-sided test. The statistical significance was set at $P < 0.05$.

Results

Table 1 shows the baseline characteristics of potential confounding factors according to the hobby engagement categories. Individuals having hobbies were younger, had the higher proportions of men, being physically active, current smoker, current drinker, medical history of hypercholesterolemia, being employed, living alone, having low mental stress, high type A characteristics, and having friends, and the lower proportion of medical history of hypertension and medication use for hypertension compared with those having no hobbies.

During the 11.0 years of median follow-up starting 12 years after exposure assessment, we confirmed 3,095 cases of disabling dementia. Having hobbies was inversely associated with the risk of incident disabling dementia (Table 2). Compared with “having no hobbies”, multivariable-adjusted HRs (95% CIs) of incident disabling dementia were 0.81 (0.75–0.88) for “having a hobby” and 0.77 (0.66–0.89) for “having many hobbies” after adjustment for age, sex, lifestyle factors, and medical history. A further adjustment for psychosocial factors did not substantially changes the association. In the stratified analysis by age, the inverse association was not significantly different between the participants aged 40–64 years and those 65-69 years at the questionnaire survey (*P* for interaction: 0.32 for having a hobby and 0.42 for having many hobbies).

Regarding disabling dementia subtypes, an inverse association of having hobbies was

observed for disabling dementia without a history of stroke, but not for post-stroke disabling dementia (Table 3). Model 3 HRs (95% CIs) of incident disabling dementia without a history of stroke were 0.77 (0.68–0.88) for "having a hobby" and 0.77 (0.60–0.98) for "having many hobbies." After stratification by age at the questionnaire survey, the inverse association for disabling dementia without a history of stroke was not significantly different between age categories. For having hobbies combining two hobby engagement categories compared to "having no hobbies" group, multivariable-adjusted HRs of disabling dementia without a history of stroke were 0.71 (95% CI: 0.60–0.85) for participants aged 40–64 years and 0.82 (95% CI: 0.68–0.99) for those aged 65-69 years (*P* for interaction = 0.09).

After excluding participants with missing data of confounding variables, the results did not change materially (Supplemental Tables 1 and 2).

Discussion

In the current study, hobby engagement in age of 40-69 years (mean, 53 years) was associated with a lower risk of disabling dementia among Japanese men and women during 12 to 23 years after hobby assessment. Further, the inverse association was apparent for disabling dementia without a history of stroke, but not for post-stroke disabling dementia. The association between hobby engagement and disabling dementia were similar between middle (40-64 years) and older ages (65-69 years) at the questionnaire survey.

In the Monongahela Valley Independent Elders Survey project of 942 US individuals aged ≥ 65 years with average 6-year of follow-up, a longer time commitment to hobbies was associated with a lower risk of dementia [8]. A 6-year follow-up for Japanese men and women aged ≥ 65 years in the Japan Gerontological Evaluation Study (JAGES) showed that several types of hobbies such as ground golf and travel were associated with a lower risk of dementia [6]. Moreover, the UK Million Women Study showed that the participation in groups for art, craft, or music at a mean age of 60 year and reading at a mean age of 64 year were associated with a lower risk of dementia in 0-4 and 5-9 years follow-up, but not in ≥10 years follow-up [22]. The Betula prospective cohort study of individuals aged ≥ 65 years also reported that leisure activity was associated with a lower risk of dementia in first period (1-5 years after baseline), but not in second and third periods (6-10 and 11-15 year after baseline) [5]. The findings from the above two

studies were different from ours probably because of different timing for exposure determination in late-life and mid-life. Our finding in mid-life corroborated the result from the Gothenburg H70 Birth Cohort Study of 800 Swedish women aged 38-54 years, reporting that cognitive and physical activity in mid-life were associated with a lower risk of dementia in a mean 44-year follow-up [13].

In the present study, we found that hobby engagement was inversely associated with the risk of disabling dementia without a history of stroke, which may correspond to non-vascular type dementia, most likely Alzheimer's disease. In most previous studies, cognitive activity was associated with a lower risk of Alzheimer's disease [2-4,7,13], while only one study reported a protective effect of cognitive activity on vascular dementia and mixed dementia [3]. On the other hand, physical activity was inversely associated with a risk of Alzheimer's disease [2,10], vascular dementia [12], dementia with cerebrovascular disease [13], and mixed dementia [13].

Several possible mechanisms can be addressed for the protective effect of hobby engagement on dementia. First, hobby engagement, as an enjoyable leisure activity at age of 19-89 years, was correlated with enhanced life engagement (purpose in life) [1], which was associated with a lower risk of dementia [14] partly due to lower levels of inflammatory markers [23]. Furthermore, high average cognitive activity across ages of 6, 12, 18, and 40 years was associated with lower β-amyloid accumulation measured by positron emission tomography

among people aged 50 years or older [24] , suggesting that cognitive activity from the early life makes cognitive reserve and prevents dementia. On the other hand, high physical activity (such as ≥ 2.5 hours of moderate to vigorous physical activity/week and participation in leisure time physical activity at ≥ 2 times/week) in mid-life was associated with lower levels of inflammatory markers [25] and a larger volume of gray matter [26] in late-life compared to the lower physical activity. Further, physical activity in old age of 60-95 years was associated with lower β-amyloid accumulation [27]. Physical activity decreases the risk of the development of hypertension, diabetes, and obesity [28-30], all of which were risk factors for the development of dementia [31].

The strengths of this study are the large sample size, minimizing the probability of chance findings. Incident disabling dementia was identified by using routinely collected government data with validated methods, which reduced the possibility of reporting error of outcome.

This study has several limitations. First, we had no information about the cognitive function and a history of dementia at the time of the questionnaire survey in 1993–1994. A cognitive decline and dementia may lead to reduced hobby engagement; therefore, reverse causation cannot be inevitable. In the present study, however, dementia outcome was assessed 12 years after the exposure assessment, and the impact of reverse causation may be small.

Second, we could not discuss the specific associations of the actual number, types, frequency and intensity of hobbies with the risk of disabling dementia because we did not ask these information. Previous studies showed that the number of hobbies [6], time commitment to hobbies [8] and the intensity of cognitive and physical activity [13] were associated with a lower risk of dementia. Third, we assessed the hobby only at questionnaire survey in 1993-1994 so that we could not take into account the changes in hobby engagement during the follow-up. Some of the participants may quit or start hobbies during the follow-up. For example, starting a new hobby in late-life could lead to lowering the dementia risk, attenuating the association between hobby engagement and the dementia risk. Fourth, we did not have a precise diagnosis of dementia subtypes, including Alzheimer's dementia, vascular dementia, and mixed dementia although we found an inverse association between hobby engagement and the risk of disabling dementia without a history of stroke, a surrogate outcome for Alzheimer's disease. Finally, residual and unmeasured confounding factors may exist, such as education levels, the presence of psychiatric disorders, and use of psychiatric medications.

In conclusion, hobby engagement in both mid-life and late-life was associated with a lower risk of disabling dementia without a history of stroke among the Japanese population.

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https://epi.ncc.go.jp/en/jphc/781/index.html

Conflicts of interest: None

Data Availability

For information on how to submit an application for gaining access to JPHC data and/or biospecimens, please follow the instructions at https://epi.ncc.go.jp/en/jphc/805/8155.html.

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Table 1. Characteristics of participants in 1993–1994 according to the hobby engagement categories.

		Hobby categories			P for difference
		Having no hobbies	Having a hobby	Having many hobbies	
No. at risk		4518	16126	1733	
Age (years), mean (SD)		53.1 (8.8)	52.5 (8.5)	52.7 (8.3)	<0.001
Sex, n (%)					
	Men	1692 (37.5)	7765 (48.2)	948 (54.7)	<0.001
	Women	2826 (62.6)	8361 (51.9)	785 (45.3)	
Body mass index					
kg/m², mean (SD)		23.3 (3.1)	23.3 (2.9)	23.4 (2.9)	0.28
n (%)	< 18.5 kg/m²	198 (4.4)	524 (3.3)	43 (2.5)	
	18.5-< 25.0 kg/m²	3098 (68.6)	11410 (70.8)	1235 (71.3)	
	25.0-< 30.0 kg/m²	1024 (22.7)	3692 (22.9)	409 (23.6)	
	≥ 30.0 kg/m²	124 (2.7)	311 (1.9)	35 (2.0)	
	Missing data	74 (1.6)	189 (1.2)	11 (0.6)	
METs/day score					
mean (SD)		34.4 (6.6)	34.8 (6.7)	35.4 (6.7)	<0.001
n (%)	First tertile (range: 23.05-30.10)	1211 (26.8)	4412 (27.4)	441 (25.5)	
	Second tertile (range: 31.85-37.45)	1751 (38.8)	5861 (36.4)	592 (34.2)	
	Third tertile (range: 37.90-46.25)	1360 (30.1)	5334 (33.1)	651 (37.6)	
	Missing data	196 (4.3)	519 (3.2)	49 (2.8)	
Smoking Status, n (%)					
	Never	2950 (65.3)	9136 (56.7)	890 (51.4)	<0.001
	Former	396 (8.8)	1982 (12.3)	219 (12.6)	
	1–19 cigarettes/day	365 (8.1)	1389 (8.6)	154 (8.9)	
	≥ 20cigarettes/day	771 (17.1)	3478 (21.6)	450 (26.0)	
	Missing data	36 (0.8)	141 (0.9)	20 (1.2)	
Alcohol intake, n (%)					
	Non-drinker	2577 (57.0)	7656 (47.5)	752 (43.4)	<0.001
	Former	94 (2.1)	307 (1.9)	28 (1.6)	
	Occasional	229 (5.1)	1031 (6.4)	104 (6.0)	
	1–<150 g/week	618 (13.7)	2924 (18.1)	338 (19.5)	
	150–<300 g/week,	444 (9.8)	1864 (11.6)	232 (13.4)	
	≥ 300 g/week	344 (7.6)	1423 (8.8)	187 (10.8)	
	Missing data	212 (4.7)	921 (5.7)	92 (5.3)	
Medical history of hypertension, n (%)					
	No	3616 (80.0)	13217 (82.0)	1439 (83.0)	0.01
	Yes	856 (19.0)	2785 (17.3)	278 (16.0)	
	Missing data	46 (1.0)	124 (0.8)	16 (0.9)	
Medication use for hypertension, n (%)					
	No	3752 (83.1)	13753 (85.3)	1490 (86.0)	<0.001

Yes	754	(16.7)	2308	(14.3)	236	(13.6)			
Missing data	12	(0.3)	65	(0.4)	7	(0.4)			
Medical history of diabetes, n (%)									
No	4256	(94.2)	15211	(94.3)	1626	(93.8)	0.49		
Yes	216	(4.8)	791	(4.9)	91	(5.3)			
Missing data	46	(1.0)	124	(0.8)	16	(0.9)			
Medication use for diabetes, n (%)									
No	4413	(97.7)	15782	(97.9)	1699	(98.0)	0.41		
Yes	91	(2.0)	275	(1.7)	26	(1.5)			
Missing data	14	(0.3)	69	(0.4)	8	(0.5)			
Medical history of hypercholesterolemia, n (%)									
No	4375	(96.8)	15588	(96.7)	1658	(95.7)	0.03		
Yes	97	(2.2)	414	(2.6)	59	(3.4)			
Missing data	46	(1.0)	124	(0.8)	16	(0.9)			
Medication use for hypercholesterolemia, n (%)									
No	4418	(97.8)	15704	(97.4)	1675	(96.7)	0.14		
Yes	86	(1.9)	354	(2.2)	50	(2.9)			
Missing data	14	(0.3)	68	(0.4)	8	(0.5)			
Job status, n (%)									
Unemployed	999	(22.1)	3296	(20.4)	329	(19.0)	0.009		
Employed	3471	(76.8)	12692	(78.7)	1394	(80.4)			
Missing data	48	(1.1)	138	(0.9)	10	(0.6)			
Living alone, n (%)									
No	4385	(97.1)	15625	(96.9)	1656	(95.6)	<0.001		
Yes	116	(2.6)	483	(3.0)	75	(4.3)			
Missing data	17	(0.4)	18	(0.1)	2	(0.1)			
Perceived mental stress, n (%)									
Low	692	(15.3)	2598	(16.1)	357	(20.6)	<0.001		
Moderate	2800	(62.0)	10415	(64.6)	923	(53.3)			
High	1007	(22.3)	3044	(18.9)	445	(25.7)			
Missing data	19	(0.4)	69	(0.4)	8	(0.5)			
Type A charasterics, n (%)									
Low	1085	(24.0)	3254	(20.2)	349	(20.1)	<0.001		
Moderate	1743	(38.6)	6543	(40.6)	519	(30.0)			
High	647	(14.3)	2624	(16.3)	290	(16.7)			
Very high	752	(16.6)	3054	(18.9)	504	(29.1)			
Missing data	291	(6.4)	651	(4.0)	71	(4.1)			
The number of friends, n (%)									
No friends	1245	(27.6)	1913	(11.9)	122	(7.0)	<0.001		
1-3 friends	2446	(54.1)	9035	(56.0)	648	(37.4)			
≥ 4 friends	744	(16.5)	4992	(31.0)	947	(54.7)			
Missing data	83	(1.8)	186	(1.2)	16	(0.9)			

METs; metabolic equivalents, SD; standard deviation.

Table 2. Hazard ratios (HRs) and 95% confidence intervals (CIs) for incidence disabling dementia according to hobby engagement categories among Japanese aged 40–69 years.

	Hobby categories		
	Having no hobbies	Having a hobby	Having many hobbies
Total			
Person-years	41483	153232	16340
No. at risk	4518	16126	1733
No. of cases	784	2099	212
[a]Model 1 HR (95% CI)	reference	0.79 (0.73 - 0.86)	0.75 (0.65 - 0.88)
[b]Model 2 HR (95% CI)	reference	0.81 (0.75 - 0.88)	0.77 (0.66 - 0.89)
[c]Model 3 HR (95% CI)	reference	0.82 (0.75 - 0.89)	0.78 (0.67 - 0.91)
40-64 years at 1993-1994			
Person-years	37636	141642	15113
No. at risk	3898	14344	1553
No. of cases	451	1294	140
[a]Model 1 HR (95% CI)	reference	0.77 (0.69 - 0.85)	0.78 (0.65 - 0.94)
[b]Model 2 HR (95% CI)	reference	0.79 (0.70 - 0.88)	0.82 (0.68 - 0.99)
[c]Model 3 HR (95% CI)	reference	0.79 (0.71 - 0.88)	0.83 (0.68 - 1.01)
		0.79 (0.71 - 0.89)	
65-69 years at 1993-1994			
Person-years	3847	11590	1226
No. at risk	620	1782	180
No. of cases	333	805	72
[a]Model 1 HR (95% CI)	reference	0.83 (0.73 - 0.94)	0.70 (0.54 - 0.90)
[b]Model 2 HR (95% CI)	reference	0.83 (0.73 - 0.95)	0.68 (0.53 - 0.89)
[c]Model 3 HR (95% CI)	reference	0.84 (0.73 - 0.96)	0.68 (0.52 - 0.90)
		0.82 (0.72 - 0.94)	

[a]Adjusted for age at 1993-1994 and sex.

[b] Adjusted further for body mass index, smoking status, alcohol intake, total physical activity, history of hypertension, diabetes, and hypercholesterolemia.

[c] Adjusted further for living alone, job status, perceived mental stress, type A characteristics, and number of friends.

Table 3. Hazard ratios (HRs) and 95% confidence intervals (CIs) for incidence disabling dementia subtypes according to hobby engagement categories among Japanese aged 40 to 69.

		Hobby categories		
		Having no hobbies	Having a hobby	Having many hobbies
Disabling dementia without a history of stroke				
Total				
	Person-years	28317	103176	11017
	No. at risk	4518	16126	1733
	No. of cases	365	878	90
	[a]Model 1 HR (95% CI)	reference	0.75 (0.66 - 0.84)	0.74 (0.59 - 0.93)
	[b]Model 2 HR (95% CI)	reference	0.76 (0.67 - 0.86)	0.76 (0.60 - 0.95)
	[c]Model 3 HR (95% CI)	reference	0.77 (0.68 - 0.88)	0.77 (0.60 - 0.98)
			0.77 (0.68 - 0.88)	
40-64 years at 1993-1994				
	Person-years	25270	94140	10101
	No. at risk	3898	14344	1553
	No. of cases	196	476	53
	[a]Model 1 HR (95% CI)	reference	0.67 (0.57 - 0.80)	0.70 (0.51 - 0.95)
	[b]Model 2 HR (95% CI)	reference	0.69 (0.59 - 0.82)	0.75 (0.55 - 1.01)
	[c]Model 3 HR (95% CI)	reference	0.71 (0.60 - 0.84)	0.75 (0.55 - 1.04)
			0.71 (0.60 - 0.85)	
65-69 years at 1993-1994				
	Person-years	3047	9036	916
	No. at risk	620	1782	180
	No. of cases	169	402	37
	[a]Model 1 HR (95% CI)	reference	0.84 (0.70 - 1.00)	0.78 (0.55 - 1.12)
	[b]Model 2 HR (95% CI)	reference	0.84 (0.70 - 1.01)	0.75 (0.52 - 1.08)
	[c]Model 3 HR (95% CI)	reference	0.83 (0.69 - 0.998)	0.75 (0.52 - 1.10)
			0.82 (0.68 - 0.99)	

Post-stroke disabling dementia													
Total													
	No. of cases	114				318						34	
	[a]Model 1 HR (95% CI)	reference	0.83	(	0.67	-	1.02	)	0.84	(	0.57	-	1.23)
	[b]Model 2 HR (95% CI)	reference	0.87	(	0.70	-	1.08	)	0.87	(	0.59	-	1.28)
	[c]Model 3 HR (95% CI)	reference	0.89	(	0.71	-	1.11	)	0.93	(	0.62	-	1.38)
							0.89	(	0.71	-	1.11	)	
40-64 years at 1993-1994													
	No. of cases	60				191						18	
	[a]Model 1 HR (95% CI)	reference	0.83	(	0.62	-	1.12	)	0.70	(	0.42	-	1.19)
	[b]Model 2 HR (95% CI)	reference	0.88	(	0.65	-	1.18	)	0.74	(	0.44	-	1.26)
	[c]Model 3 HR (95% CI)	reference	0.89	(	0.66	-	1.20	)	0.76	(	0.44	-	1.32)
							0.88	(	0.65	-	1.18	)	
65-69 years at 1993-1994													
	No. of cases	54				127						16	
	[a]Model 1 HR (95% CI)	reference	0.81	(	0.59	-	1.12	)	1.06	(	0.60	-	1.85)
	[b]Model 2 HR (95% CI)	reference	0.84	(	0.60	-	1.16	)	1.01	(	0.57	-	1.78)
	[c]Model 3 HR (95% CI)	reference	0.85	(	0.61	-	1.19	)	1.09	(	0.60	-	1.98)
							0.87	(	0.62	-	1.21	)	

[a] Adjusted for age at 1993-1994 and sex.

[b] Adjusted further for body mass index, smoking status, alcohol intake, total physical activity, history of hypertension, diabetes, and hypercholesterolemia.

[c] Adjusted further for living alone, job status, perceived mental stress, type A characteristics, and number of friends.

Figure 1. Flowchart of study participants.