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Genetic and Environmental Determinants of Healthy Aging

Healthy Cognitive Aging and Leisure Activities Among the Oldest Old in Japan: Takashima Study

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Background. Little is known regarding the normative levels of leisure activities among the oldest old and the factors that explain the age-associated decline in these activities.

Methods. The sample included 303 cognitively intact community-dwelling elderly persons with no disability in Activities of Daily Living (ADL) and minimal dependency in Instrumental ADL (IADL) in Shiga prefecture, Japan. We examined (i) the nature and frequency of leisure activities, comparing the oldest old versus younger age groups; (ii) factors that explain the age-associated differences in frequencies of engagement in these activities; and (iii) domain-specific cognitive functions associated with these activities, using three summary index scores: physical and nonphysical hobby indexes and social activity index.

Results. The oldest old (85 years old or older) showed significantly lower frequency scores in all activity indexes, compared with the youngest old (age 65–74 years). Gait speed or overall mobility consistently explained the age-associated reduction in levels of activities among the oldest old, whereas vision or hearing impairment and depressive symptoms explained only the decline in social activity. Frequency of engagement in nonphysical hobbies was significantly associated with all cognitive domains examined.

Conclusions. Knowing the factors that explain age-associated decline in leisure activities can help in planning strategies for maintaining activity levels among elderly persons.

***Key Words*:** Oldest old—Normative data—Leisure activities—Healthy aging—Japanese cohort—Takashima Study.

CONTINUING engagement with life has been described as one of the three components of successful aging (1). Higher engagement in leisure activities appears to be protective against cognitive decline and dementia (2–7), although the mechanism is not fully understood (8,9). Although some decline in activity level is expected with advancing age, there is little information thus far on their normative levels, and on factors (e.g., morbidities, cognitive functions) that explain age-associated decline in leisure activities, particularly among relatively healthy and cognitively unimpaired elderly persons. As individuals 85 years old or older (''oldest-old'') are the fastest growing segment of the population in Japan and most industrialized countries (10), such information can be useful for planning recreational programs to improve the quality of life of the elderly population in the community, strategies to maintain the activity levels among them, and to help distinguish normal from pathological aging.

In a sample of community-dwelling, cognitively unimpaired elderly persons in Shiga, Japan, we identified three types of leisure activities: physically demanding activities, nonphysical activities, and activities mostly requiring social interactions. We hypothesized that (i) activity levels are lower among the oldest old than the younger old, (ii) decline in leisure activities among the oldest old is explained by decreased physical function and lower general cognitive function, and (iii) levels of engagement in specific leisure activities are associated with specific domains of cognitive function.

Methods

The survey was conducted in Takashima County, Shiga Prefecture, located west of Biwako Lake, the largest lake in Japan. In 2005, the county's population was 53,950, with 25.1% 65 years old or older, higher than the national average of 20.1%. About 7.7% of the total labor force engages in farming, fishing, or forestry; about 35% in construction and manufacturing industries; and 58% in wholesale, medical, welfare, or other service industries.

The Takashima county municipal government generated a list of names, addresses, and telephone numbers of the population, based on comprehensive resident registration records. An age-stratified random sample was drawn of residents 65 years old or older, over sampling the oldest old. The list was generated until we reached the targeted sample size of approximately 130 individuals each in the age groups 65–74 years, 75–84 years, and 85 years old or older, with similar proportions for men and women. The survey was conducted between 2005 and 2006, and approved by the Institutional Review Boards at Shiga University of Medical Science in Japan, the University of Pittsburgh, and the Oregon State University.

Among 957 randomly selected individuals invited by letter to participate in the study, a total of 391 participants (40.8%) consented and underwent face-to-face interviews. The participation rates varied from 32.2% (women 85 years old or older) to 52.1% (men 65–74 years). Of persons younger than 85 years, 41.8% of refusers indicated that they were ''too busy'' to particulate. In the older age group, 41.0% of refusers were either hospitalized or ''too sick'' to participate. Registered nurses conducted the interviews after undergoing intensive training for assessment reliability. Surveys were conducted at participants' homes unless they preferred another location.

We defined as normal those participants who were free from cognitive impairment and could live in the community with minimal dependency on others. For the current study, we selected community-dwelling elderly persons with test scores $\geq$21 on the Japanese version of the Mini-Mental State Examination (J-MMSE) (11,12), with no disabilities in ADL tasks, and with minimal ($\leq$2) IADL disabilities. The conventional threshold MMSE score of 24 for defining cognitive impairment was lowered to 21 in consideration of the low educational level of the sample (mean 9.6 years of education, corresponding to finishing middle school in Japan). The eight IADL tasks examined were the abilities to independently use public transportation, shop for daily necessities, prepare meals, pay bills, handle their own banking, use the telephone, manage their own medication, and clean their own rooms. The first five tasks are taken from the Tokyo Metropolitan Institute of Gerontology Index of Competence (13). We added questions regarding abilities for telephone usage, medication management, and cleaning their own rooms on the basis of face validity, because of the increasing importance of these tasks for independent living. Interviewer nurses indicated their impression of the accuracy of self-reported (I)ADL items.

Local nurses, area caregivers, and researchers consensually created a comprehensive list of the various types of leisure activities conducted by the elderly persons in the survey areas. A survey questionnaire was then developed based on this list. For each activity, participants scored their frequency of engagement as follows: 1 = not at all, 2 = once per year or less, 3 = several times per year, 4 = several times per month, 5 = several times per week, and 6 = every day or almost every day. Summing scores for each activity provided an ''index score'' for each of the three groups of activities: physical and nonphysical hobbies and social activity. In the statistical models, we used *z*-transformed scores based on the distribution for each index to take into account the differences in score ranges.

Domain-Specific Cognitive Functions

In addition to the J-MMSE, an indicator of general cognitive function, Japanese cognitive tests examined and their specific domains were as follows: (i) Digit Span Forward and Backward (attention and working memory) from Wechsler Adult Intelligence Scale Revised (WAIS-R) (14); (ii) Word list immediate recall (learning/acquisition) from the Alzheimer's Disease Assessment Scale (ADAS) (15); (iii) Word list delayed recall (memory) from the ADAS (15); (iv) Block Designs-5 blocks, even numbers (visuospatial ability) from the WAIS-R Block Design (14); (v) Trail-making test A (16) (psychomotor speed); (vi) Trail-making test B (16) (executive function); and (vii) Word Fluency Categories: Animals and Vegetables (language) from the Consortium to Establish a Registry for Alzheimer Disease (CERAD) (17). The above tests are already validated in Japan.

Other Variables

Other potential explanatory factors for age-associated reduction in leisure activities were considered within the following blocks: (i) Basic demographic variables: age, sex, years of education, living arrangement (alone vs with others); (ii) Basic physical function: vision or hearing impairment, gait speed/mobility measured by the Timed Up and Go (TUG) test (18,19); and (iii) Morbidity burden: number of depressive symptoms measured by the Japanese Geriatric Depression Scale, 15-item version (J-GDS-15) (20), and total numbers of prescription medication.

Vision impairment was assessed by response to a question ''what is your visual ability with your visual aid?'' (1 = Normal, 2 = Can recognize a person's face approximately 1 meter away, and 3 = Unable or almost unable to see.) Hearing was assessed by a self-report to a question ''what is your hearing ability with your hearing aid?'' (1 = No difficulty in daily communication, 2 = Can only hear loud voices or sounds, and 3 = Unable or almost unable to hear.) Participants with scores of 2 or 3 were regarded as having vision and/or hearing impairment. The total number of prescription medications was used as an objective measure of overall morbidity and medical burden (21) and was recorded by the study nurses, who examined the participant's medication bottles and envelopes.

Statistical Methods

Age group differences in each of the three indexes were first examined by *t* test (nonphysical and social activity indexes) and Wilcoxon rank sum nonparametric test (physical activity index, due to skewed distribution), comparing the youngest age group (65–75 years) with each of two other age groups (75–84 years and 85 years or older). We examined factors mediating the age-associated differences in each of the three indexes using linear regression models (outcome being nonphysical hobby and social activity indexes) and a logistic regression model (outcome

Table 1. Characteristics of Study Participants Based on Inclusion Criteria: MMSE ≥ 21, No ADL Disabilities, and Minimal IADL Disabilities (≤2): Takashima Study 2005–2006

Age Group	65–69	70–74	75–79	80–84	85+	*p* Value
Total *N* = 391	*N* = 72	*N* = 67	*N* = 89	*N* = 65	*N* = 98	
N (%) meeting inclusion criteria						
Total *N* = 303	*N* = 68 (94.4)	*N* = 62 (92.5)	*N* = 77 (86.5)	*N* = 53 (81.5)	*N* = 43 (43.9)	
Female, %	51.5	41.9	55.8	49.1	45.2	NS*
Years of education	10.6	9.7	9.5	9.2	8.9	.003†
% Living alone	2.9	4.8	6.5	18.9	14.0	.011*
% With either vision or hearing impairment	0	3.2	3.9	7.6	53.5	<.001*
Timed Up and Go (TUG) test	10.3	11.8	12.4	14.0	19.0	<.001†
Japanese Geriatric Depression Scale						
(J-GDS-15), % with score ≥ 11	1.5	1.6	5.2	3.8	7.0	.471*
Total No. of prescription medication	2.5	3.4	4.0	4.3	5.6	<.001†
IADL disabilities, %						
None	89.7	87.1	80.5	73.6	55.8	<.001*
1	10.3	9.7	18.8	22.6	23.4	
2	0	3.2	1.3	3.8	20.9	
% with 21 ≤ J-MMSE ≤ 24	5.9	11.3	15.6	17.0	34.9	.001*
WAIS-R Digit Span Forward (*SD*)	5.89 (2.15)	5.85 (1.82)	5.92 (1.85)	5.88 (1.56)	5.30 (2.23)	NS†
WAIS-R Digit Span Backward (*SD*)	5.08 (1.42)	4.83 (1.19)	4.96 (1.52)	4.73 (1.46)	4.09 (1.22)	.005†
ADAS-word list immediate recall sum of						
three trials (*SD*)	21.19 (3.24)	18.95 (3.66)	18.75 (3.74)	17.96 (3.82)	15.54 (4.31)	<.001†
ADAS-word list delayed recall (*SD*)	7.52 (2.10)	6.57 (2.02)	5.97 (2.63)	5.86 (2.48)	4.42 (2.50)	<.001†
WAIS-R Block Design–5 block designs (*SD*)	14.55 (4.02)	13.01 (3.46)	11.50 (4.17)	10.98 (4.33)	7.95 (4.49)	<.001†
Trail-Making A: connections per second (*SD*)	0.59 (0.20)	0.41 (0.14)	0.38 (0.13)	0.36 (0.12)	0.27 (0.11)	<.001†
Trail-Making B: connections per second (*SD*)	0.23 (0.07)	0.17 (0.06)	0.16 (0.06)	0.13 (0.06)	0.07 (0.06)	<.001†
Word Fluency Category (*SD*)	32.37 (8.07)	29.67 (7.82)	27.86 (6.48)	26.96 (5.67)	23.47 (6.54)	<.001†

Notes: *Pearson chi-square statistics.

†Analysis of variance.

J-MMSE = Japanese version of the Mini-Mental State Examination; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living; *SD* = standard deviation; WAIS-R = Wechsler Adult Intelligence Scale Revised; ADAS = Alzheimer's Disease Assessment Scale; NS = not significant.

being the physical activity index, the lowest 25th percentile vs others). We first included in the model two age groups (75–84 years and 85 years old or older), with the youngest age group as a reference group, controlling for sex, years of education, and living arrangement. In preliminary analysis, the oldest group showed significantly lower frequency scores in all activity indexes, compared with the youngest group. We then added the three blocks of covariates mentioned above separately into the model, and finally fit a full model with all variables.

The associations between domain-specific cognitive functions and each of three activity indexes were examined using linear regression models with each *z*-transformed cognitive test score as an outcome, controlling for covariates mentioned above.

Results

Among 391 potential participants interviewed, we excluded 42 persons (10.7%) who could not conduct one or more ADL tasks, 31 persons (7.9%) with MMSE scores <21, 12 persons (3.4%) who had two or more disabilities in IADL tasks, and 3 persons (0.9%) with ADL/IADL responses considered unreliable by the assessing nurses. Proportions of persons included in the current analysis of 391 potential participants are listed in the third row of Table 1. As expected, the proportion declined with increasing age group.

The characteristics of the 303 participants used in the current study are listed in Table 1. Their mean age (standard deviation) [ranges] was 76.1 (6.9) [65.0–96.0]. The most frequently observed IADL dependencies were meal preparation among men (n = 25, 16.2%) and using public transportation among women (n = 17, 11.4%). All other disabilities were reported by fewer than 10 participants. The proportion of participants living in a two- or three-generational household was 68.9%.

Table 2 shows common activities and distribution of frequency by age groups, limited to activities in which more than 15 participants (5% of the sample) were engaged at least once per year. Overall, compared with the youngest old group, the oldest group had significantly lower scores in all three activity indexes. Notable findings include: >30% of the oldest old also engaged in gardening every day or almost every day; talking with the younger generation did not differ much by age groups, possibly reflecting the high prevalence of multigenerational households in the survey area; the oldest old age group was much less likely to socialize with neighbors, friends, and relatives.

Table 3 shows the results of models examining factors that explain the reduced levels of leisure activities among the oldest old in three indexes. In models with only demographic variables, participants 85 years old or older had significantly lower nonphysical and social activity index scores and also a higher likelihood of being in the lowest 25 percentile in physical activity index, compared with the youngest group.

Nonphysical Hobby Index

In each subsequent model, adding physical functional indicators, morbidity burden, or general cognitive function

Table 2. Frequently Engaged Activities ($N = 303$)

Activities	Not at all %	Once per Year or More %	Once per Month or More %	Almost Every Day %
Nonphysical activities				
Watching TV				
$65 \leq$ Age < 75	0.7	0	0.7	98.4
$75 \leq$ Age < 85	1.5	0	0.7	96.9
Age ≥ 85	0	0	2.3	97.7
Listening to radio				
$65 \leq$ Age < 75	64.2	1.5	10.0	23.8
$75 \leq$ Age < 85	74.6	0.7	9.2	15.3
Age ≥ 85	81.4	4.7	4.7	9.3
Reading newspaper				
$65 \leq$ Age < 75	3.0	0	6.9	90.0
$75 \leq$ Age < 85	5.3	0	6.1	88.5
Age ≥ 85	9.3	0	2.3	88.4
Reading magazines				
$65 \leq$ Age < 75	32.3	17.6	42.3	7.6
$75 \leq$ Age < 85	35.3	20.0	36.9	7.6
Age ≥ 85	46.5	7.0	34.8	11.6
Reading books				
$65 \leq$ Age < 75	40.0	23.0	23.0	13.8
$75 \leq$ Age < 85	45.3	14.6	20.7	19.2
Age ≥ 85	60.4	4.6	20.9	13.9
Playing board/card games				
$65 \leq$ Age < 75	69.2	18.4	8.4	3.8
$75 \leq$ Age < 85	81.5	10.0	7.6	0.7
Age ≥ 85	86.0	2.3	11.6	0
Doing crafts				
$65 \leq$ Age < 75	43.0	20.0	29.4	8.4
$75 \leq$ Age < 85	39.2	21.5	30.0	9.2
Age ≥ 85	55.8	16.2	27.9	0
Performing in a chorus/singing karaoke				
$65 \leq$ Age < 75	79.2	3.8	14.6	2.3
$75 \leq$ Age < 85	77.6	5.4	13.8	3.0
Age ≥ 85	81.4	2.3	13.9	2.3
Writing haiku/senryu				
$65 \leq$ Age < 75	92.3	2.3	5.3	0
$75 \leq$ Age < 85	86.9	3.8	7.6	1.5
Age ≥ 85	90.7	2.3	6.9	0
Traveling				
$65 \leq$ Age < 75	20.7	72.3	6.1	0.7
$75 \leq$ Age < 85	36.9	59.2	3.8	0
Age ≥ 85	60.4	39.5	0	0
Attending classes				
$65 \leq$ Age < 75	63.0	23.0	13.8	0
$75 \leq$ Age < 85	72.3	15.3	11.5	0.7
Age ≥ 85	72.0	18.6	9.3	0
Nonphysical Activity Index, Mean (*SD*)*				
$65 \leq$ Age < 75	26.9 (7.8)		p value on the difference (compared with the youngest)[†]	
$75 \leq$ Age < 85	25.7 (7.9)		$p = .19$	
Age ≥ 85	21.8 (7.9)		$p < .001$	
Physical activities				
Playing Gate Ball[‡]				
$65 \leq$ Age < 75	74.6	4.6	20.0	0.7
$75 \leq$ Age < 85	67.6	6.1	24.6	1.5
Age ≥ 85	79.0	4.6	11.6	4.6
Hiking				
$65 \leq$ Age < 75	84.6	12.3	3.0	0
$75 \leq$ Age < 85	93.0	6.9	0	0
Age ≥ 85	100.0	0	0	0

Table 2. Frequently Engaged Activities ($N = 303$) (*Continued*)

Activities	Not at all %	Once per Year or More %	Once per Month or More %	Almost Every Day %
Swimming				
$65 \leq$ Age < 75	84.6	3.8	6.1	1.5
$75 \leq$ Age < 85	98.4	0	0.7	0.7
Age ≥ 85	97.6	2.3	0	0
Stretching				
$65 \leq$ Age < 75	65.3	9.2	10.7	14.6
$75 \leq$ Age < 85	70.0	3.8	13.0	13.0
Age ≥ 85	60.4	0	11.6	27.9
Walking				
$65 \leq$ Age < 75	66.9	3.0	16.1	13.8
$75 \leq$ Age < 85	58.4	0.7	14.6	26.1
Age ≥ 85	67.4	0	9.3	23.2
Fast Walking (sport)				
$65 \leq$ Age < 75	75.3	3.8	11.5	9.2
$75 \leq$ Age < 85	90.7	0.7	4.6	3.8
Age ≥ 85	100.0	0	0	0
Bicycling				
$65 \leq$ Age < 75	92.3	0	3.8	3.8
$75 \leq$ Age < 85	87.6	0	3.0	9.2
Age ≥ 85	95.3	0	0	4.6
Gardening				
$65 \leq$ Age < 75	10.0	7.6	34.6	47.6
$75 \leq$ Age < 85	10.7	6.1	32.3	50.7
Age ≥ 85	25.5	9.3	27.9	37.2
Physical Activity Index, Mean (*SD*)[§]				
$65 \leq$ Age < 75	6.0 (4.6)		*p* value on the difference (compared with the youngest)[‖]	
$75 \leq$ Age < 85	5.4 (4.3)		$p = .45$	
Age ≥ 85	4.3 (4.2)		$p = .04$	
Social activities				
Talk with younger generation				
$65 \leq$ Age < 75	5.3	8.4	35.5	50.7
$75 \leq$ Age < 85	5.3	12.3	33.8	48.4
Age ≥ 85	6.9	18.6	27.9	46.5
Talk with neighbors				
$65 \leq$ Age < 75	3.8	3.0	50.7	42.3
$75 \leq$ Age < 85	3.8	4.6	46.9	44.6
Age ≥ 85	18.6	4.6	48.8	27.9
Visit/call friends and relatives				
$65 \leq$ Age < 75	9.2	13.8	66.9	10.0
$75 \leq$ Age < 85	13.0	16.9	59.2	10.7
Age ≥ 85	30.2	9.3	53.4	6.9
Volunteering				
$65 \leq$ Age < 75	38.4	33.8	26.1	1.5
$75 \leq$ Age < 85	28.4	46.9	24.6	0
Age ≥ 85	53.4	41.8	4.6	0
Social Activity Index Mean (*SD*)				
$65 \leq$ Age < 75	11.0 (2.6)		*p* value on the difference (compared with the youngest)[†]	
$75 \leq$ Age < 85	10.6 (2.7)		$p = .22$	
Age ≥ 85	9.2 (3.6)		$p < .001$	

Notes: *Activities not listed in this table, but included in the calculation of the index (i.e., reported by <15 participants): pachinko (an arcade game similar to pinball) ($n = 3$), computer games ($n = 9$), writing in diaries/novels ($n = 8$), and listening to music ($n = 8$).

[†]Based on the *t* test.

[‡]Gate Ball: A type of miniature golf where teams score a point for each ball to hit through a gate.

[§]Activities not listed in this table, but included in the calculation of the index (i.e., reported by <15 participants): jogging ($n = 6$), golf ($n = 8$), tennis/bowling/ping-pong ($n = 3$), dancing/Japanese dancing ($n = 4$), martial arts/Kikou (Qigong) ($n = 4$), and fishing ($n = 11$).

[‖]Based on the Wilcoxon rank sum nonparametric test.

SD = standard deviation.

Table 3. Factors Explaining Age Differences in Leisure Activity Frequencies

	Nonphysical Activity Index*				Social Activity Index*				Physical Activity Index†	
	Demographic Variables Only		Full Model		Demographic Variables Only		Full Model		Demographic Variables Only	Full Model
Covariates	Coefficient	(*SD*)	Coefficient	(*SD*)	Coefficient	(*SD*)	Coefficient	(*SD*)	OR (95% CI)	OR (95% CI)
Demographic variables										
Age 75–84	NS	—	NS	—	NS	—	NS	—	NS	NS
Age 85+	−0.30‡	0.15	NS	—	−0.77§	0.20	NS	NS	5.10‡ (1.33, 19.58)	NS
Female	0.35§	0.09	0.29§	0.09	0.48§	0.13	0.42§	0.12	NS	NS
Years of education	0.15§	0.02	0.11§	0.02	NS	—	NS	—	NS	NS
Living alone	NS	—	NS	NS	NS	—	NS	—	NS	NS
Physical Function										
Visual or hearing impairment			NS	—			−0.48‡	0.24		NS
Gait speed/Lower extremity function (TUG test)			−0.02‡	0.01			−0.03§	0.01		1.16§ (1.05, 1.27)
Morbidity Burden										
J-GDS			−0.07§	0.01			−0.09§	0.02		NS
Total No. of prescription medications			0.02‡	0.01			NS	—		NS
General cognitive function										
J-MMSE			NS	—			NS	—		NS

Notes: *Based on ordinal linear regression models.

†Based on logistic regression; outcome is persons with the lowest 25th percentile in physical activity index (vs others).

‡$p < .05$.

§$p < .01$.

SD = standard deviation; CI = confidence interval; TUG = Timed Up and Go; J-GDS = Japanese Geriatric Depression Scale; J-MMSE = Japanese version of the Mini-Mental State Examination; NS = not significant.

separately in the model, the coefficient of 85 years old or older became insignificant (not in table). In the full model, higher levels of nonphysical hobby activities were associated with female gender, more education, higher mobility (TUG), and fewer depressive symptoms (J-GDS). The J-MMSE, which was significant in the model containing only this variable and demographic variable, became insignificant in the full model, suggesting that the effect of general cognition on the levels of nonphysical hobbies was not independent of morbidity burden.

Social Activity Index

The reduced levels of social interaction among the oldest old became insignificant when we added the block of physical function variables. In the full model, higher levels of social interaction were associated with female gender, no vision or hearing impairment, higher mobility function, and fewer depressive symptoms.

Physical Hobby Index

The reduced level of engagement in physical hobbies among the oldest old was explained only by mobility. No other variables were significant in the full model.

Associations Between Domain-Specific Cognitive Functions and Activity Indexes

Physical hobby and social activity indexes were not associated with any specific cognitive domains, whereas the nonphysical hobby index was associated with all of the cognitive domains (not in table). Among the cognitive domains, visuospatial ($p = .0002$) and language abilities ($p < .0001$) were strongly associated with nonphysical hobby index even with the p value adjusted under multiple comparisons ($p < .0024$).

We conducted three post hoc analyses. First, the strong association between mobility function and nonphysical and social activities could have been because of the inability of participants with limited mobility to use public transportation, for example, for attending classes and visiting friends. To test this hypothesis, we refit the model after deleting 22 participants (17 women and 5 men) with disability in using public transportation. The results reported in Table 3 were virtually unchanged.

Second, we replaced the prescription medications variable with self-reported information on specific current diseases to determine whether specific disorders might have independent effects on activity index. We created the following seven disease categories for the presence of cerebrovascular disease, cardiovascular disease, hypertension, hypercholesterolemia, musculoskeletal diseases, diabetes, and others. None of these disease variables were significant, and the results did not change.

Third, we separately examined the associations of domain-specific cognitive functions with frequencies of engagement in each of 11 nonphysical activities. Significant associations with z-standardized scores at $p < .0045$ (significance level adjusted for multiple comparisons) were found for the following activities: reading books, with digit span forward and backward (attention and working memory) ($p = .003$) and block design (visuospatial ability) ($p = .0007$); traveling, with word list immediate recall (learning/acquisition) ($p = .003$), and word fluency (language) ($p = .0005$).

Discussion

The news media frequently carry human interest stories about very old individuals who maintain very high activity levels, implying that these are exceptional people. In fact, little is known regarding the normative levels of leisure activities and social engagement among the oldest old and the factors that explain the apparently typical age-associated decline among normal elderly persons. Overall, in this community-dwelling, relatively healthy, cognitively unimpaired, elderly Japanese sample, we found significant declines in activity scores among the oldest old (85 years old or older) compared with the youngest old (65–74 years) in all three types of leisure activities (physical and nonphysical hobbies and social activities).

Gait speed consistently explained the age-associated reduction in levels of activities. Previous studies of older adults have reported that average gait speed/velocity predicted disabilities and health outcomes including disability incidence, nursing home admission, new falls, mortality (22–24), and cognitive decline (25,26). Abnormal gait also predicts non-Alzheimer's disease dementia (27) and cognitive decline (28). Gait is not a simple motor activity, but a cognitively complex task (29). Various leisure activities have been found to be associated with reduced risk of dementia and rate of cognitive decline (2–7). Greater cognitive challenge might stimulate and increase cognitive reserve (8), or, alternatively, persons with greater cognitive reserve might be capable of rising to greater cognitive challenges than could persons with less reserve. Our finding suggests that mobility could play a role in the relationship between leisure activities and dementia risk: slowing gait speed leading to reduced engagement in various hobby activities, in turn associated with lesser cognitive reserve and increased likelihood of manifesting dementia. In addition, subclinical cerebrovascular or other brain pathology, reducing gait speed (30–33), could also contribute to the development of dementia. Regardless of mechanism, gait speed could add a dimension to the study of potential mechanisms underlying the apparently protective effect of leisure activity against cognitive decline. Further, the elderly population may benefit from opportunities to strengthen lower extremity functions, improving gait and mobility so as to maintain optimal activity levels and potentially benefit their cognitive functioning as well.

Contrary to our hypothesis, vision or hearing impairment did not explain the decreased levels of engagement except in social activities. Our finding suggests that relatively healthy elderly persons might be able to retain their levels of physical and nonphysical leisure activities, if they avoid depressive symptoms and reduced mobility.

Interestingly, age-associated decline in the levels of engagement in physical activities was not explained by morbidity burden, as was also found in the Study of Osteoporotic Fractures (34). That study found that self-reported arthritis was not independently associated with taking walks, the most popular physical exercise among their study participants. It has been suggested that deteriorating health or disease can work either as a motivator for increasing physical activity or as a factor reducing the activity (35). Possibly because of this bidirectional effect of morbidity on physical activity, neither the total numbers of prescription medications taken nor specific disease variables were significantly associated with physical activity among our sample of relatively healthy community-dwelling participants. Furthermore, because our study selection criteria included absence of ADL limitations with minimal IADL disabilities, our participants' illnesses may have been too mild to interfere substantially with their physical activities. Additionally, physical hobby activities could be associated with factors not examined in this study such as proximity to the park or walking path, easy access to public transportation, climate, or life course factors such as exposure to exercise during adolescence (35).

We found that the frequency of engagement in nonphysical hobbies was significantly associated with all of the cognitive domains examined here. Reading a book and traveling were found to be especially cognitively demanding activities; reading a book was associated with attention, working memory, and visuospatial ability, and traveling with learning or acquisition and fluency. These activities could be encouraged among the elderly population even though their longitudinal effect on cognition has yet to be confirmed.

Our study had some limitations. Results from a particular area in Japan have limited generalizability to other regions. Categorization of each activity into the three indices used in this study is somewhat arbitrary because there is much potential for overlap among them. Factor analysis is often used for categorizing psychometric measurements or functional abilities, but it is not appropriate here as hobbies are based on personal choices. We did not measure socioeconomic status or daily pain, which can influence the level of leisure activities, or health-related quality of life, which is reportedly improved by cognitively demanding activities such as cognitive training (36). The study participation rate of 40% is quite low, and our sample may have been biased toward persons who tend to volunteer and be socially active. The cross-sectional nature of this study limits the ability to infer causal directions.

Japan and also the United States are projected to experience a large increase of the oldest old population (37). Preserved cognitive function is a central component of healthy aging and associated with reduced risk of disabilities and mortality (38–42). Because even the oldest old with superior health are at high risk of developing dementia (43), it is urgent to find preventive strategies against cognitive decline (44). If increased opportunities to conduct appropriate leisure and social activities could sustain and prolong their physical and cognitive health, they would have important public health implications. Further research on factors explaining age-associated decline among healthy elderly persons is warranted.

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