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Social participation patterns and the incidence of functional disability: The Japan Gerontological Evaluation Study

Authors: Shigekazu Ukawa^{*1,2}, Akiko Tamakoshi², Yutaka Okada³, Yoichi M. Ito⁴, Rika Taniguchi⁵, Yukako Tani⁶, Yuri Sasaki⁷, Junko Saito^{8,9}, Maho Haseda⁹, Naoki Kondo⁹, Katsunori Kondo^{10,11}, for the Japan Gerontological Evaluation Study group

Affiliations

¹ Osaka City University Graduate School of Human Life Science, Osaka, Japan

² Department of Public Health, Faculty and Graduate School of Medicine, Hokkaido University, Hokkaido, Japan

³ School of Medicine, Hokkaido University, Hokkaido, Japan

⁴ Clinical Research and Medical Innovation Center, Hokkaido University Hospital, Hokkaido, Japan

⁵ Osaka City University School of Human Life Science, Osaka, Japan

⁶ Department of Global Health Promotion, Tokyo Medical and Dental University, Tokyo, Japan

⁷ Department of International Health and Collaboration, National Institute of Public Health, Saitama, Japan

⁸ Behavioral Science Division, Center for Public Health Sciences, National Cancer Center, Tokyo, Japan

⁹ Department of Health Education and Health Sociology, School of Public Health, The University of Tokyo, Tokyo, Japan

¹⁰ Department of Social Preventive Medical Sciences, Center for Preventive Medical Sciences, Chiba University, Chiba, Japan

¹¹ Department of Gerontological Evaluation, Center for Gerontology and Social Science, National Center for Geriatrics and Gerontology, Aichi, Japan

Corresponding author: Shigekazu Ukawa, Osaka City University Graduate School of Human Life Science, 1-1-138 Sugimoto, Sumiyoshi-ku, Osaka, Japan. Telephone/Fax: +81 6 6605 2897, Email: ukawa@life.osaka-cu.ac.jp

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ABSTRACT

Aim: To examine whether patterns of social participation vary in their associations with functional disability.

Methods: Data from 44,978 participants (22,750 men and 22,228 women) who participated in the 2010 Japan Gerontological Evaluation Study—a study of those aged ≥ 65 years from 23 municipalities in eight prefectures—were analyzed. Social participation information was obtained at baseline with an 8-item questionnaire. Incidence of functional disability from 2010–2013 was defined as a new certification of eligibility for municipal public long-term care insurance. Social participation patterns were analyzed using exploratory factor analysis and participants were classified into quartiles of factor scores of social participation patterns. A competing risk model was used to calculate the hazard ratios and 95% confidence intervals for the incidence of functional disability in three years of follow-up.

Results: Two social patterns were identified: sports groups/clubs and hobby groups and political groups/organizations and industry/trade associations. For both patterns, compared to participants in the lowest quartile, participants in the highest quartile were more likely to be male, college educated, high-income, and current drinkers. Both patterns were associated with reduced incidence of functional disability (adjusted hazard ratios for top quartile of sports and hobby pattern: 0.66, 95% confidence interval: 0.59, 0.74; for political and industry/trade pattern: 0.81, 95% confidence interval: 0.72, 0.90; p for trend $< .001$ for both).

Conclusions: Those whose social participation patterns were characterized by frequent participation in sports groups/clubs and hobby groups or political groups/organizations and industry/trade associations were less likely to develop a functional disability.

Keywords: aged, epidemiology, Japan, long-term care, social participation

Introduction

Japan is one of the fastest-aging societies worldwide, and preventing the need for long-term care (LTC) is a pressing social issue. Persons aged older than 65 years are certified as needing LTC when they are independent in performing the basic activities of daily living but require some assistance in performing instrumental activities of daily living; the primary causes of certification are disease burdens such as stroke, and dementia, and frailty.¹ The prevalence of people aged 65 years or older that were certified as needing LTC was 18.8% in 2017, which has been increasing.² Since LTC insurance (LTCI) is a mandatory national insurance system in Japan, the issue has both societal and fiscal implications.

National and local governments have been promoting social participation by senior individuals to prevent the need for LTC. Social participation in multiple activities^{3,4}—specifically, participation in local community, hobby, or sports organizations^{4,5}—is protective against functional disability. More frequent participation in social activities was associated with a lower risk of incident disability³ in studies in Chicago, USA. An intervention to provide community salons was associated with lower incidence of functional decline in Aichi Prefecture in Japan.⁶

The details of social participation have not been as widely studied: holding a leadership role in an organization is associated with a reduced risk of dementia⁷ and functional disability;⁵ however, even fairly minimal participation (inactive or less than once a month) in some groups is associated with the maintenance of functional competence.⁸ Social participation activities conducted with others, such as neighbors or friends, was found to have a stronger protective effect than other leisure activities against the onset of non-communicable disease among middle-aged Japanese adults.⁹ One study that examined

patterns of activity among older Italian adults found that leisure could be organized into “surrounding” (e.g., socializing, attending church), “organized” (formal activities), and “indoor” (individual and home activities) style,¹⁰ with the best health observed among those participating in “organized style” activities.

The approach of considering activities individually or by frequency of participation has been valuable; however, it also has several conceptual limitations. It does not consider the variety of social participation possibilities and their interactions because people do not take part in isolated social activities. One method of identifying and examining broader social participation patterns is exploratory factor analysis—a statistical tool for aggregating inter-related variables into composite factors. These factors represent social participation patterns in the study population and help to distinguish individuals per the combination of social activities they choose to participate in. Social participation patterns may go further than individual activity exposures toward explaining the incidence of functional disability. Thus, our aim was to elucidate the association between social participation pattern scores and the further onset of LTC need via a large-scale nationwide cohort study in Japan.

Methods

Study population

Data from the 2010 Japan Gerontological Evaluation Study (JAGES) and incident functional disability within three years were used for this analysis. The study has been described in detail elsewhere.⁵ Briefly, 81,971 non-disabled people (37,842 men and 44,129 women) aged ≥ 65 years from 23 municipalities, including urban, suburban, and rural areas in 8 (out of 47) prefectures throughout Japan were enrolled. The baseline survey was conducted between August 2010 and January 2012. The data were obtained through a self-

administered questionnaire distributed and collected by mail (response rate = 66%). Of the original cohort members, 36,993 participants with missing data for social participation were excluded; therefore, the data from 44,978 participants (22,750 men and 22,228 women) were analyzed in this study.

Data collection

Information on social participation and other lifestyle factors was obtained in the baseline questionnaire. Social participation involved eight items that are described in detail elsewhere:⁴ sports groups or clubs, hobby groups, volunteer groups, citizen/consumer groups, religious organizations, political groups/organizations, local community activities (including neighborhood associations, senior citizen clubs, or firefighting teams), and industry or trade associations. Participants were asked about their social participation: “Do you belong to any of the following groups or organizations?” If they said *yes*, they were asked how often they participated: every day, 2–3 times/week, 1 time/week, 1–2 times/month, a few times a year, or none. We converted all answers into times per week (7, 2.5, 1, 0.35, 0.05, or 0 times/week).

Functional non-disability was defined as not a certificate of needing LTCI benefit along with our previous studies.^{4-6,13} All individuals aged ≥ 65 years are eligible for the insurance program regardless of their income status.¹⁴ The data on the incidence of functional disability from 2010 to 2013 were obtained from municipal public LTCI system databases, with those who were newly certified as eligible for the LTCI benefit considered as functionally disabled. The certification of eligibility for the LTCI benefit is judged based on a nationally standardized procedure including a physician’s examination and evaluation of physical and cognitive functions.¹⁴

Statistical analysis

Social participation patterns based on the eight social participation items were analyzed using exploratory factor analysis with the SAS PROC FACTOR procedure, applying the principal factors method with two factors and a promax (oblique) rotation. We treated the frequency data as continuous. For determination of the number of factors to be retained, we first conducted a principal factor analysis, and then considered components with an eigenvalue > 1.0 as well as the scree test results and interpretability of the factors. The factor scores—a linear composite of the optimally weighted variables under analysis—were also calculated for each participant within the same SAS procedure and standardized to a mean value of 0.0 and a standard deviation of 1.0. Each participant was assigned a factor score for each identified pattern. Participants were then classified into quartiles of factor scores of social participation patterns. Bivariate analyses were conducted, examining the demographic and other predictors of social participation patterns using chi-square tests.

A competing risk model was used to calculate the hazard ratios (HRs) and 95% confidence intervals (CIs) for incidence of functional disability.¹⁵ We treated death as a competing event because all-cause mortality and functional disability share a lack of social involvement as a common risk factor. We used the SAS PROC PHREG procedure to calculate HRs, incorporating Fine and Gray's model using the eventcode option. Trend p -values were calculated to assess associations between the four categories of social participation patterns and the incidence of functional disability. Multiplicative interaction terms between sex and each social participation pattern were evaluated in the fully adjusted models using likelihood ratio tests.

The following variables measured at baseline were included in the model^{4,5}: municipality; sex (man or woman); age (65–69, 70–74, 75–79, or ≥ 80 years); marital status

(married, widowed/divorced, single, or other/missing); employment status (working, not working, or missing); educational attainment (< 6, 6–9, 10–12, \geq 13 years, or other/missing); equivalized incomes (< 2.00, 2.00–3.99, \geq 4.00 million yen, or missing); smoking status (current, former, never, or missing); drinking status (current, former, never, or missing); depressive tendencies (presence, absence, or missing); functional capacity (high, low, or missing); subjective cognitive complaint (presence, absence, or missing); social support (presence or absence/missing); and medical history of cancer (yes, no/missing), heart disease (presence or absence/missing), stroke (yes or no/missing), respiratory disease (presence or absence/missing), arthritic disorder (presence or absence/missing), and trauma and/or bone fracture (presence or absence/missing).

Annual equivalized household income was adjusted for household size by dividing the income by the square root of the number of people in that household. We assessed depressive symptoms with the Japanese short version of the Geriatric Depression Scale (GDS-15)—a self-rating depression-screening tool for older people that has been validated among Japanese older people.¹¹ A total score of six or higher was treated as indicating depressive tendencies. Functional capacity was assessed by a validated questionnaire of the Tokyo Metropolitan Institute of Gerontology Index of Competence,¹² and total scores ranged from 0 to 13, with a score of \geq 10 considered as high competence. Presence of emotional and/or institutional social support was measured by the following two questions: “Do you have someone who listens to your concerns and complaints?” and “Do you have someone who looks after you when you are sick and have to stay in bed for a few days?” If participants received social support from someone, it denoted the presence of social support. Subjective cognitive complaints were assessed with following three questions: “Do you often get into

trouble when you leave your belongings behind somewhere?,” “Do you often get times or places confused?,” and “Do you often forget things that happened recently (e.g., what you had for breakfast)?” Presence of subjective cognitive complaints was defined by answering *yes* to at least one item.

An alpha level of .05 was considered significant. All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Ethical considerations

The study protocol for the JAGES project was approved by the Ethics Committee for Research on Human Subjects at Nihon Fukushi University, Japan (no. 10–05), and the Hokkaido University Graduate School of Medicine Institutional Ethical Board for Epidemiological Studies (no. 14-024).

Results

Two social participation patterns were extracted using an exploratory factor analysis. The factor-loading matrix for social participation patterns and social participation items is shown in Table 1. The first pattern had a higher loading of sports groups or clubs and hobby groups. The second pattern had a higher loading of political groups/organizations and industry/trade associations. These two patterns were labeled as follows: The sports and hobby pattern and the political and industry pattern.

Participants’ baseline characteristics are shown per the factor score quartiles of the two social participation patterns in Tables 2 and 3. For both the sports groups or clubs and hobby and the political groups/organizations and industry/trade associations patterns, compared to participants in the lowest quartile, participants in the highest quartile were older; had higher baseline functional capacity; and were more likely to be male, working, college

educated, high-income, and current drinkers; had more comorbidities; and were less likely to have cognitive complaints ($p < .001$). For the sports groups or clubs and hobby pattern, participants in the highest quartile were less likely to be current smokers ($p < .001$).

The median follow-up time was 2.9 years. During a total of 124,870 person-years, 3,221 participants experienced incident functional disability. Table 4 shows the HR and 95% CI of functional disability of the two social participation patterns by score quartile among Japanese older participants. After adjusting for potential confounders such as age; sex; municipality; marital status; employment status; educational attainment; annual equivalized household income; smoking status; drinking status; depressive tendencies; functional capacity; social support; subjective cognitive complaints; and medical history of cancer, heart disease, stroke, respiratory disease, arthritic disorder, and trauma and/or bone fracture, the HRs for the sports groups or clubs and hobby pattern were 0.88 (95% CI: 0.80–0.98) for the second, 0.84 (95% CI: 0.76–0.93) for the third, and 0.66 (95% CI: 0.59–0.74) for the fourth quartile compared with the bottom quartile (p for trend $< .001$). The political groups/organizations and industry/trade associations for the second (HR: 0.89, 95% CI: 0.80–0.99), third (HR: 0.85, 95% CI: 0.77–0.94), and fourth (HR: 0.81, 95% CI: 0.72–0.90) quartile also showed a decreased risk for the incidence of functional disability (p for trend $< .001$). No significant interactions between sex and social participation patterns were found (p for interaction = .44 for sports groups or clubs and hobby pattern; 0.99 for political groups/organizations and industry/trade associations pattern).

Discussion

We derived two major social participation patterns—“sports groups or clubs and hobby groups” and “political groups/organizations and industry/trade associations”—from a

large-scale nationwide cohort study in Japan. These two social participation patterns were inversely associated with incident functional disability. Even when we set our outcome to a severe disability defined as care levels 2–5¹⁷, the same trends were found in these two social participation patterns (data not shown). Only a few previous studies have addressed broader patterns of social participation. One study of a Finnish-Swedish population found four patterns: voluntary associational activity, friendship, religious association, and hobby participation;¹⁶ while, in our analysis only two patterns were identified. A study of leisure patterns in Italy produced the broader categories of “surrounding,” “organized,” and “indoor” style;¹⁰ consistent with our analysis, sports and other activities were included in the “organized style,” which was associated with the best health.

Overall, the results are largely consistent with previous studies of individual types of social participation. For the sports groups or clubs and hobby groups pattern, our results were consistent with our former prospective cohort study—2003 AGES, in Japan^{4,5}—which reported an inverse association between incident functional disability and participation in sports and hobby organizations. Those who participated in a sports club (adjusted HR: 0.66; 95% CI: 0.51–0.85) or hobby group (adjusted HR: 0.69; 95% CI: 0.55–0.87) were less likely to be functionally disabled than other participants in the same cohort.⁵ The benefit of participation in a sports club and hobby group in protecting against functional disability may be owing to not only the physical¹⁷ or recreational activities performed,¹⁸ but also the social benefits obtained, such as instrumental or emotional support.⁴ Previous studies have found participation in alumni groups, volunteer groups, neighborhood community associations, hobby clubs, and cultural clubs to be associated with better functional competence.^{8,19} In a Korean study, participation in senior citizen clubs or centers was associated with reduced

cognitive decline.²⁰ One study found stronger effects in women than men;¹⁹ however, we did not observe any sex-related effects.

In contrast to the results of our previous prospective cohort study⁵, which indicated that there were no significant associations between participation in political organizations or groups (adjusted HR: 1.24; 95% CI: 0.97–1.58) and industrial or trade associations (adjusted HR: 1.13; 95% CI: 0.88–0.1.44) and incident disability, we found that higher political groups/organizations and industry/trade associations pattern scores were associated with significantly decreased incident functional disability. These inconsistent results may be owing to an interaction or the synergistic effect of multiple social participations. Although the potential pathways are still unclear, better social relationships, obtaining formal/informal social support, and social ties may be linked to positive health behaviors.²¹ However, further studies are needed to elucidate the direct mechanisms of effect. A Chinese study found that playing cards/mahjonn and organized social activities were protective against functional decline.²² Both types of activity were mediated by cognitive ability; however, the first was partially mediated by positive emotions and the second by physical exercise.²² Analysis of the Ohsaki Cohort of 2006 found that cognitive activity, walking, psychological state, and social support all mediated the effect of volunteering, hobbies, and neighborhood associations on functional disability.²³ In addition, political groups/organizations and industry/trade associations serve to link the social capital that individuals build in their relationships with institutions and individuals that have relative power over them.²⁴ Although our findings are not directly comparable, one report from Denmark²⁵ and two reports from Sweden^{26,27} found an association between neighborhood social capital—defined by neighborhood voting participation rates—and lower all-cause mortality as well as mortality

due to coronary heart disease, psychiatric disorders, cancer, stroke, chronic lower respiratory diseases, and type II diabetes.²⁷ A Japanese study also found that higher community mistrust was associated with the onset of disability,¹³ and this association was possibly mediated by social participation.

The strengths of this study include its prospective cohort design and the inclusion of participants from throughout Japan, as well as a very complete follow-up for functional disability. However, the current study contains some limitations that warrant consideration. First, our previous report showed a lack of social participation to be a risk factor for all-cause mortality.²⁸ Therefore, as all-cause mortality and functional disability share a lack of social involvement as a common risk factor, this may lead to an underestimation of its effect on incident functional disability. To reduce this bias, we conducted a competing risk analysis. Second, the information on social participation was collected only at baseline and was not updated during the study period. National and local governments have undertaken efforts to promote social participation for older individuals in Japan;²⁹ thus, some individuals who became more socially active might have been misclassified; if non-differential, this may have diminished the estimated HR. Third, although the participants were exclusively independent older individuals, we cannot rule out the possibility of reverse causality owing to the short follow-up period of three years. Even with control for functional status at baseline, residual confounding may be produced as those who are healthier are more likely to participate in social activities. Most likely, however, this concern would not differentially affect one social participation pattern or another. Fourth, cognitive function could reduce the response rate and affect the quality of responses, which might lead to those with poorer functional prognosis and less social participation to be underrepresented in the study and, among those

participating, having differentially poorer quality of data. Fifth, although we used the Kaiser-Guttman criteria, deciding the number of factors was subjective and ambiguous. However, even if we set three or four factors in the principal factor analysis, the first two patterns were similar. Therefore, the two social participation patterns we extracted might have robustness. Finally, since social participation patterns were extracted from data obtained within the study population, it is reasonable that the results are not reproduced in different populations. Despite this drawback, an advantage of this approach is that the description of social participation patterns allowed for the promotion of changes to be focused on the participation of social activities that are readily recognized by the target group.

In conclusion, this nationwide cohort study indicates that those whose social participation patterns were characterized by frequent participation in sports groups or clubs and hobby groups, or political groups/organizations and industry/trade associations, were less likely to develop a functional disability. Generally speaking, the results have been consistent across different settings and countries;³⁰ however, further research is needed to determine whether these social patterns are specific to Japan or are more broadly applicable. Grouping activities into those with similar effects can help in designing optimal interventions to improve participation and health; for instance, a “one from column A, one from column B” approach may be best for maintaining health. Consequently, the present findings can be used to assess types of social participation and methods for preventing the need for LTC.

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Table 1 Factor loading matrix for the two major social participation patterns, JAGE

Study

	sports groups or clubs and hobby groups	political groups/organizations and industry/trade associations
Political groups/organization	0.03	0.54
Industry or trade associations	-0.01	0.48
Volunteer groups	0.11	0.28
Local community activities	0.31	0.16
Religious organizations	-0.04	0.22
Sports groups or clubs	0.65	-0.06
Citizen/consumer groups	0.15	0.24
Hobby groups	0.64	0

Factors with loadings ≥ 0.4 are in boldface.

Table 4 Hazard ratios and 95% confidence intervals of functional disability of two social participation patterns by score quartile among Japanese elderly participants

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	<i>P</i> for trend
Sports groups or clubs and hobby groups					
Person-years	39,090	21,330	32,170	32,280	
Number of cases	1688	497	600	436	
Number of deaths	638	196	196	128	
HR (95% CI) ¹	1.00	0.67(0.60, 0.74)*	0.57(0.52, 0.62)*	0.42(0.38, 0.47)*	< .001
HR (95% CI) ²	1.00	0.88(0.80, 0.98)*	0.84(0.76, 0.93)*	0.66(0.59, 0.74)*	< .001
Political groups/organizations and industry/trade associations pattern					
Person-years	40,568	20,693	31,566	32,042	
Number of cases	1611	445	638	527	
Number of deaths	627	168	206	157	
HR (95% CI) ¹	1.00	0.70(0.61, 0.76)*	0.61(0.56, 0.67)*	0.54(0.49, 0.60)*	< .001
HR (95% CI) ²	1.00	0.89(0.80, 0.99)*	0.85(0.77, 0.94)*	0.81(0.72, 0.90)*	< .001

HR hazard ratio, CI confidence interval. **P*< .05.

¹competing risk model adjusted for age, sex, and municipality.

²competing risk model adjusted for age, sex, municipality, marital status, employment status, educational attainment, annual equivalized household income, smoking status, drinking status, depressive tendency,

functional capacity, social support, subjective cognitive complaints, and medical history of cancer, heart disease, stroke, respiratory disease, arthritic disorder, and trauma and/or bone fracture.

Table 3 Factors associated with political groups/organizations and industry/trade associations patterns at baseline by score quartiles

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
Variable	<i>n</i> = 15,107	<i>n</i> = 7,398	<i>n</i> = 11,233	<i>n</i> = 11,240	<i>p</i> -value
Sex					
Men	53.3	50.5	50.0	43.1	< .001
Age (years)					
65–69	34.2	41.1	38.3	38.8	< .001
70–74	20.9	24.4	24.2	25.9	
75–79	15.9	14.1	16.0	16.8	
≥ 80	29.0	20.4	21.6	18.5	
Marital status					
Married	67.7	73.3	74.7	76.2	< .001
Widowed/divorced	25.8	21.9	20.9	19.7	
Single	2.0	1.6	1.4	1.0	
Other/missing	4.5	3.2	3.0	3.1	
Employment status					
Working	17.7	21.3	25.4	26.7	< .001
Not working	69.5	69.7	66.5	65.3	

Missing	12.9	9.0	8.1	8.0	
Educational attainment (years)					
< 6	4.0	2.1	1.3	1.4	< .001
6–9	51.9	44.5	42.7	37.5	
10–12	27.6	34.0	35.7	37.1	
≥ 13	12.2	16.2	17.3	20.7	
Other/missing	4.4	3.1	3.0	3.3	
Equivalized incomes (million yen)					
< 2.00	43.2	42.3	37.8	37.1	< .001
2.00–3.99	29.4	35.2	37.9	38.5	
≥ 4.00	60.0	6.6	8.0	8.6	
Missing	21.4	15.9	16.2	15.8	
Smoking status					
Current	11.7	11.7	10.4	11.2	< .001
Former	25.8	28.2	27.9	29.7	
Never	53.3	53.4	54.9	52.7	
Missing	9.3	7.0	6.8	6.5	
Drinking status					
Current	27.6	33.8	36.5	42.4	< .001

Former	4.0	3.6	3.2	2.9	
Never	63.3	58.1	56.0	4.3	
Missing	5.1	4.5	4.3	4.5	
GDS-15					
≥ 6	24.9	16.4	14.1	10.7	< .001
< 6	60.1	71.0	73.5	77.9	
Missing	15.0	12.7	12.4	11.4	
TMIG					
≥ 10	63.5	80.2	84.4	88.0	< .001
< 10	25.0	11.3	7.8	5.0	
Missing	11.5	8.5	7.8	7.1	
Subjective cognitive complaints					
Presence	40.9	32.3	30.7	29.3	< .001
Absence	53.0	62.3	64.1	65.8	
Missing	6.2	5.5	5.1	4.9	
Social support					
Presence	96.0	98.1	98.5	98.7	< .001
Medical history of Cancer					

Presence	4.9	4.7	4.1	3.6	< .001
Heart disease					
Presence	13.3	11.9	11.7	10.8	< .001
Stroke					
Presence	1.8	1.2	1.3	1.3	< .001
Respiratory disease					
Presence	4.3	3.8	3.3	2.9	< .001
Arthritic disorder					
Presence	11.9	10.7	11.0	9.7	< .001
Trauma and/or bone fracture					
Presence	1.7	1.1	1.2	1.0	< .001

Values are expressed as percentages. GDS = Geriatric Depression Scale, TMIG = Tokyo Metropolitan Institute of Gerontology Index of Competence. GDS, smaller values mean better mental status. TMIG, greater values mean better functional status.

p-values were calculated with chi-square tests.

Table 4 Hazard ratios and 95% confidence intervals of functional disability of two social participation patterns by score quartile among Japanese elderly participants

	Quartile 1	Quartile 2	Quartile 3	Quartile 4	<i>P</i> for trend
Sports groups or clubs and hobby groups					
Person-years	39,090	21,330	32,170	32,280	
Number of cases	1688	497	600	436	
Number of deaths	638	196	196	128	
HR (95% CI) ¹	1.00	0.67(0.60, 0.74)*	0.57(0.52, 0.62)*	0.42(0.38, 0.47)*	< .001
HR (95% CI) ²	1.00	0.88(0.80, 0.98)*	0.84(0.76, 0.93)*	0.66(0.59, 0.74)*	< .001
Political groups/organizations and industry/trade associations pattern					
Person-years	40,568	20,693	31,566	32,042	
Number of cases	1611	445	638	527	
Number of deaths	627	168	206	157	
HR (95% CI) ¹	1.00	0.70(0.61, 0.76)*	0.61(0.56, 0.67)*	0.54(0.49, 0.60)*	< .001
HR (95% CI) ²	1.00	0.89(0.80, 0.99)*	0.85(0.77, 0.94)*	0.81(0.72, 0.90)*	< .001

HR hazard ratio, CI confidence interval. **P*< .05.

¹competing risk model adjusted for age, sex, and municipality.

²competing risk model adjusted for age, sex, municipality, marital status, employment status, educational attainment, annual equivalized household income, smoking status, drinking status, depressive tendency,

functional capacity, social support, subjective cognitive complaints, and medical history of cancer, heart disease, stroke, respiratory disease, arthritic disorder, and trauma and/or bone fracture.