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CLINICAL INVESTIGATION

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Social participation and incident disability and mortality among frail older adults: A JAGES longitudinal study

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Abstract

Background: Frailty is the highest risk factor for incident disability and mortality. Social participation is a modifiable factor for reducing adverse outcomes among independent older adults. However, the association between social participation and incident disability and mortality among frail older adults remains unclear. Therefore, we examined the association between various social activities and incident disability and mortality.

Methods: This nationwide prospective cohort study (The Japan Gerontological Evaluation Study) recruited older adults with frailty, aged 65 years and older ($N = 9090$) who were followed up for 6 years (2010–2016). We examined incident disability and all-cause mortality at the end of the follow-up period. Frailty was assessed using the Kihon Checklist. The independent variable was social participation in 2010, grouped into the following seven categories: hobby groups, sports groups or clubs, volunteer groups, senior citizens' clubs, industries, neighborhood communities, and paid work.

Results: The incidence of disability among participants was 19.5% (1770) and that of mortality was 19.2% (1753). Belonging to sports groups or clubs (Hazard Ratios [HR] = 0.74; 95% Confidence Interval [CI] = 0.57, 0.98) or hobby groups (HR = 0.77; 95% CI = 0.60, 0.98) was significantly associated with a lower risk

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of incident disability. Meanwhile, hobby groups (HR = 0.68; 95% CI = 0.56, 0.83), sports groups or clubs (HR = 0.71; 95% CI = 0.57, 0.88), volunteer groups (HR = 0.69; 95% CI = 0.54, 0.88), and senior citizens' club (HR = 0.75; 95% CI = 0.61, 0.90) were associated with lower risk of incident mortality.

Conclusions: Social participation was associated with a lower risk of incident disability and mortality, not only in healthy older adults but also in frail older adults who are at higher risk of incident disability and mortality. This suggests that frail older adults should be encouraged to participate in all the seven types of social participation examined in this study, as this may lower the risk of subsequent disability and mortality.

KEYWORDS

frailty, long-term care, mortality, social participation

INTRODUCTION

With the rapidly aging population,[1] the population of frail older adults is increasing worldwide.[2,3] Frailty is defined as loss of reserve capacity in multiple physiological systems and results in increased vulnerability to various stressors.[4] Frailty increases the risk of developing several adverse health outcomes, such as fractures, incident disability, hospitalization, institutionalization, and mortality.[5–7] Particularly, frailty compared with non-frailty and pre-frailty is the highest risk factor for adverse health outcomes. Therefore, it is important for clinical practitioners and public health experts to prevent the progression from frailty to adverse health outcomes.

Among community-dwelling older adults, social participation is one of the modifiable factors for reducing adverse health outcomes, such as incident disability, including functional and cognitive aspects,[8–14] and mortality.[13,14] Social participation comprises various concepts and types, including leisure activities, meeting friends, volunteering, and others.[15] A previous study[15] classified activities into six levels (levels 1–6), with social participation considered to range from level 2 (talking to neighbors) to level 6 (engaging in political and socially oriented activities). Particularly, social activities (e.g., sports groups or clubs, hobby groups, and paid work) reduce the risk of functional disability.[8,12] In addition, these activities have gained increasing attention in recent aging research because of their relatively low cost, accessibility, and health benefits.[16]

However, evidence about social participation among frail older adults is still limited. A study reported that community-based self-management activities in frail older adults effectively reduced incident disability.[6] Frail older adults benefit longitudinally from participating in sporting, cultural, and social activities, which manifest as improvement in physical function and well-being.[17] Frail older adults participate in various activities, but no previous studies have examined how these activities are longitudinally associated with incident disability and mortality. In addition, no validation study based on large-scale longitudinal data of multi-municipalities has been performed. The social participation of frail older adults is influenced by the built environment, including the physical environment.[18] Using large longitudinal data, we can clarify the association between social participation and mortality among frail older adults, including the built environment, which has not been considered in previous studies.

Key points

- The percentages of participation in different social activities among frail older adults vary widely by type, with participation in neighborhood communities and hobby groups exceeding 20%.
- In this nationwide Japanese cohort, frail older adults who participated in hobby groups or sports groups, or clubs were at lower risk of incident disability and mortality.
- The lower risk of incident disability and mortality due to social participation is not only limited to healthy older adults but also occurs in frail older adults.

Why does this paper matter?

This study encourages social participation to extend the healthy life expectancy of frail older adults.

In this study, we examined the association of various social participations with incident disability and mortality using large-scale longitudinal data from Japan to control for confounding resulting from the physical environment, which was not accounted for in previous studies. This study closes a potential gap in the evidence on the potential effect of social participation among frailty older adults. By examining the effects of various types of social participation for frail older adults, policymakers and researchers can provide evidence to encourage new social participation activities for frail older adults.

METHODS

Data sources

We used longitudinal cohort data from the 2010 waves of the Japan Gerontological Evaluation Study (JAGES),[19,20] which is a nationwide gerontological survey in Japan, focused on social determinants of health and social environment. The baseline survey was conducted between August 2010 to January 2012 among 95,827 older adults aged 65 years or older living in 13 municipalities of seven prefectures in Japan, including both rural and urban areas. The participants were not certified to receive long-term care. A random sampling method was used in the 4 large municipalities, while the self-administered questionnaire was sent by mail to all eligible residents in 9 small municipalities. Among the 62,426 respondents (response rate: 65.1%), 56,587 respondents had valid information on ID number, sex, and age. Among the 56,587 respondents, 54,537 (96.2%) were successfully linked with the records of the national long-term care insurance (LTCI) database containing information on the onset of all-cause mortality between August 2010 and December 2016. We excluded 991 individuals from the baseline survey due to limitations in and missing responses regarding performing basic activities of daily living such as walking, bathing, and toileting. In addition, 27,920 individuals who were determined as non-frail based on the Kihon Checklist (KCL)[21–23] and 15,051 individuals with incomplete responses to the KCL items were excluded. Finally, 9090 eligible frail older adults (5012 women) were included.

Frailty

Frailty was assessed using the KCL, developed by the Japanese Ministry of Health, Labour, and Welfare. The KCL is a simple yes/no questionnaire that assesses multiple aspects of daily living functions, such as physical strength, nutrition, eating habits, socialization, memory, mood, and lifestyle.[21,24,25] Each item was scored yes = 1 or no = 0, with a total score ranging from 0 to 25 and a higher score indicating worse functioning. The KCL is strongly associated with the Cardiovascular Health Study criteria for frailty based on Fried's Phenotypic Model[4] with the sensitivity and specificity of these cut-off values being 89.5% and 80.7%,[22] respectively. In addition, the predictive validity of new support and care needs certifications and deaths has been reported.[22] Based on previous studies,[22–24,26] frailty (≥8 points) was defined, and the non-frail (0–7 points) was excluded from this study.

The JAGES participants were informed that participation was voluntary and that returning the questionnaire implied consent to participate in the study. Our research protocol and informed consent method were approved by the Ethics Committees of Chiba University (approval number: 2493), the National Center for Geriatrics and Gerontology (approval number: 992), and Nihon Fukushi University (approval number: 10–05).

Incident disability and mortality

We examined incident disability and all-cause mortality at the end of the 6-year observational period. Incident disability was assessed based on the LTCI system, that is, the need for nursing care and the situation. Disability classification was subdivided into the following seven levels: support needed (support levels 1 and 2) and nursing care needed (care levels 1–5).[27,28] To address the possibility of functional disability regardless of social participation, the functional disability outcome was defined as care levels 2 or higher, excluding support levels 1 and 2 and care level 1, which are considered mild functional disabilities.[27,29]

Social participation

The independent variable was social participation, which was recorded from the baseline survey. Based on the six levels of social activities[15] and previous studies,[8,12] we classified social participation into the following seven groups; participation in hobby groups, sports groups or clubs, volunteer clubs, senior citizens' clubs, industries, neighborhood communities, and paid work. The organization that is particularly unique to Japan among the social participation types is senior citizens' clubs, industries, and neighborhood communities. Japan's senior citizens' clubs organize a wide range of activities, including group activities such as sports, hobbies, cultural activities, and performing arts. In addition, industries are interest groups composed of companies and individuals involved in a particular industry as its members.

Neighborhood community is a voluntary or local association organized by residents and others in a community or part of a city in Japan for friendship, promotion of common interests, and local self-government, as well as its meetings and gatherings.

Participants were asked, "How often do you participate in the following groups or clubs?" Participants chose an option from the following choices: "almost every day," "twice or thrice a week," "once a week," "once or twice a month," "a few times a year," and "never." The responses were categorized as "yes" if individuals selected any of the five options from "a few times a year" to "almost every day," and "no" if they selected "never." Participation in work was assessed using the following question: "What is your current working status?" Participants chose from the following options: "working," "retired and not working now," and "never had a job." The response was categorized as "yes" if the participants answered, "working" and "no" if they answered, "retired and not working now," or "never got a job."

Covariates

All covariates were obtained from the baseline survey. Based on previous studies,[8,12] 19 variables were considered potential confounding factors that may correlate with social participation and incident disability or mortality. Sociodemographic characteristics included age, sex, annual equivalent income, educational attainment, marital status, and living arrangement. Health conditions included current alcohol drinking or smoking status, self-rated health, body mass index, instrumental activities of daily living (IADL) disability, and chronic diseases such as hypertension, heart disease, stroke, diabetes, cancer, respiratory disease, and arthritis. We also included the social and physical environment because these factors influence social participation among the frail.[18] The social environment includes social support (emotional and instrumental) and the frequency of meeting friends. The physical environment refers to the environment within 1 km of a participant's home, such as "parks or footpaths suitable for exercise or walking," "shops or facilities that sell fresh fruits and vegetables," houses or facilities that can easily be accessed," "locations that make walking difficult, such as hills or staircases," and "roads or crossroads with a significant risk of traffic accidents." All variables were categorized as shown in Table 1.

TABLE 1 Basic characteristics of participants at the baseline survey.

Baseline characteristics	Total ($N = 9090$)
Age (years)	
65–69	1747 (19.2)
70–74	2264 (24.9)
75–79	2300 (25.3)
80–84	1749 (19.2)
≥85	1030 (11.3)
Sex, women	5012 (55.1)
Annual equivalent income (million yen)	
Low (<2.0)	4252 (46.8)
Middle (2.0–3.9)	2493 (27.4)
High (≥4.0)	2345 (25.8)
Educational attainment (years)	
Low (<10)	5131 (57.6)
Middle (10–12)	2653 (29.8)
High (≥13)	1126 (12.6)
Marital status, single	3078 (34.6)
Living arrangement, living alone	1287 (14.4)
Current alcohol drinking	
Current	2501 (28.0)
Past	470 (5.3)
Never	5976 (66.8)
Current smoking	
Current	1073 (12.6)
Past	2495 (29.2)
Never	4972 (58.2)
Self-rated health, not good	3814 (42.4)
Body mass index	
Low (<18.5)	1100 (12.1)
Middle (18.5–24.9)	5899 (64.9)
High (≥25)	2091 (23.0)
IADL disability, yes	5358 (59.4)
Chronic diseases	
Hypertension	3928 (50.2)
Heart disease	1539 (19.7)
Stroke	164 (2.1)
Diabetes	1380 (17.6)
Cancer	558 (7.1)
Respiratory disease	557 (7.1)
Arthritis	1756 (22.5)

Abbreviation: IADL, instrumental activities of daily living.

Statistical analysis

First, descriptive analyses were performed to characterize baseline characteristics. Second, a Cox proportional hazard model was developed to compute the multivariate-adjusted incident disability and mortality risk. Hazard ratios (HR) and 95% confidence intervals (CI) of incident disability and mortality for 6 years were calculated. In the model of incident disability, a competing risk model was used. We used Fine and Gray's model to account for

mortality as a competing risk. Social participation was categorized into three types. For example, in the case of the hobby group, we assessed non-participation in any group (reference category), participation in a hobby group, and those who do not participate in hobby groups but participate in other community activities. We used the Bonferroni correction to account for multiple comparisons.

To address potential bias due to missing data, we performed multiple imputations using the multivariate normal regression method, assuming that the data were missing at random. Social participation was missing in 19.4% (hobby group) to 27.3% (industry) of the participants according to the groups. Covariates were missing in 2.1% (living arrangement) to 23.7% (chronic diseases) of the participants, according to covariates. Other missing variables were less than 10%. We created 20 imputed datasets and combined the effect estimates using Rubin's rule.[30] The numbers and proportions of missing variables are shown in Table S1.

We conducted three sensitivity analyses. First, to evaluate the robustness of the estimated associations with unmeasured confounders, we calculated E-values for each exposure-outcome association.[31] E-values quantify the minimum strength required for the association of an unmeasured confounder with both the exposure and outcome, above and beyond the adjusted covariates on the risk ratio scale, to explain the observed association. Second, to reduce the possibility of reverse causation (i.e., short follow-up time resulting in incident disability or mortality with or without social participation), we excluded the participants with incident disability or mortality within the first two-year follow-up. Third, to account for the possibility of different effects on incident disability and mortality depending on the frequency of social participation, we analyzed six types of social participation, excluding paid work, by frequency (≥1 day/month and ≥1 day/week). All analyses were performed using STATA MP 16.1 (Stata Corp, College Station, TX, USA).

RESULTS

We analyzed data from 9090 frail older adults. The proportion of women was 55.1%, and the mean age (SD) was 76.0 (6.6) years. The mean follow-up period (maximum) for incident disability and mortality was 5.0 (6.4) and 5.4 (6.6) years, respectively. Of the participants, mortality occurred in 1770 (19.5%) participants and disability occurred in 1753 (19.2%) of the participants.

Table 1 shows the basic characteristics of participants in the baseline survey. Approximately half of the participants were in the low-income and low-education groups and had IADL disability and hypertension.

TABLE 2 Characteristics of the social and physical environment at baseline survey.

Characteristics	Total ($N = 9090$)
Social support, available	
Emotional support	8011 (90.3)
Instrumental support	8255 (92.4)
Frequency of meeting friends	
Almost daily	767 (8.7)
2–3 times/week	1562 (17.8)
About once/week	1378 (15.7)
1–2 times/month	1863 (21.3)
A few times a year or less	3197 (36.5)
Parks or footpaths suitable for exercise or walking	
Exists	5705 (63.9)
Does not exist	2795 (31.3)
Unknown	435 (4.9)
Shops or facilities that sell fresh fruits and vegetables	
Exists	6034 (67.5)
Does not exist	2725 (30.5)
Unknown	185 (2.1)
Houses or facilities you can easily visit	
Exists	2603 (29.1)
Does not exist	5402 (60.5)
Unknown	925 (10.4)
Locations that make walking difficult, such as hills or steps	
Exists	3672 (41.0)
Does not exist	4930 (55.1)
Unknown	351 (3.9)
Roads or crossroads with a great risk of traffic accidents	
Exists	6170 (69.0)
Does not exist	2402 (26.9)
Unknown	365 (4.1)

The percentage of IADL disability by type of social participation was as follows: sports groups or clubs (73.7%), volunteer (72.4%), hobby groups (71.6%), neighborhood communities (67.9%), industries (67.6%), senior citizens' clubs (61.4%), paid work (59.5%), not any participation (46.9%). Table 2 shows the characteristics of the social and physical environment at the baseline survey. Most people received social support (emotional and instrumental support). Regarding the physical environment, approximately half of the participants answered as follows: parks or footpaths were suitable for exercise or walking, there were shops or facilities that sold fresh fruits and vegetables, and there were roads or crossroads with great risk of traffic accidents.

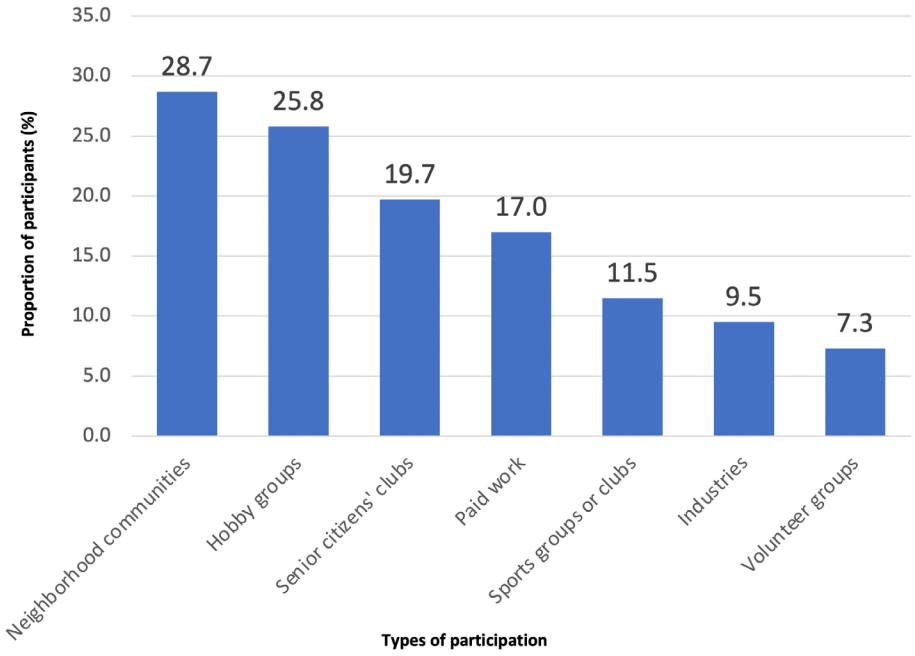

FIGURE 1 Bar graph showing the proportions of participants who participate in each organization as a few times a year or more.

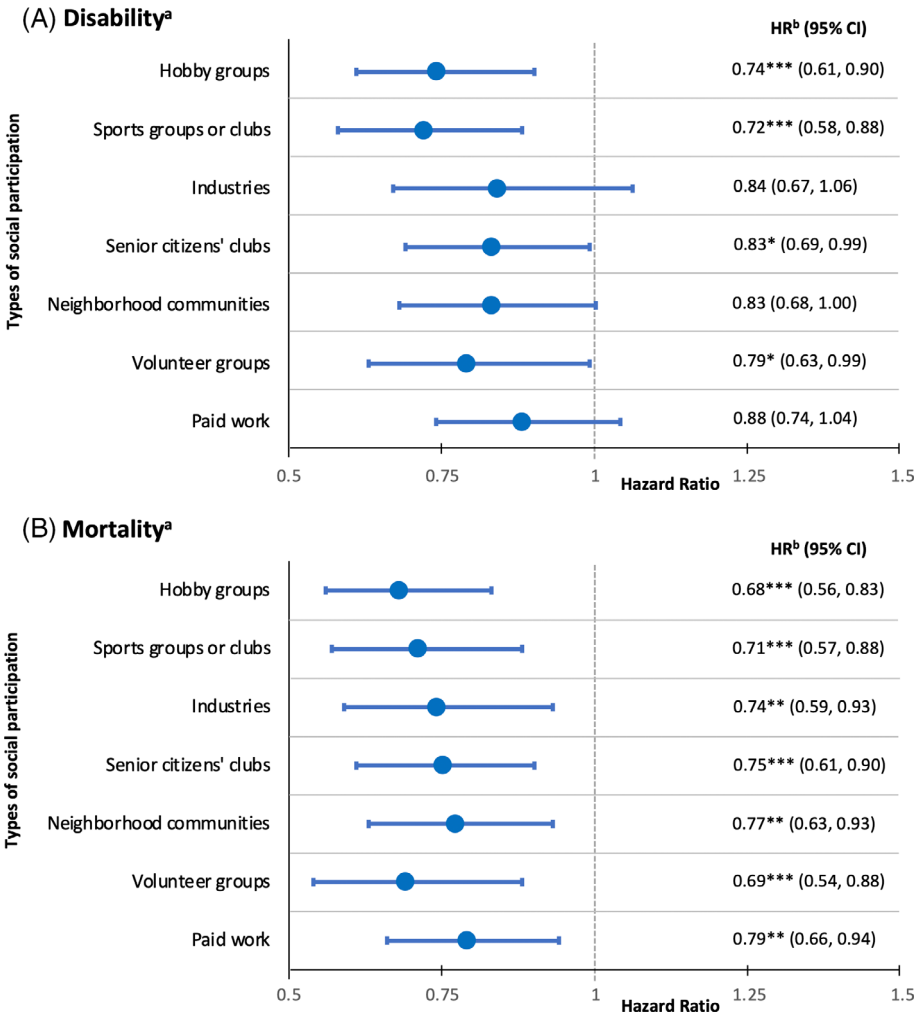

FIGURE 2 Hazard ratios and 95% confidence intervals of Cox regression analysis for social participation and risk of incident disability (A) and mortality (B). Reference, no participation. All models were adjusted for age, sex, income, education, marital status, living arrangement, alcohol, smoking, self-rated health, body mass index, the instrumental activity of daily living, chronic diseases, social support, frequency of meeting friends, and the existence of parks, shops, houses, locations that make walking difficult, and roads. HR, hazard ratio; CI, confidence interval. *$p < 0.05$ before Bonferroni correction; **$p < 0.01$ before Bonferroni correction; ***$p < 0.05$ after Bonferroni correction (the p-value cutoff for Bonferroni correction is $p = 0.05/7$ outcomes $= p < 0.0071$).

Figure 1 shows the proportions of participation in each type of social organization. The organization with the highest proportion of participants was neighborhood communities (28.7%). Additionally, the proportion of participation in neighborhood communities and hobby groups was more than 20%.

Figure 2 shows the association between social participation and incident disability and mortality. In comparison to non-participation in any group, participation in hobby groups (HR = 0.74; 95% CI = 0.61–0.90) and sports groups or clubs (HR = 0.72; 95% CI = 0.58–0.88) were significantly associated with a lower incidence of disability. On the other hand, hobby groups (HR = 0.68; 95% CI = 0.56–0.83), sports groups or clubs (HR = 0.71; 95% CI = 0.57–0.88), senior citizens' clubs (HR = 0.75; 95% CI = 0.61–0.90), and volunteers (HR = 0.69; 95% CI = 0.54–0.88) were significantly associated with a lower incidence of mortality. These associations remained below the $p = 0.05$ threshold after accounting for multiple comparisons via Bonferroni correction.

In the sensitivity analyses, we calculated E-values to evaluate the robustness of the observed associations between social participation and subsequent incident disability and mortality among frail older adults to unmeasured confounders (Table S2, S3). For example, to fully explain the observed association between participation in hobbies and certification of incident disabilities, unmeasured confounders had to be associated with subsequent incident disability, with a risk ratio of 1.77 each in participation in hobbies. A 1.36-fold risk ratio was required to shift the CI to include the null value. We also analyzed the risks of outcomes while excluding data obtained within two years of follow-up (Table S4). Excluding participants' data obtained within two years of follow-up, incident disability occurred in 881 (9.7%) of the participants, and mortality occurred in 533 (5.9%). There was no significant association between incident disability and the hobby and sports or club groups, but point estimation was almost at the same level, as shown in Figure 2. There was a significant association between mortality and each social participation group (Figure 2). In addition, for the six types of social participation, excluding paid work, we analyzed the frequency of participation by dividing it into once a month or more and once a week or more (Table S5, S6). The overall trend was for HR to decrease as the frequency of participation increased, but the change was slight.

DISCUSSION

To our knowledge, this is the first study to examine the association of various social participation groups with the incidence of disability and mortality among frail older adults. We found that social participation compared to non-participation in any social group among frail older adults was associated with a lower risk of incident disability and mortality. Sports or club and hobby groups were protective against both incident disability and mortality, while other types of social participation were protective against mortality. These results, after adjusting for all 27 observable confounding factors, confirm the robustness of the association between social participation and incident disability and mortality among frail older adults.

Previous studies among community-dwelling older adults have shown that sports or clubs[8,12,13] and hobby groups[8,12–14,27] were associated with low-incidence disability. The present study, which focused on frail older adults, had findings that were similar to these previous studies. Furthermore, all seven types of social participation assessed in this study were associated with a reduced risk of subsequent mortality. The results from this study, similar to the findings of previous studies,[13,32,33] were obtained based on assessments that focused on frail older adults.

Frail older adults have smaller social networks, receive less social support, and are more isolated than that observed in the non-frail.[34] A chronic health condition may contribute to social isolation or loneliness by interfering with the quality, quantity, or structure of relationships or by worsening pathophysiological processes,[35] and are further associated with lower participation in social activities.[36] This study showed that participation in community activities may contribute to reducing the risk of subsequent disability and mortality. Participation in an exercise program for health may lead to reductions in social isolation or loneliness due to the social nature of the program rather than the exercise itself.[35] A study suggested that community activities and connections with other people may promote outings, which in turn may lead to the maintenance of daily life functions. Although the potential pathways are still unclear, better social relationships, obtaining formal/informal social support, and social ties may be associated with positive health behaviors.[37]

Although it has been shown that frail older adults have increased healthcare costs compared to healthy older adults,[38] this evidence from frailty studies has not yet been fully translated into clinical practice and healthcare policy-making.[39] To meet the needs of a rapidly aging society, policymakers and healthcare providers need to encourage equal social participation for both healthy and frail older adults and to provide regular opportunities for social participation. This may help prevent further progression from frailty to incident disability and mortality, as well as optimize social security expenditures.

There are some limitations in this study. First, because this is an observational study, the effect of selection bias on the results cannot be eliminated. We used E-values to estimate the extent to which observed associations were influenced by unmeasured confounders and sought to minimize the impact of selection bias as much as possible. We used E-values to confirm that the results are robust. Second, we did not assess other forms of participation except social participation. In this study, social participation was defined as participation in community organizations. However, the frequency of meeting with friends was considered a confounding factor affecting both social participation and outcomes and was included in the analysis, but the results were consistent. Third, because we analyzed the association of social participation at baseline, we were unable to account for the effect of those who stopped social participation during the follow-up period. A previous study reported that sustained social participation may be more strongly associated with fewer depressive symptoms.[40] Thus, the results of this study may have underestimated the effects of social participation. Further studies should consider the difference between the effects of sustained and temporary social participation. Fourth, the details of social participation activities are unknown. For example, the types of hobbies (go, shogi, handicrafts, etc.) or sports (golf, walking, tennis, etc.) they participated in were unknown. In addition, the details of the paid work (what kind of work was done, part-time or full-time) were unknown. Previous studies focusing on the type of sport have reported that subjective sense of health, frequency of laughter, and their association with depression varies according to the type of sports activities.[41] Finally, the generalizability of the results is limited by the fact that the study focused on Japanese older adults.

In conclusion, the results suggest that the lower risk of incident disability and mortality due to social participation is not only limited to healthy older adults but also occurs in frail older adults who were at higher risk of incident disability and mortality. In addition, the results suggest that all seven types of social participation examined in this study can lower the risk of subsequent disability and mortality. For both healthy and frail older adults, social participation is important in health policy to prevent future disability and mortality.

AUTHOR CONTRIBUTIONS

All authors (1) made substantial contributions to the study concept or the data analysis or interpretation; (2) drafted the manuscript or revised it critically for the important intellectual concept; (3) approved the final version of the manuscript to be published; and (4) agreed to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors have declared no conflicts of interest in this article.

SPONSOR'S ROLE

None.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Table S1. Numbers and proportions of missing variables of the participants in 2020 (Total $N = 9090$).
Table S2. Hazard ratios and 95% confidence intervals of Cox regression analysis and E-value for the risks of incident disability.
Table S3. Hazard ratios and 95% confidence intervals of Cox regression analysis and E-value for the risks of incident mortality.
Table S4. Risks of incident disability and mortality in frail older adults excluding data obtained within the first two years of follow-up.
Table S5. Risks of incident disability and mortality in frail older adults according to the frequency of social participation (≥1 day/month).
Table S6. Risks of incident disability and mortality in frail older adults according to the frequency of social participation (≥1 day/week).

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