



Types and frequency of social participation and comprehensive frailty among community-dwelling older people in Japan

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ABSTRACT

Although research has established social participation as important for preventing frailty in older people, the association between the type and frequency of social participation and comprehensive frailty remains unclear. This study aimed to reveal the associations between types and frequency of social participation and comprehensive frailty among community-dwelling older people. This was a cross-sectional study conducted in four cities and towns (Inabe City, Nabari City, Odai Town, and Kiho Town) of Mie Prefecture, Japan, among adults who were: (i) aged ≥ 65 years and (ii) not certified as needing long-term care. We measured comprehensive frailty using the participants' total scores on the Kihon Checklist, developed by Ministry of Health, Labour and Welfare of Japan, which divides frailty status into three categories: robust (0–3 points), prefrail (4–7), and frail (8–25). Types and frequency of social participation were explanatory variables, and ordered logistic regression analysis adjusted for potential confounding factors identified the associations. The frailty status of the 296 participants (age 65–74 years: 44.3 %; female: 74.0 %) was as follows: frail, 21.3 %; prefrail, 40.2 %; and robust, 38.5 %. Lower level of frailty was associated with interaction using smartphones 2–3 times per month, participating in sports ≥ 4 times per week, participating in local improvement activities several times per year, and engaging in activities for children 2–4 times per month. Social participation among older adults at appropriate frequencies were associated with the lower level of comprehensive frailty. However, future longitudinal studies are needed using populations from more diverse countries or regions and from different cultures.

1. Introduction

With populations worldwide aging rapidly, frailty is gaining global attention. Frailty is a syndrome characterized by diminished strength, endurance, and reduced physiologic function, but it is not static; improvement is possible (Morley et al., 2013). Because frailty encompasses physical, mental, and social facets (Gobbens et al., 2010), it needs to be investigated and understood from all three perspectives.

In a systematic review of 21 high-income countries, the frailty prevalence was 4.0–59.1 % (Collard, Boter, Schoevers & Oude Voshaar, 2012), and in Japan, the prevalence was 4.6–9.5 % among community-dwelling older people (Kojima et al., 2017). Frailty can cause detrimental health outcomes such as falls, mobility impairment, decline in the ability to complete activities of daily living, hospitalization, death (Morley et al., 2013), cognitive impairment (Chu et al., 2021), and depression (Chu et al., 2020). Notably, the COVID-19 pandemic countermeasures drastically altered lifestyles around the world, and the post-

pandemic frailty prevalence exceeds that of the period before COVID-19 (Hirose et al., 2023; Son et al., 2022). Therefore, it is imperative to improve strategies for preventing frailty in older adults.

A substantial body of research has established many factors as being associated with frailty, including age, sex, education, and economic status (Myers, Drory, Goldbourt & Gerber, 2014); diseases such as depression (Imaoka et al., 2021; Oyon et al., 2022), diabetes (Espinoza, Jung & Hazuda, 2012), heart failure and cerebrovascular diseases (Huang et al., 2022); living alone (Kojima, Taniguchi, Kitamura & Fujiwara, 2020); and social participation (Ning, Zhang, Xie, Jiang & Xie, 2023; Yamada et al., 2023; Abe et al., 2020). Of these factors, social participation is one of the most modifiable. Levasseur et al. defined social participation as a “person’s involvement in activities that provide interaction with others in society or the community,” which includes important shared spaces such as home and the Internet (Levasseur, Richard, Gauvin & Raymond É, 2010; Levasseur et al., 2022).

However, it has also been established that the effects of social

Abbreviations: AOR, Adjusted odds ratio; CI, Confidence interval; CHS, Cardiovascular Health Study; KCL, Kihon Checklist; OR, Odds ratio.

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participation on older people's health vary according to type (Tomioka, Kurumatani & Saeki, 2018; Komatsu et al., 2019; Xie & Ma, 2021; Croezen, Avendano, Burdorf & van Lenthe, 2015) and frequency (Xie & Ma, 2021; Wang, Chen & Zhou, 2021). For instance, researchers have found significant positive associations between physical health and engaging in hobbies (Tomioka et al., 2018; Komatsu et al., 2019), sports (Komatsu et al., 2019; Xie & Ma, 2021) and volunteering (Tomioka et al., 2018; Xie & Ma, 2021) and between both physical and mental health and engaging in sports (Ukawa et al., 2020; Ling, Tsuji, Nagamine, Miyaguni & Kondo, 2020) and learning activities (Croezen et al., 2015; Ling et al., 2020). As the findings indicate, there are established correlations between social participation among older adults and their physical health including frailty. However, it has also been established that frailty has physical, mental, and social components (Gobbens et al., 2010) and older people's quality of life was affected by all physical, mental, and social well-being (Gothe et al., 2020). The World Health Organization has defined health as a state of complete physical, mental, and social well-being (World Health Organization, 2022) and has indicated that all three health-related perspectives must be apprehended for health promotion (World Health Organization, 1946). To the best of our knowledge, we are the first to comprehensively address the associations of social participation with all three facets together. This study aimed to determine the types and frequencies of social participation that were associated with the lowest level of comprehensive frailty among community-dwelling older people.

2. Material and methods

2.1. Study design, setting, and participants

This was a cross-sectional study involving community-dwelling older people. Our inclusion criteria were, first, the age should be ≥ 65 years. Second, individuals requiring less than care level one under Japan's long-term care insurance system (care level one defined as the total estimated assisting care time per day is ≥ 32 min, but < 50 min (Digital Agency of Japan, n.d.). In other words, such individuals find it difficult to perform the essential routine activities by themselves (Shinjuku City Long-term Care Insurance Division, 2018). Thus, they require partial care because their abilities to handle the routine instrumental activities are diminished to some extent (Shinjuku City Long-term Care Insurance Division, 2018). Third, they must have the ability to complete a self-administered questionnaire. The study areas were four cities and towns (Inabe City, Nabari City, Odai Town, and Kiho Town) in Mie Prefecture.

Mie Prefecture is long and thin and situated close to the center of Japan, and it covers an area of 5777 km² (Mie Prefectural Government, 2023a). It has plains, basin areas, and mountainous regions that support agriculture, forestry, and fishing (Mie Prefectural Government, 2023a). In 2021, the population was approximately 1.8 million, and the aging rate was 29.9 % (Mie Prefectural Government, 2021). The study areas include all similar rural cities and towns. The population density of Nabari City, Inabe City, Kiho Town, and Odai Town were 588.6, 204.6, 129.6, and 23.9 inhabitants per km², respectively, in 2021 (Mie Prefectural Government, 2023b). According to the Organisation for Economic Cooperation and Development, the urban area is defined as one with ≥ 1500 inhabitants per km² (Organisation for Economic Cooperation and Development, 2013); therefore, the four cities and towns were classified as non-urban cities and towns.

2.2. Data collection

We administered the self-report questionnaire from June to November in 2022 with the cooperation of public health nurses and staff in the local governments of the four cities and towns. We distributed the questionnaires to individuals participating in group activities throughout communities or during home visits. When a visit could not

be held because of COVID-19 pandemic restrictions, questionnaires were left at individuals' homes, they filled them out, and they called us to let us know they had completed them.

2.3. Measurements

2.3.1. Frailty

The objective variable was comprehensive frailty status, that is, physical, mental and social frailty status. To measure frailty, we administered the Kihon Checklist (KCL) developed by the Ministry of Health, Labour and Welfare of Japan and widely used in Japan (Ministry of Health, Labour and Welfare of Japan, 2005). It consists of 25 questions regarding seven domains: instrumental activities of daily living, social activities of daily living, physical functions, nutrition status, oral function, cognitive function, and depression. The total KCL score significantly correlates with the total score for the Cardiovascular Health Study (CHS) criteria, which are the most-used frailty criteria globally (Satake et al., 2016). There is no international consensus on the cut-off score of the KCL for the prefrail and frail categories. The suggested cut-off scores were 3/4 (Satake et al., 2016; Esenkaya et al., 2019; Sentandreu-Mañó et al., 2021) and 4/5 (Wang et al., 2023) for prefrail and 5/6 (Sentandreu-Mañó et al., 2021), 6/7 (Watanabe et al., 2022; Salaffi, Farah & Di Carlo, 2023), 7/8 (Satake et al., 2016), 8/9 (Esenkaya et al., 2019), and 10/11 (Wang et al., 2023) for frail. In this study, we adopted the cut-off score suggested by a previous study conducted in Japan and used the CHS criteria, namely, 3/4 for prefrail and 7/8 for frail (Satake et al., 2016).

2.3.2. Social participation

The explanatory variables were each of the following 23 types of social participation and the respondents' frequency of participation in each: (i) interaction with friends, (ii) interaction with family living together, (iii) interaction with family living separately, (iv) taking care of family living together, (v) taking care of family living separately, (vi) interaction using smartphones, (vii) self-education (e.g., learning languages, computing, business), (viii) sports (e.g., walking, light physical exercise, jogging, fishing), (ix) local events, (x) hobbies and amusements (e.g., karaoke, dancing, gardening), and (xi) work.

We also tested the associations of participation in 12 kinds of volunteer activities: (xii) activities for older people (e.g., assisting in daily life or recreation activities), (xiii) activities related to disability (e.g., learning sign language or Braille), (xiv) activities related to children (e.g., supporting children's group, helping with school events), (xv) health-related or medical activities (e.g., donating blood, visiting hospital patients), (xvi) local improvement activities (e.g., cleaning up parks and roads, planting flowers, promoting the local community), (xvii) safety promotion activities (e.g., disaster and crime prevention, road safety), (xviii) conservation or environmental activities (e.g., bird watching, promoting recycling or environmental preservation), (xix) disaster-related activities (e.g., donating to disaster victims), (xx) activities related to sports (e.g., coaching), (xxi) activities related to culture/art (e.g., volunteering at a museum), (xxii) activities related to science (e.g., participating in research studies), (xxiii) activities related to international cooperation (e.g., facilitating conferences, symposia, etc.).

We developed our study questionnaire based on the Survey on Time Use and Leisure Activities conducted by the Statistics Bureau of Japan (Statistics Bureau of Japan, 2021). Participation in each activity was answered with yes or no, and we divided frequency into eight categories: ≥ 4 times per week, 2–3 times per week, once per week, 2–3 times per month, once per month, several times per year, once per year, or none.

2.3.3. Confounding factors

The confounding factors we included were participants' socio-demographic characteristics that had shown evidence of association with both frailty status and social participation (Myers et al., 2014;

Espinoza et al., 2012; Huang et al., 2022; Kojima et al., 2020; Nemoto et al., 2018; Cook, Verstaappen, Lunt & O'Neill, 2022; Cohen-Mansfield, Shmotkin & Hazan, 2012; Chen, Zeng & Fang, 2022). These included age group (65–74 years; ≥ 75 years), gender (female; male), cohabitants (yes; no), final academic background (elementary school, junior high school; high school; vocational school, junior college; university, college or more), economic situation (very good; good; poor; very poor), and existence of diseases under treatment or that are presenting after effects (yes; no).

2.4. Statistical analysis

We excluded respondents from our analysis who were missing responses on the KCL because we could not determine their frailty status. First, we calculated descriptive statistics for all variables. Second, we performed Fisher's exact test to assess the relationships between each variable and frailty status. Third, ordinal logistic regression models were specified to examine the association between frailty status (frail, prefrail, and robust) and each type of social participation. We calculated unadjusted odds ratio (OR), adjusted odds ratio (AOR), and 95 % confidence interval (CI). Fourth, using the types of social participation that showed a statistically significant association with frailty status, we performed additional ordinal logistic regression analyses to assess the association between frailty status and the frequency (eight levels) of each type of social participation; in the case of complete separation, we combined some levels of frequency. We calculated OR and AOR (adjusted for confounding factors and other types of social participation) as well as 95 % CI, and we excluded variables with complete separation or potential multicollinearity (adjusted generalized variance inflation factor ≥ 2) from the models. We considered the results statistically significant if the 95 % CI did not overlap 1 or $P < 0.05$. All analyses were carried out using R version 4.2.2 (R Core Team, 2022).

2.5. Ethical approval and consent to participate

Written informed consent was obtained from all participants in this study. The study procedure was performed in accordance with the 1964 Helsinki Declaration and its later amendments. Ethical clearance for this study was received from the Clinical Research Ethics Review Committee of Mie University Hospital in 2022 (No. U2022-008).

3. Results

3.1. Participant characteristics

In the data cleaning process, 12 observations with missing or inconsistent responses were excluded from analysis: one missing response on the KCL and 11 inconsistent responses on the existence of cohabitants. Of the remaining 296 respondents, 74.0 % were female and 44.3 % were aged 65–74 years (Table 1). The prevalence of frail, prefrail, and robust were 21.3 %, 40.2 %, and 38.5 %, respectively. The types of social participation with the highest participation rate were interaction with friends (95.3 %) and with family living separately (86.4 %), although rates were also high for interactions using smartphones (84.1 %) and interactions with family living together (73.0 %).

3.2. Types of social participation associated with frailty

We excluded three variables from the logistic regression analysis due to multicollinearity or complete separation: activities related to international cooperation, interaction with family living together, and cohabitants. The ordinal logistic regression model (Table 2) revealed associations between social participation types and the level of frailty. Lower level was associated with engaging in interaction using smartphones (AOR: 0.39, 95 % CI: 0.21–0.72), sports (AOR: 0.49, 95 % CI: 0.31–0.79), activities for children (AOR: 0.38, 95 % CI: 0.18–0.80), and

local improvement activities (AOR: 0.43, 95 % CI: 0.25–0.75). In contrast, older people who engaged in self-education were more likely to be frail (AOR: 1.77, 95 % CI: 1.03–3.04).

3.3. Frequency of social participation associated with frailty

Using the five types of social participation that showed a significant association with frailty status, we performed additional ordinal logistic regression analyses for each to assess the association between its frequency and frailty. One third of participants (39.2 %) interacted using smartphones ≥ 4 times per week, followed by 2–3 times per week (19.8 %) (Table 3). The frailty level was lowest with 2–3 times per month (AOR: 0.21, 95 % CI: 0.07–0.58), followed by once per week (AOR: 0.33, 95 % CI: 0.15–0.75), ≥ 4 times per week (AOR: 0.36, 95 % CI: 0.18–0.73) (Table 4). There was no significant association between frailty and the frequency of self-education.

One fifth of participants (21.0 %) engaged in sports once per week, followed by 2–3 times per week (16.3 %) and ≥ 4 times per week (15.3 %) (Table 3). The frailty level was lowest with ≥ 4 times per week (AOR: 0.36, 95 % CI: 0.18–0.71), followed by once per week (AOR: 0.42, 95 % CI: 0.23–0.78) and 2–3 times per week (AOR: 0.47, 95 % CI: 0.24–0.92) (Table 4). Most participants did not engage in local improvement activities (72.5 %) (Table 3); however, lower frailty level was associated with participating just several times per year (AOR: 0.27, 95 % CI: 0.12–0.63) (Table 4). Similarly, most participants did not engage in activities for children (85.9 %) (Table 3), but among those who did, doing so 2–4 times per month and several times per year were associated with a lower level of frailty (AOR: 0.20, 95 % CI: 0.04–0.95; AOR: 0.24, 95 % CI: 0.06–0.93, respectively) (Table 4).

4. Discussion

This study is the first examination of associations between comprehensive frailty and the types and frequency of social participation among older people in Japan. The prevalences of frail (21.3 %) and prefrail (40.2 %) were higher than those found by previous researchers who used the KCL (Hagiyama, Takao, Matsuo & Yorifuji, 2022; Shimazaki et al., 2020), but this was because the participants in this study had a higher mean age (76.7 years) than that in previous studies. Furthermore, we conducted our study during the COVID-19 pandemic. Research has established that frailty rates are higher since the pandemic than they were before (Hirose et al., 2023) because people tended to refrain from going out and interacting with others during the COVID-19 pandemic to prevent infection resulting in decline in physical activity and social participation.

We also found higher social participation rates for many activities than did authors of studies targeting general older populations (Cabinet Office of Japan, 2021a; Statistics Bureau of Japan, 2022). This was because we did not include any adults who were certified as needing long-term care. In addition, the employment rate among our participants was lower than that found in the national survey (16.4 % vs. 37.0 %) (Cabinet Office of Japan, 2021a). People who do not work may have time and relaxed mind to participate in social activities.

The key finding of this study was that a lower level of comprehensive frailty was associated with using smartphones, with the lowest odds for using a phone 2–3 times per month. In findings from earlier longitudinal studies, contact with people by phone or online was associated with reduced level of cognitive decline (Amini, Chee, Mendieta & Parker, 2019). During the COVID-19 lockdowns, 66.3 % of people in their 60s and even 49.0 % of people 70 or older reported that digital devices such as smartphone had become indispensable for the new way they had to live (Cabinet Office of Japan, 2021b). Ministry of Health, Labour, and Welfare of Japan endorses health promotion activities and supports venues labeled "Kayoi-no-ba" where older people can casually meet in their communities, and can plan and conduct activities (e.g., exercise, cooking, farming) by interacting with others (Ministry of Health, Labour

Table 1

Distribution of characteristics and social participation according among community-dwelling older people and to frailty status: Four cities and towns in Mie Prefecture of Japan, 2022.

	Total n (%)	Frail n (%)	Prefrail n (%)	Robust n (%)	P ^a
Characteristics					
Age (n = 296)					
65–74 years	131 (44.3)	17 (13.0)	48 (36.6)	66 (50.4)	<0.001
≥75 years	165 (55.7)	46 (27.9)	71 (43.0)	48 (29.1)	
Sex (n = 296)					
Female	219 (74.0)	49 (22.4)	89 (40.6)	81 (37.0)	<0.001
Male	77 (26.0)	14 (18.2)	30 (39.0)	33 (42.9)	
Cohabitants (n = 296)					
Yes	224 (75.7)	45 (20.1)	91 (40.6)	88 (39.3)	0.661
No	72 (24.3)	18 (25.0)	28 (38.9)	26 (36.1)	
Economic situation (n = 295)					
Very good	18 (6.1)	2 (11.1)	6 (33.3)	10 (55.6)	0.032
Good	203 (68.8)	37 (18.2)	82 (40.4)	84 (41.4)	
Poor	68 (23.1)	21 (30.9)	30 (44.1)	17 (25.0)	
Very poor	6 (2.0)	3 (50.0)	1 (16.7)	2 (33.3)	
Education (n = 293)					
Elementary/Junior high school	80 (27.3)	28 (35.0)	29 (36.3)	23 (28.8)	0.008
High school	152 (51.9)	29 (19.1)	60 (39.5)	63 (41.4)	
Vocational school/Junior college	41 (14.0)	6 (14.6)	19 (46.3)	16 (39.0)	
University/College or more	20 (6.8)	0 (0.0)	10 (50.0)	10 (50.0)	
Disease (n = 294)					
Yes	185 (62.9)	45 (24.3)	78 (42.2)	62 (33.5)	0.039
No	109 (37.1)	17 (15.6)	40 (36.7)	52 (47.7)	
Types of social participation					
Interaction with friends (n = 296)					
Yes	282 (95.3)	57 (20.2)	114 (40.4)	111 (39.4)	0.137
No	14 (4.7)	6 (42.9)	5 (35.7)	3 (21.4)	
Interaction with family living together (n = 296)					
Yes	216 (73.0)	42 (19.4)	88 (40.7)	86 (39.8)	0.647
No	8 (2.7)	3 (37.5)	3 (37.5)	2 (25.0)	
Not applicable (No cohabitants)	72 (24.3)	18 (25.0)	28 (38.9)	26 (36.1)	
Interaction with family living separately (n = 295)					
Yes	255 (86.4)	53 (20.8)	102 (40.0)	100 (39.2)	0.335
No	14 (4.7)	6 (42.9)	4 (28.6)	4 (28.6)	
Not applicable (No cohabitants)	26 (8.8)	4 (15.4)	13 (50.0)	9 (34.6)	
Taking care of family living together (n = 295)					
Yes	64 (21.7)	18 (28.1)	18 (28.1)	28 (43.8)	0.102
No	159 (53.9)	27 (17.0)	73 (45.9)	59 (37.1)	
Not applicable (No cohabitants)	72 (24.4)	18 (25.0)	28 (38.9)	26 (36.1)	
Taking care of family living separately (n = 296)					
Yes	27 (9.1)	4 (14.8)	12 (44.4)	11 (40.7)	0.750
No	242 (81.8)	55 (22.7)	94 (38.8)	93 (38.4)	
Not applicable (No cohabitants)	27 (9.2)	4 (14.8)	14 (51.9)	9 (33.3)	
Interaction using smartphones (n = 295)					
Yes	248 (84.1)	44 (17.7)	100 (40.3)	104 (41.9)	<0.001
No	47 (15.9)	19 (40.4)	19 (40.4)	9 (19.1)	
Self-education (n = 295)					
Yes	67 (22.7)	13 (19.4)	27 (40.3)	27 (40.3)	0.904
No	228 (77.3)	50 (21.9)	92 (40.4)	86 (37.7)	

(continued on next page)

Table 1 (continued)

	Total	Frail	Prefrail	Robust	P ^a
	n (%)	n (%)	n (%)	n (%)	
Sports (n = 295)					
Yes	195 (66.1)	34 (17.4)	81 (41.5)	80 (41.0)	0.068
No	100 (33.9)	29 (29.0)	38 (38.0)	33 (33.0)	
Local events (n = 293)					
Yes	48 (16.4)	8 (16.7)	19 (39.6)	21 (43.8)	0.634
No	245 (83.6)	53 (21.6)	100 (40.8)	92 (37.6)	
Hobbies and amusements (n = 293)					
Yes	198 (67.6)	38 (19.2)	82 (41.4)	78 (39.4)	0.613
No	95 (32.4)	23 (24.2)	37 (38.9)	35 (36.8)	
Work (n = 292)					
Yes	48 (16.4)	3 (6.3)	19 (39.6)	26 (54.2)	0.005
No	244 (83.6)	58 (23.8)	100 (41.0)	86 (35.2)	
Volunteer					
Activities for older people (n = 290)					
Yes	89 (30.7)	12 (13.5)	36 (40.4)	41 (46.1)	0.055
No	201 (69.3)	49 (24.4)	83 (41.3)	69 (34.3)	
Activities for people with disability (n = 290)					
Yes	13 (4.5)	3 (23.1)	4 (30.8)	6 (46.2)	0.760
No	277 (95.5)	58 (20.9)	114 (41.2)	105 (37.9)	
Activities for children (n = 290)					
Yes	41 (14.1)	2 (4.9)	13 (31.7)	26 (63.4)	<0.001
No	249 (85.9)	59 (23.7)	105 (42.2)	85 (34.1)	
Health or medical -related activities (n = 292)					
Yes	15 (5.1)	4 (26.7)	1 (6.7)	10 (66.7)	0.008
No	277 (94.9)	57 (20.6)	118 (42.6)	102 (36.8)	
Local improvement activities (n = 292)					
Yes	80 (27.4)	5 (6.3)	30 (37.5)	45 (56.3)	<0.001
No	212 (72.6)	56 (26.4)	89 (42.0)	67 (31.6)	
Safety promotion activities (n = 292)					
Yes	32 (11.0)	4 (12.5)	12 (37.5)	16 (50.0)	0.302
No	260 (89.0)	57 (21.9)	107 (41.2)	96 (36.9)	
Conservation or environmental activities (n = 292)					
Yes	57 (19.5)	7 (12.3)	20 (35.1)	30 (52.6)	0.037
No	235 (80.5)	54 (23.0)	99 (42.1)	82 (34.9)	
Disaster-related activities (n = 291)					
Yes	20 (6.9)	1 (5.0)	6 (30.0)	13 (65.0)	0.033
No	271 (93.1)	60 (22.1)	113 (41.7)	98 (36.2)	
Activities related to sports (n = 290)					
Yes	9 (3.1)	0 (0.0)	3 (33.3)	6 (66.7)	0.144
No	281 (96.9)	61 (21.7)	116 (41.3)	104 (37.0)	
Activities related to culture/art (n = 291)					
Yes	13 (4.5)	2 (15.4)	4 (30.8)	7 (53.8)	0.579
No	278 (95.5)	59 (21.2)	115 (41.4)	104 (37.4)	
Activities related to science (n = 290)					
Yes	6 (2.1)	0 (0.0)	1 (16.7)	5 (83.3)	0.123
No	284 (97.9)	61 (21.5)	118 (41.5)	105 (37.0)	
Activities related to international cooperation (n = 292)					
Yes	2 (0.7)	0 (0.0)	0 (0.0)	2 (100.0)	0.191
No	290 (99.3)	60 (20.7)	119 (41.0)	111 (38.3)	

^a Fisher's exact test. Boldface indicates statistical significance.

Table 2

The odds ratios of social participation types for the level of frailty among community-dwelling older people: Four cities and towns in Mie Prefecture of Japan, 2022.

	OR	95 % CI	AOR ^a	95 % CI
Types of social participation				
Interaction with friends				
Yes	0.36	0.17	0.79	0.62 0.24 1.62
No	1.00	reference	1.00	reference
Interaction with family living separately				
Yes	0.43	0.20	0.94	0.90 0.34 2.37
No	1.00	reference	1.00	reference
Taking care of family living together				
Yes	1.06	0.70	1.60	0.97 0.56 1.69
No	1.00	reference	1.00	reference
Taking care of family living separately				
Yes	0.81	0.45	1.44	1.13 0.54 2.40
No	1.00	reference	1.00	reference
Interaction using smartphones				
Yes	0.32	0.20	0.51	0.39 0.21 0.72
No	1.00	reference	1.00	reference
Self-education				
Yes	0.88	0.60	1.31	1.77 1.03 3.04
No	1.00	reference	1.00	reference
Sports				
Yes	0.62	0.44	0.88	0.49 0.31 0.79
No	1.00	reference	1.00	reference
Local events				
Yes	0.76	0.48	1.19	1.19 0.66 2.14
No	1.00	reference	1.00	reference
Hobbies and amusements				
Yes	0.84	0.59	1.19	1.01 0.63 1.61
No	1.00	reference	1.00	reference
Work				
Yes	0.41	0.25	0.66	0.73 0.40 1.33
No	1.00	reference	1.00	reference
Volunteer				
Activities for older people				
Yes	0.57	0.40	0.83	1.14 0.67 1.93
No	1.00	reference	1.00	reference
Activities for people with disability				
Yes	0.83	0.37	1.86	0.73 0.24 2.21
No	1.00	reference	1.00	reference
Activities for children				
Yes	0.28	0.16	0.48	0.38 0.18 0.80
No	1.00	reference	1.00	reference
Health or medical related activities				
Yes	0.41	0.18	0.94	1.31 0.42 4.11
No	1.00	reference	1.00	reference
Local improvement activities				
Yes	0.32	0.21	0.48	0.43 0.25 0.75
No	1.00	reference	1.00	reference

Table 2 (continued)

	OR	95 % CI	AOR ^a	95 % CI
Safety promotion activities				
Yes	0.57	0.33	0.99	1.01 0.46 2.24
No	1.00	reference	1.00	reference
Conservation or environmental activities				
Yes	0.48	0.31	0.74	1.10 0.59 2.06
No	1.00	reference	1.00	reference
Disaster related activities				
Yes	0.29	0.14	0.62	0.43 0.15 1.23
No	1.00	reference	1.00	reference
Activities related to sports				
Yes	0.26	0.08	0.83	0.98 0.20 4.79
No	1.00	reference	1.00	reference
Activities related to culture/art				
Yes	0.54	0.23	1.27	1.50 0.47 4.79
No	1.00	reference	1.00	reference
Activities related to science				
Yes	0.11	0.02	0.70	0.17 0.02 1.61
No	1.00	reference	1.00	reference

Abbreviation: OR, odds ratio; AOR, adjusted odds ratio, CI, confidence interval. Ordinal logistic regression analysis. Objective variable: frailty status (frail, prefrail, and robust). Higher OR means greater level of frailty. Boldface indicates statistical significance.

OR and AOR were calculated by excluding “not applicable” cases.

^a Adjusted for confounding factors (i.e., age group, gender, education, economic situation and diseases).

and Welfare of Japan, n.d.). The National Center for Geriatrics and Gerontology has developed a smartphone application for the “Kayoi-noba.” Older people can interact with others using this application (National Center for Geriatrics and Gerontology, n.d.). Given this finding, one important way to help reduce frailty in older adults is to ensure that they have access to digital devices that allow them to maintain contact even when they are homebound.

Participating in local improvement activities several times per year was associated with a lower level of frailty in our study. Previous studies have shown that holding leadership positions leads to a lower risk of developing dementia (Nemoto et al., 2017) and a lower risk of depression (Takagi et al., 2018). It is noteworthy that highest frequency in this study was no-participation (72.5 %), followed by participating in several times a year (9.6 %). Previous study revealed that participation in volunteer activities for a long time was associated with lower self-rated health (Van Willigen, 2000) and higher mortality (Musick, Herzog & House, 1999). It is possible that frequent participation in such activities can be burdensome if not practiced in moderation. Thus, it is paramount for older people to participate in the activity with appropriate frequency.

Participating in activities for children 2–4 times per month and several times per year were also associated with a lower level of frailty, possibly because interacting with youngsters gives older adults a sense of fulfillment and purpose in passing on their knowledge and experience to the younger generation. This aligns with longitudinal study findings in which interacting with children in primary school and kindergarten improved older adults’ depressive symptoms (Kamei et al., 2011), and self-rated health (Fujiwara et al., 2009). However, most of our respondents (85.9 %) did not engage in activities with children, and it could be important to increase older adults’ opportunities for such engagement. A child-rearing volunteer organization in Japan, named “Family Support Center,” offers services such as taking care of children

Table 3

Frequency of social participation among community-dwelling older people and according to frailty status: Four cities and towns in Mie Prefecture of Japan, 2022.

	Total n (%)	Frail n (%)	Prefrail n (%)	Robust n (%)	P ^a
Interaction using smartphones (n = 293)					
≥4 times per week	115 (39.2)	18 (15.7)	47 (40.9)	50 (43.5)	0.035
2–3 times per week	58 (19.8)	12 (20.7)	25 (43.1)	21 (36.2)	
Once per week	42 (14.3)	7 (16.7)	17 (40.5)	18 (42.9)	
2–3 times per month	20 (6.8)	3 (15.0)	6 (30.0)	11 (55.0)	
Once per month	11 (3.8)	4 (36.4)	4 (36.4)	3 (27.3)	
None	47 (16.0)	19 (40.4)	19 (40.4)	9 (19.1)	
Self-education (n = 295)					
≥4 times per week	6 (2.0)	1 (16.7)	3 (50.0)	2 (33.3)	0.910
2–3 times per week	10 (3.4)	1 (10.0)	3 (30.0)	6 (60.0)	
Once per week	31 (10.5)	9 (29.0)	12 (38.7)	10 (32.3)	
2–3 times per month	11 (3.7)	1 (9.1)	4 (36.4)	6 (54.5)	
Once per month	4 (1.4)	1 (25.0)	2 (50.0)	1 (25.0)	
Several times per year	5 (1.7)	0 (0.0)	3 (60.0)	2 (40.0)	
None	228 (77.3)	50 (21.9)	92 (40.4)	86 (37.7)	
Sports (n = 295)					
≥4 times per week	45 (15.3)	5 (11.1)	20 (44.4)	20 (44.4)	0.131
2–3 times per week	48 (16.3)	8 (16.7)	20 (41.7)	20 (41.7)	
Once per week	62 (21.0)	10 (16.1)	28 (45.2)	24 (38.7)	
2–3 times per month	29 (9.8)	9 (31.0)	6 (20.7)	14 (48.3)	
Once per month	7 (2.4)	1 (14.3)	5 (71.4)	1 (14.3)	
Several times per year	4 (1.4)	1 (25.0)	2 (50.0)	1 (25.0)	
None	100 (33.9)	29 (29.0)	38 (38.0)	33 (33.0)	
Local improvement activities (n = 291)					
≥4 times per week	4 (1.4)	1 (25.0)	1 (25.0)	2 (50.0)	0.042
2–3 times per week	6 (2.1)	0 (0.0)	2 (33.3)	4 (66.7)	
Once per week	5 (1.7)	0 (0.0)	2 (40.0)	3 (60.0)	
2–3 times per month	8 (2.7)	1 (12.5)	2 (25.0)	5 (62.5)	
Once per month	17 (5.8)	1 (5.9)	8 (47.1)	8 (47.1)	
Several times per year	28 (9.6)	2 (7.1)	10 (35.7)	16 (57.1)	
Once per year	12 (4.1)	0 (0.0)	5 (41.7)	7 (58.3)	
None	211 (72.5)	55 (26.1)	89 (42.2)	67 (31.8)	
Activities for children (n = 290)					
≥4 times per week	4 (1.4)	0 (0.0)	1 (25.0)	3 (75.0)	0.016
2–3 times per week	2 (0.7)	1 (50.0)	1 (50.0)	0 (0.0)	
2–4 times per month	8 (2.8)	0 (0.0)	2 (25.0)	6 (75.0)	
Once per month	8 (2.8)	0 (0.0)	4 (50.0)	4 (50.0)	
Several times per year	14 (4.8)	0 (0.0)	3 (21.4)	11 (78.6)	
Once per year	5 (1.7)	1 (20.0)	2 (40.0)	2 (40.0)	
None	249 (85.9)	59 (23.7)	105 (42.2)	85 (34.1)	

^a Fisher’s exact test. Boldface indicates statistical significance.

before and after the working hours of daycare facilities, transferring them to their daycare facilities, and taking charge of children after their club meetings or after-school activities (Cabinet Office of Japan, 2012). Many volunteers at this organization are aged ≥60 years (Cabinet Office of Japan, 2012). Results of our study indicate that frailty could be prevented if older people are prompted to engage in such activities.

Lower level of comprehensive frailty was also associated with participation in sports activities, with the lowest level for participation ≥4 times per week. This result was consistent with findings from previous studies that physical exercise decreased the risk of physical frailty (Xie & Ma, 2021; Wang et al., 2021). Sports creates opportunities for diverse community members to connect with each other, and social connections have also been associated with a reduced risk of depression (Domènech-Abella, Mundó, Haro & Rubio-Valera, 2019), as well as less cognitive decline (Saito et al., 2021), and physical decline (Imamura et al., 2020). It was a new finding that participation in sports was associated with a lower level of comprehensive frailty.

This study has six limitations. First, the study followed a cross-sectional design, which does not allow causal relationships to be determined. Second, we conducted this survey in four cities in one

prefecture, which might make our results less generalizable given previous findings of regional differences in frailty prevalence (Sinclair et al., 2022); future researchers could conduct similar studies across broader areas. Third, volunteer bias is a concern because random sampling was not applied. Besides, social-desirability bias could result from the self-administered questionnaire of this study. Fourth, the results can differ if the cut-off value of the KCL for the pre-frail and frailty categories was adopted. Fifth, the experience of surviving the COVID-19 pandemic might have changed older people’s attitudes and behavior related to social contact, and future longitudinal researches could assess such changes between before and after the pandemic. Sixth, frailty and social participation levels could differ for respondents depending on data collection methods (i.e., through group activities or home visits).

5. Conclusions

In conclusion, among older people in Japan, a lower level of comprehensive frailty was associated with the frequency of engaging in certain types of social activities, specifically, smartphone interaction 2–3 times per month, sports ≥4 times per week, local improvement

Table 4

The odds ratios of frequency of social participation for the level of frailty among community-dwelling older people: Four cities and towns in Mie Prefecture of Japan, 2022.

	OR	95 % CI	AOR ^a	95 % CI		
Model 1: Interaction using smartphones						
≥4 times per week	0.29	0.18	0.49	0.36	0.18	0.73
2–3 times per week	0.40	0.23	0.70	0.48	0.23	1.02
Once per week	0.30	0.16	0.57	0.33	0.15	0.75
2–3 times per month	0.20	0.09	0.45	0.21	0.07	0.58
Once per month	0.74	0.29	1.93	0.46	0.14	1.48
None	1.00	reference		1.00	reference	
Model 2: Self-education						
≥4 times per week	1.00	0.31	3.22	3.14	0.67	14.65
2–3 times per week	0.40	0.15	1.09	1.21	0.30	4.91
Once per week	1.36	0.80	2.33	1.78	0.84	3.79
2–3 times per month	0.47	0.19	1.21	1.16	0.30	3.95
Once per month	1.47	0.36	6.04	2.15	0.39	11.91
Several times per year	0.63	0.17	2.35	3.54	0.59	21.38
None	1.00	reference		1.00	reference	
Model 3: Sports						
≥4 times per week	0.50	0.30	0.84	0.36	0.18	0.71
2–3 times per week	0.60	0.37	0.99	0.47	0.24	0.92
Once per week	0.65	0.41	1.02	0.42	0.23	0.78
2–3 times per month	0.68	0.37	2.23	0.72	0.33	1.57
Once per month	1.11	0.37	3.30	2.79	0.68	11.41
Several times per year	1.11	0.27	4.61	0.69	0.12	3.81
None	1.00	reference		1.00	reference	
Model 4: Local improvement activities						
≥4 times per week	0.57	0.13	2.50	1.38	0.22	8.63
2–3 times per week	0.20	0.05	0.84	0.55	0.09	3.19
Once per week	0.26	0.06	1.14	0.52	0.03	8.64
2–3 times per month	0.29	0.09	0.91	0.53	0.13	2.08
Once per month	0.43	0.20	0.92	0.59	0.23	1.51
Several times per year	0.32	0.17	0.60	0.27	0.12	0.63
Once per year	0.27	0.11	0.71	0.44	0.14	1.39
None	1.00	reference		1.00	reference	
Model 5: Activities for children						
≥4 times per week	0.16	0.02	1.07	0.27	0.02	2.99
2–3 times per week	4.16	0.47	37.13	1.10	0.04	29.82
2–4 times per month	0.16	0.04	0.62	0.20	0.04	0.95
Once per month	0.41	0.13	1.23	0.58	0.12	2.73
Several times per year	0.13	0.04	0.39	0.24	0.06	0.93
Once per year	0.78	0.21	2.88	0.98	0.22	4.38
None	1.00	reference		1.00	reference	

Abbreviation: OR, odds ratio; AOR, adjusted odds ratio, CI, confidence interval.

Ordinal logistic regression analysis. Objective variable: frailty status (frail, prefrail, and robust). Higher OR means greater level of frailty. Boldface indicates statistical significance.

^a Each model was adjusted for confounding factors and participation of other 20 types of social participation.

activities several times per year, and activities for children 2–4 times per month. Promoting social participation with appropriate frequency might effectively prevent comprehensive frailty for older people.

CRedit authorship contribution statement

Nanako Saeki: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft. **Mayumi Mizutani:** Conceptualization, Methodology, Investigation, Writing – original draft, Project administration. **Susumu Tanimura:** Conceptualization, Methodology, Formal analysis, Writing – review & editing. **Ritsuko Nishide:** Conceptualization, Methodology, Investigation, Writing – review & editing, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

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