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Original Research

Association between Non-Face-to-Face Interactions and Incident Disability in Older Adults

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Abstract

OBJECTIVES: This observational prospective cohort study, conducted between September 2015 and February 2019, aimed to investigate the association between the incidence of disability and non-face-to-face interactions among community-dwelling older adults in Japan.

DESIGN: Participants reported their interaction status using a self-report questionnaire. Face-to-face interactions comprised in-person meetings, while virtual interactions (e.g., via phone calls or emails) were defined as non-face-to-face interactions. We examined the relationship between their interaction status at baseline and the risk of disability incidence at follow-up. We also considered several potential confounding variables, such as demographic characteristics.

SETTING: The National Center for Geriatrics and Gerontology–Study of Geriatric Syndromes.

PARTICIPANTS: We included 1159 adults from Takahama City aged ≥75 years (mean age ± standard deviation = 79.5 ± 3.6 years).

MEASUREMENTS: Interaction status was assessed using a self-reported questionnaire consisting of two sections (face-to-face and non-face-to-face interactions), and four questionnaire items. Based on the responses we categorized study participants into four groups: "both interactions," "face-to-face only," "non-face-to-face only," and "no interactions."

RESULTS: Individuals with both kinds of interactions (49.3/1000 person-years) or only one kind of interaction (face-to-face = 57.7/1000 person-years; non-face-to-face = 41.2 person-years) had lower incidence of disability than those with no interactions (88.9/1000 person-years). Moreover, the hazard ratios adjusted for potential confounding factors for the incidence of disability in the both interaction, face-to-face-only, and non-face-to-face only groups were 0.57 (confidence interval = 0.39–0.82; p = 0.003), 0.66 (confidence interval = 0.44–0.98; p = 0.038), and 0.47 (confidence interval = 0.22–0.99; p = 0.048), respectively.

CONCLUSION: Considering the interaction status of older adults in their day-to-day practice, clinicians may be able to achieve better outcomes in the primary prevention of disease by encouraging older adults to engage in any form of interaction, including non-face-to-face interactions.

Key words: Communication, community dwelling, disability studies, older adults, social interaction.

Introduction

Japan is expected to have the largest proportion of older adults worldwide by 2050 with 39.9% of the national population projected to be aged >65 years (1). The population of the older population (≥65 years) reached 35.25 million individuals in March 2019, with 17.3 million adults aged <75 years and 17.96 million adults aged ≥75 years (2). In developed nations faced with an aging population (including Japan), many of these older adults require care (1, 3). Since the introduction of Japan's long-term care insurance (LTCI) system in 2000, the number of older adults requiring this service has increased. The Japanese LTCI system has been operating for approximately 20 years and currently serves nearly 6.58 million people (4). In terms of percentage of senior adults aged ≥65 who have been certified as requiring long-term care, 0.73 million (women; 0.37 million) are aged <75 years and 5.72 million (women; 4.08 million) are aged ≥75 years (2). Therefore, the number of people certified as needing long-term care increases significantly after 75 years of age (5). Dementia, cerebrovascular disease, and age-related weaknesses account for about half the factors that cause disability in the older adults of both sexes in Japan (5). Community-dwelling older adults in Japan with physical frailty, a typical example of age-related weakness, were at higher risk of requiring care in the LTCI system, and the total cost of LTCI incurred was correspondingly higher for these adults (6). The rapid aging of populations in some countries has led to a growing increase in the number of older disabled adults. This exacerbates the need for long-term care and meeting the associated costs, which is typically borne by the families of the disabled older adults and governments (7). Therefore, it is necessary to clarify the risk of disability in people aged ≥75 years.

Studies are increasingly focusing on the impact of social interaction on the health of older adults. Social activity can include interactions with the environment and ingroup members (e.g. like-minded people) and can engage the mind and body (8). Previous studies showed that participation in social activities is associated with a reduced risk of developing disability in the future (9, 10). However, due to the recent global spread of coronavirus disease (COVID-19), opportunities for face-to-face interactions with other people are decreasing worldwide (11). A study conducted before and

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during the first wave of COVID-19 outbreaks in Japan (January to April 2020) showed that the duration of physical activity in older adults decreased by approximately 30% after the first wave of COVID-19 in Japan (12). Similarly, the number of steps taken by older Japanese adults decreased by up to 30% after the initial spread of COVID-19 (13). This has fueled concerns that the incidence of disability may increase after the COVID-19 pandemic due to a decrease in daily physical activity (12). Interestingly, a previous study indicated that the daily physical activity time recovered after the spread of COVID-19 (at June 2020) up to pre-infection levels (at January 2020), although recovery was difficult when living alone and being socially inactive (14).

Even before the COVID-19 pandemic, studies reported that one in four older adults was socially isolated and more than 40% experienced loneliness (15). Decades of observational studies have demonstrated the long-term negative health outcomes of social isolation and loneliness (16, 17). This highlights the importance of non-face-to-face interactions such as communication via telephone and video calls (15). According to a Japanese government report on the use of social networking services (SNS) by older Japanese adults in 2019, 51.7% of those aged 60-69 years, 40.7% of those aged 70-79 years, and 42.8% of those aged 80 years and above used SNS, and 86.9% of their use time was to communicate with acquaintances (18).

Therefore, non-face-to-face interactions with friends and acquaintances may prevent disability among older adults when face-to-face interaction is not possible because of the spread of COVID-19. However, there is insufficient evidence to determine whether non-face-to-face interactions are associated with a reduced risk of disability in the older Japanese population. Therefore, this study aimed to clarify whether non-face-to-face interactions are associated with a reduced risk of disability in community-dwelling adults aged ≥75 years who are at high risk of disability incidence. We hypothesized that the risk of disability incidence would be lower among older adults who engage in non-face-to-face interaction, as opposed to those who do not engage in either face-to-face or non-face-to-face interactions.

Methods

Study design

This was an observational prospective cohort study of adults enrolled in a population-based cohort study, which is part of the National Center for Geriatrics and Gerontology–Study of Geriatric Syndromes (NCGG–SGS). The NCGG–SGS is a cohort study with the primary goal of establishing a screening system for geriatric syndromes and validating evidence-based interventions for preventing geriatric syndromes (19). This study investigated the association between non-face-to-face interaction at the baseline and the incidence of disability during a mean follow-up of 33.7 months (standard deviation [SD] = 8.3 months) from baseline.

Participants

Overall, 1352 community-dwelling older adults participated in the assessments, which included face-to-face interviews and physical and cognitive function evaluations. We included participants who resided in Takahama City who were aged ≥75 years at the time of the study (September 2015 to February 2017). We excluded data from the following sets of participants: (1) individuals who had health problems that critically affected disability incidence (such as dementia, Parkinson's disease, and a history of strokes) (n = 116), based on face-to-face interviews conducted by a qualified nurse; (2) individuals who needed support or care, as certified by the Japanese public LTCI system, due to disability (n = 67); (3) individuals with disabilities affecting basic activities of daily living (ADLs) (n = 3); and (4) individual with responses with missing variables of exclusion criteria (n = 7). Of the initial 1352 participants, 193 were excluded based on these criteria. The study participants were followed up from September 2015 to February 2019, with a mean follow-up of 33.7 months (SD = 8.3 months). All participants provided written informed consent prior to participating in the study. This study was approved by the Ethics Committee of the National Center for Geriatrics and Gerontology (Approval Number: 1440-3). Using an opt-out approach, we disclosed information about this study and excluded data when the participants declined to participate directly or via proxy.

Measurement of face-to-face and non-face-to-face interaction

Interaction status was assessed using a self-reported questionnaire consisting of two sections (face-to-face and non-face-to-face interactions), and four questionnaire items. Questionnaire items were adapted from the NCGG–SGS (20, 21). The face-to-face interaction items included: (1) "Do you eat out or participate in a tea party with friends?" and (2) "Do you go shopping with friends?" Interaction frequency was assessed by participants as "never," "once a month or less," "several times a month," "1–2 times per week," "3–6 times per week," and "every day." Individuals who answered "never" to both questions were classified as having no face-to-face interaction, while those who picked any other option for either question were classified as having face-to-face interaction. The non-face-to-face interaction items included: (3) "How many days in a week do you call or email your friends?" and (4) "How many days in a week do you call or email acquaintances (neighbors, business associates, etc.)?" Interaction frequency was assessed by interaction as "0–1 day," "2–3 days," "4–5 days," and "6–7 days." Individuals who answered "0–1 day" to both questions were classified as having no non-face-to-face interaction, while those who answered other than "0–1 day" to either question were classified as having non-face-to-face interaction. Then, based on these responses, we categorized study participants into four groups: the group that conducted both face-to-face and non-face-to-face exchanges was labeled as having "both interactions," the group that conducted only

face-to-face interactions was labeled "face-to-face only," the only non-face-to-face interactions group was labeled "non-face-to-face only," and the group that did not conduct face-to-face or non-face-to-face interactions was labeled as having "no interactions."

Disability determination

Participants were tracked monthly for a new incidence of LTCI certification, as recorded by the Japanese LTCI system and measured by each municipal government. The LTCI system classifies a person in "Support Level 1 or 2" to indicate a need for assistance to support ADLs, or in "Care Levels 1 through 5" to indicate a need for continuous care (22). In this study, disability was defined as any LTCI certification level, and we defined disability onset as the point at which a participant received LTCI certification.

Potential confounding factors

Potential confounding variables included demographic variables, chronic disease, cohabitation status, and paid work status that may be independently associated with disability in older adults (9, 10, 21, 23). Therefore, our model included the following covariates: age at enrollment, sex, presence of chronic diseases, medication use, body mass index (BMI), cohabitation status, and work. Self-reported presence of chronic diseases (heart disease, diabetes, and hypertension) through face-to-face interviews with nurses were also included as covariates. Cohabitation status assessment was conducted by staff, who were trained by the study authors. The participants were asked to self-report their work status using a questionnaire.

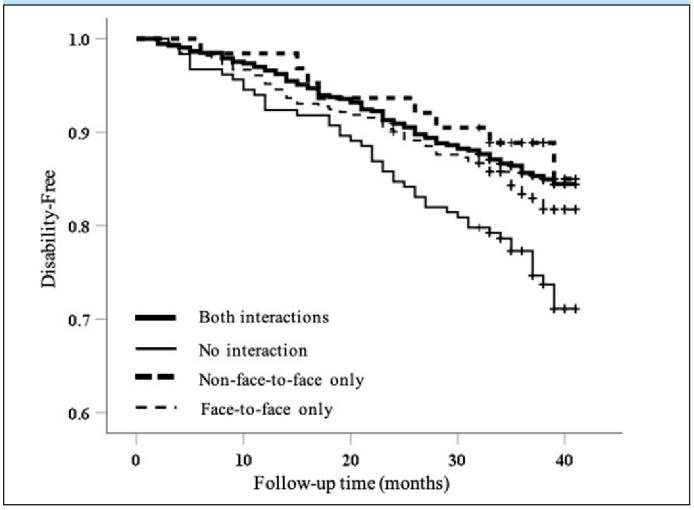
Statistical analysis

One-way analysis of variance and Pearson's chi-square tests were used to compare variables among groups of participants who were disability-free, who had a disability, and those who died or relocated. Similarly, the aforementioned tests were used to compare predictor variables among participants who engaged in "both interactions," "face-to-face only" interaction, "non-face-to-face only" interaction, and "no interaction" (group labels in quotation marks). Adjusted standardized residuals >1.96 indicated $P < 0.05$. Sensitivity analyses were performed to evaluate whether a potential bias could be introduced by the censoring mechanism for persons who died or relocated. We calculated the cumulative incident disability during follow-ups for each of the four above-mentioned interaction groups using Kaplan–Meier curves. Intergroup differences were estimated using the log-rank test. Crude and adjusted Cox proportional hazard models were constructed to calculate hazard ratios (HRs) with 95% confidence intervals (CIs) for incident disability risk. The adjusted model was adjusted for covariates known to be associated with disability in previous studies; age, sex, heart disease, diabetes, hypertension, medication use, BMI, cohabitation status, and work (9, 10, 21, 23). The significance level was set at $P < 0.05$. All analyses were performed using IBM SPSS (version 25.0; IBM Japan, Tokyo).

Results

The final analysis included data from 1159 older adults (666 women; mean age ± SD 79.5 ± 3.6 years; age range = 75–96 years). Among 1159 participants, 917, 188, and 54 participants remained disability-free, developed a disability, and either died or relocated, respectively. Table 1 shows the baseline characteristics of the study participants who remained disability-free, developed a disability, and died or relocated. At the baseline, participants who had died or relocated were older than those who were successfully followed up with and remained disability-free ($P < 0.001$); participants who developed a disability were older and had not worked than those who were followed up with and remained disability-free ($P < 0.05$). Table 2 shows the baseline characteristics of the study participants according to interaction status. Significant differences between the four interaction groups were found for participant age, sex, and paid work status ($P < 0.05$).

Figure 1. Kaplan–Meier survival estimates with respect to the interaction status groups



Note: The participants who belonged to the no interaction group had a lower probability of being disability-free than those who belonged to the other groups.

The incidence of disability was 49.3 per 1000 person-years for those who in the "both interactions" group, 57.7 per 1000 person-years for those in the "face-to-face only" group, and 41.2 per 1000 person-years for those in the "not face-to-face only" group, compared with 88.9/1000 person-years for participants in the "no interaction" group. In Figure 1, the Kaplan–Meier survival estimates show that participants who were involved in both face-to-face and non-face-to-face interactions had a higher probability of being disability-free than those who did not ($P = 0.001$, $P = 0.021$, and $P = 0.036$, respectively). The potential confounder-adjusted disability HRs for participants in the "both interactions," "face-to-face only," and "non-face-to-face only" groups were 0.57 (CI, 0.39–0.82; $P = 0.003$), 0.66 (CI, 0.44–0.98; $P = 0.038$), and 0.47 (CI, 0.22–0.99; $P = 0.048$), respectively (Table 3).

Table 1. Baseline characteristics of study participants by follow-up status

Variable	Total (n = 1159)	Participants Free of Disability (n = 917)	Participants with Disability (n = 188)	Participants Who Died or Relocated (n = 54)	p-Value	Post Hoc
Mean age at baseline, y	79.5 ± 3.6	79.0 ± 3.2	81.8 ± 3.9	81.5 ± 4.7	<0.001 *	Free < Disability, Died or relocated
Sex, Female (%)	666 (57.5)	527 (57.5)	112 (59.6)	27 (50.0)	0.455 †	
Medication use, n	3.6 ± 2.7	3.6 ± 2.7	3.7 ± 2.6	4.2 ± 3.0	0.228 *	
Chronic disease						
Heart disease, no (%)	926 (79.9)	729 (79.5)	152 (80.9)	45 (83.3)	0.743 †	
Diabetes, no (%)	991 (85.5)	785 (85.6)	163 (86.7)	43 (85.5)	0.421 †	
Hypertension, no (%)	485 (41.9)	383 (41.8)	81 (43.3)	21 (38.9)	0.835 †	
BMI, kg/m2	23.4 ± 3.1	23.1 ± 3.7	23.3 ± 4.2	23.3 ± 3.2	0.517 *	
Cohabitation status, yes (%)	165 (14.2)	125 (13.6)	34 (18.1)	6 (11.1)	0.225 †	
Work, yes (%)	206 (17.8)	176 (19.2) ‡	21 (11.2) §	9 (16.7)	0.031 †	
Interaction status					0.022 *	
Both interactions, n (%)	550 (47.5)	451 (49.2) ‡	77 (41.0)	22 (40.7)		
Face-to-face interaction, n (%)	347 (29.9)	275 (30.0)	56 (29.8)	16 (29.6)		
Non-face-to-face interaction, n (%)	68 (5.9)	55 (6.0)	8 (4.3)	5 (9.3)		
No interaction, n (%)	194 (16.7)	136 (14.8) §	47 (25.0) ‡	11 (20.4)		

* p-values reported from one-way ANOVA. Significant difference obtained by Tukey post-hoc test. † p-values obtained by Pearson's chi-square test. ‡ Statistically significant association was determined by adjusted standardized residual >1.96 ($p < 0.05$). § Statistically significant association was determined by adjusted standardized residual < –1.96 ($p < 0.05$). BMI, body mass index; n, number; y, years.

Table 2. Baseline characteristics of the study participants by interaction status

Variable	Both interactions (n = 550)	Face-to-face interaction (n = 347)	Non-face-to-face interaction (n = 68)	No interactions (n = 194)	p-Value	Post Hoc
Mean age at baseline, y	79.3 ± 3.4	79.6 ± 3.7	79.4 ± 3.3	80.2 ± 4.1	0.030 *	Both < No
Sex, Female (%)	335 (60.9) ‡	218 (62.8) ‡	23 (33.8) §	90 (46.4) §	<0.001 †	
Medication use, n Chronic disease	3.7 ± 2.7	3.6 ± 2.6	3.9 ± 2.7	3.7 ± 2.9	0.844 *	
Heart disease, no (%)	432 (78.5)	282 (81.3)	53 (77.9)	159 (82.0)	0.635 †	
Diabetes, no (%)	468 (85.1)	300 (86.5)	56 (82.4)	167 (86.1)	0.819 †	
Hypertension, no (%)	218 (39.7)	150 (43.2)	27 (39.7)	90 (46.4)	0.380 †	
BMI, kg/m2	23.6 ± 3.3	23.1 ± 3.1	23.3 ± 3.4	22.7 ± 3.1	0.003 *	No < Both
Cohabitation status, yes (%)	460 (83.6)	308 (88.8)	58 (85.3)	168 (86.6)	0.194 †	
Work, yes (%)	116 (21.1) ‡	43 (12.4) §	16 (23.5)	31 (16.0)	0.005 †	

* p-values reported from one-way ANOVA. Significant difference obtained by Tukey post-hoc test. † p-values obtained by Pearson's chi-square test. ‡ Statistically significant association was determined by adjusted standardized residual >1.96 ($p < 0.05$). § Statistically significant association was determined by adjusted standardized residual < –1.96 ($p < 0.05$). BMI, body mass index; CI, confidence interval; n, number; y, years.

Discussion

In this observational, prospective population–based cohort study, we found that those involved in both face-to-face and non-face-to-face interactions (49.3/1000 person-years), those with only face-to-face interactions (57.7/1000 person-years), and only non-face-to-face interactions (41.2/1000 person-years) had lower incidence rates of disability compared to those with no interaction (88.9/1000 person-years). The potential confounding factors adjusted HRs for incidence of disability in the both interactions, face-to-face-only, and non-face-to-face only groups were 0.57 (CI, 0.39–0.82; P = 0.003), 0.66 (CI, 0.44–0.98; P = 0.038), and 0.47 (CI, 0.22–0.99; P = 0.048), respectively; these correspond to a 42%, 34%, and 53% decrease in the disability risk of participants with both interactions, face-to-face only interactions, and non-face-to-face only interactions, respectively.

Several longitudinal studies have shown that a greater level of participation in social activities is related to a lower risk of incident functional disability (24, 25). Persons who participate in social activities have an opportunity to communicate and collaborate with others (26). Therefore, the risk of developing disability may be reduced in the groups that were involved in face-to-face interactions. These results support the findings of previous studies that social activities reduce the risk of incident functional disability (24, 25). Our study uncovered an important association between the incidence of disability and non-face-to-

Table 3. Cox proportional hazard models of the relationships between interaction status and incident disability

Interaction status	Number of Participants	Incident Disability Rate	Crude model			Adjusted model		
			HR	95% CI	p	HR	95% CI	p
No interactions	183	47 (25.7%)	1.00			1.00		
Both interactions	528	77 (14.6%)	0.38	0.38–0.78	0.001	0.57	0.39–0.82	0.003
Face-to-face only	331	56 (16.9%)	0.43	0.43–0.94	0.023	0.66	0.44–0.98	0.038
Non-face-to-face only	63	8 (12.7%)	0.22	0.22–0.97	0.042	0.47	0.22–0.99	0.048

Adjusted model is adjusted for age, sex, medication, heart disease, diabetes, hypertension, BMI, cohabitation status, and work.

face interaction in older adults aged >75 years; this is a novel finding.

The most frequently used SNS in older adults is LINE (a popular message application in Japan). A previous study demonstrated that frequent usage of LINE (both posting and checking) among older adults was independently associated with better well-being (27). We also found that high activity on Facebook Messenger may also have a positive impact on depressed mood (28). Older adults aged >75 years who engage in non-face-to-face interactions may have the same opportunities to communicate, cooperate, and support others as they do when participating in face-to-face social activities. However, we did not have access to the applications and content used for non-face-to-face interaction; this is a promising area for future investigation.

Our findings suggest that even non-face-to-face interactions may reduce the risk of social inactivity-related disability in the same way as face-to-face interactions. To the best of our knowledge, this is the first study to evaluate and contrast the impact of face-to-face and non-face-to-face interactions on the relationship between interaction status and disability incidence. Since the start of the COVID-19 pandemic in February 2020, opportunities for face-to-face interactions have decreased in Japan, and more broadly, worldwide (11). The COVID-19 crisis has exacerbated the challenges, with increasing social isolation and loneliness among those who live alone and may even cause a decline in the well-being of older adults with previously active or healthy social lives (15). The results of this study support the original hypothesis that older adults who engage in non-face-to-face interaction alone have a lower risk of disability incidence than older adults who engage in neither face-to-face nor non-face-to-face interaction (in other words, who do not participate in any form of interaction). Our findings suggest that non-face-to-face interaction may reduce the risk of disability among Japanese adults aged ≥75 years who are at high risk of developing disability during a period when face-to-face interaction is reduced due to the spread of COVID-19. However, in this study, we were not able to perform a detailed assessment and analysis to adjust for important confounding factors influencing the development of disability, such as exercise, daily activity patterns, nutritional status, and daily intake. This aspect should be verified in the future. Among the participants in this study, it was more common for men to engage in non-face-to-face interactions. Since the life expectancy of Japanese women is higher than that of men, women are more likely to live alone in Japan. In addition to the aftermath of COVID-19, this may suggest that establishing safe face-to-face interactions and enforcing measures that allow women to have more opportunities for non-face-to-face interactions may be necessary for disability prevention. Additionally, group rehabilitation exercises linked to the therapist in one site, with group members in their own homes may be arranged. Likewise, other group therapies may also be conducted.

A central strength of this study is the large sample size of study participants aged >75 years. In addition to this, the operationalized assessment to identify non-face-to-face interactions and risk of disability provided a high level of standardization across study participants. Finally, by classifying the interaction status into four groups, we were able to compare and contrast the impact of face-to-face interactions with non-face-to-face interactions on disability incidence. However, this study also had some limitations. First, we sent participation invitation letters to individuals who lived in Takahama City, who were not hospitalized or in residential care, who were not certified by the LTCI system as having a functional disability, or who were not participating in another study. The participants in our study were older adults who had access to health checkups from their homes; this implies that the sample excluded people with other conditions. Second, we tracked the monthly incidence of new LTCI certifications as recorded by the Japanese LTCI system which was measured by the municipality. However, information on the causes of disability at follow-up was not available. Additionally, medications used vary with time, and participants may have been on different medications at follow-up than at baseline. Moreover, the participant may have been hospitalized for acute illnesses that create a strong risk for disability. Thus, we did not know whether the older adults during the follow-up period had developed additional diseases; therefore, future studies should account for such variables. Third, sensory function is also important in the process of physical and mental decline; however, we did not conduct a detailed assessment of sensory function. In future studies, we intend to perform a detailed evaluation and adjust it using a statistical model. Finally, we did not have access to the applications and content used for non-face-to-face interactions, and these aspects are being assessed in a longitudinal study.

Conclusion

Although our study leaves room for further investigation, we found that there may be an important association between

the incidence of disability and non-face-to-face interactions in older adults aged >75 years. These findings suggest that even non-face-to-face interactions may reduce the risk of disability from social activities the way face-to-face interactions do. Given the increasingly high prevalence of disability and its strong association with numerous adverse health outcomes, clinicians may be able to achieve better outcomes in the primary prevention of disease by encouraging older adults to engage in non-face-to-face interactions by including an older adult's interaction status in their day-to-day medical practice.

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Ethical Standards: The study protocol was approved by the Ethics Committee of the National Center for Geriatrics and Gerontology (No. 1440-3).

Disclosure Statement: The authors declare no conflict of interest.

Data Availability Statement: Data available on request from the authors.

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