Influence of social interaction on behavioral and psychological symptoms of dementia over 1 year among long-term care facility residents

Asuna Arai, PhD[a,*], Amartuvshin Khaltar, MD, PhD[a,b], Takashi Ozaki, MD[c], Yuriko Katsumata, PhD[d]

[a]*Department of Health Care Policy, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Sapporo, Japan;* [b]*General Hospital for State Special Servants of Mongolia, Ulaanbaatar, Mongolia;* [c]*Hokkaido University Hospital, Sapporo, Japan;* [d]*College of Public Health, University of Kentucky, Lexington, USA*

Authors' notes:

(*Corresponding author) Asuna Arai, PhD, Department of Health Care Policy, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Kita 15, Nishi 7, Kita-ku, Sapporo, Hokkaido 060-8638, Japan

Amartuvshin Khaltar, MD, PhD, General Hospital for State Special Servants of Mongolia, Ministry of Justice and Home affairs, Khuulichid Street, Baga Toiruu, 4th khoroo, Chingeltei District, Ulaanbaatar 15160, Mongolia

Takashi Ozaki, MD, Hokkaido University Hospital, Kita 14, Nishi 5, Kita-ku, Sapporo, Hokkaido 060-8648, Japan

Yuriko Katsumata, PhD, College of Public Health, University of Kentucky, 111 Washington Avenue, Lexington, KY 40536, USA

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Declaration of Interest:

None.

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Highlights

- Personalized psychosocial interventions including social interaction are expected to reduce BPSD.
- A 1-year follow-up study investigated the effect of social interaction on BPSD among long-term care facility residents.
- Less contact with family/relatives at baseline was significantly associated with increased severity of BPSD over 1 year.
- Active interaction with family/relatives among facility residents may prevent exacerbation of BPSD at least over 1 year.

Abstract

This study investigated the effect of social interaction including activity participation, relationships with residents, and communication with family/relatives and friends at baseline on the behavioral and psychological symptoms of dementia (BPSD) among long-term care facility residents over 1 year. This follow-up study was conducted among older adult residents with dementia or similar symptoms. Generalized linear mixed effect models were used to examine associations between social interaction and changes in the number and severity of BPSD symptoms over 1 year. Among 220 participants, rare participation in activities and poor relationships with other residents at baseline were associated with greater baseline BPSD. Less communication with family/relatives at baseline was associated with increased severity of BPSD over 1 year. Active interaction with family and relatives may prevent progression of BPSD severity among long-term care facility residents for at least 1 year.

Keywords: caregiving, family involvement, long-term care, institutional care/residential care

Introduction

Behavioral and psychological symptoms of dementia (BPSD) frequently occur in people living with dementia in addition to cognitive symptoms. BPSD include symptoms of disturbed perception, thought content, mood, or behavior. [1] Multiple etiologies have been reported for BPSD, including biological, psychological, and social aspects. The factors that contribute to BPSD development are multifaceted, and it is difficult to establish universal solutions for different types of BPSD in different individuals. BPSD are therefore well-known contributors to the burdens on family caregivers [2, 3] and care staff in long-term care facilities. [4] In Japan, the number of people with dementia among the population aged 65 years or over was estimated at 4.62 million in 2012 (15.0% of the older population). It is estimated that by 2025, 7 million people will suffer from dementia, which accounts for 20% of the older population. [5, 6] Currently, about a half of the people who require long-term care and have dementia live in their own home and the remainder live in various types of long-term care facilities, including medical facilities, nursing homes, and adult group homes for people with dementia. [7] It is therefore necessary to develop appropriate preventive measures for BPSD to maintain and improve the quality of life (QOL) of people living with dementia and their caregivers/care staff, both in their own homes and in care facilities.

Currently, there is no cure for cognitive decline, which means that BPSD are likely to remain the main treatment target. It has also been suggested that most factors associated with BPSD involving the patient, caregiver, and environment are potentially modifiable. [8] Non-pharmacological treatments are recommended as the first-line treatment for BPSD because pharmacological treatment (especially antipsychotics) is controversial given the limited efficacy and risk for serious adverse effects. [9] In Japan, the clinical practice guideline for dementia states that in principle, non-pharmacological treatment should be

the first priority for BPSD. [10] Recent reviews of non-pharmacological interventions in both residential and community care settings showed that personalized psychosocial approaches were promising in reducing some specific symptoms of BPSD, although consensus on overall efficacy remains limited. [11-13]

Social interaction that emphasizes the importance of relationships and communication between individuals (both one-to-one and in groups) has been proposed as a suitable psychosocial intervention in this context. [12] Social interactions with family members, friends, residential care staff, and other residents represent social behaviors and also comprise an important element of QOL for older people with Alzheimer's disease. [14] However, it has been reported that individuals with dementia may experience distance from social relationships and known activities. [15] A previous study showed that social engagement was likely to reduce after a diagnosis of dementia among people aged 50 years and older. [16] Given that more people diagnosed with dementia are relocated to long-term care facilities, social interaction in such facilities needs to be explored. Observational studies have shown that residents in such facilities interact with other residents spontaneously throughout the day. [17, 18] Long-term care facilities could offer opportunities to provide active social interaction and accessible social activities for residents. [19] However, another study found that residents in residential care expressed little emotion and experienced limited positive social interaction in their daily routine. [20] In particular, contact with family and friends among newly admitted nursing home residents decreased by approximately half after admission. [21]

Some researchers have investigated the association of social interaction with BPSD among long-term care facility residents. [17, 22-24] One study found that social engagement helped to diminish agitated behavior. [23] However, another study showed that agitation was significantly greater in situations with high social interaction compared with those

with low social interaction regardless of premorbid personality of extraversion. Recent studies demonstrated that social interaction among residents and between residents and staff/family affected positive and negative emotions. [17, 22] A review indicated that there was no evidence that greater social integration could reduce BPSD in long-term care facilities. [25] Most previous studies were cross-sectional and observed affect, emotion, and agitated behaviors in relation to social interaction and social engagement. It remains unclear what type of social interaction could impact the longitudinal change of BPSD in residential care settings.

Therefore, we investigated how social interaction affected BPSD among long-term care facility residents in terms of the number and severity of BPSD symptoms over a 1-year follow-up period. Given that social interaction that is commonly observed in residential facilities could be modifiable and offer an important resource for psychosocial interventions, we conceptualized social interaction as the frequency with which residents engaged in activities and communicated with people, including their relationships with other residents. We hypothesized that any low social interactions at baseline, such as rare activity participation, poor relationships with other residents, and rare contact with family/relatives and friends, would be associated with: 1) high BPSD at baseline and 2) increased BPSD over a 1-year period among facility residents with dementia. The findings from this study may provide useful insights regarding resources for measures to prevent BPSD in long-term care facilities.

Methods

Design

We conducted a 1-year prospective cohort study and followed older people with dementia or similar symptoms residing at 10 selected long-term care facilities in Hokkaido, Japan's

northernmost prefecture. We selected these 10 facilities using snowball sampling to increase cooperation and response rates. The facilities included six intensive care homes, three long-term care health facilities, and one adult group home for people with dementia. The intensive care homes for the elderly provide long-term care in daily living for older adults who require assistance. Long-term care health facilities, which act as transitional facilities from hospital to home, focus on providing routine healthcare and rehabilitation for people with medical needs. Adult group homes for people with dementia provide long-term care in daily living especially for older people suffering from dementia in an intimate home-like setting. Full details of the baseline study have been described elsewhere. [26] Participants were assessed twice at a 1-year interval (approximately) using a questionnaire for care staff (baseline: April–November 2015; follow-up: September–December 2016). This study adhered to the Declaration of Helsinki and was approved by the Ethical Committee of the Hokkaido University Graduate School of Medicine.

Participants

The study sample included residents from above-mentioned facilities that were considered to have dementia. To identify people with dementia we used the "screening judgment of the level of independence in daily life for the elderly with dementia," as these data were available for all residents. This measure was developed by the Japanese Ministry of Health, Labour and Welfare [27] and is the most common method used by health practitioners and care workers in Japan to evaluate the severity of dementia. The measure specifies eight levels of dementia (none, I, IIa, IIb, IIIa, IIIb, IV, and M) according to the severity of disability in daily living as influenced by symptoms of dementia (Table 1). Symptoms include declines in learning and memory, executive function, complex attention, perceptual-motor skills, and social cognition. The assessment of the degree of disability in daily living based on cognitive decline is similar to diagnostic procedures for

major neurocognitive disorder outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. [28] The validity of this measure has been reported in a previous study, in which the correlation coefficient with the Functional Assessment Staging of Alzheimer's disease [29] was 0.684. [30] Residents in each facility were assessed regularly by care staff including care workers and nurses. We regarded residents assessed at level I or higher as having dementia and included these residents in our study.

Due to concerns regarding cognitive status, informed consent was obtained from residents' representatives (i.e., family members or facility directors). Of the family members of 558 residents' in seven long-term care facilities, 242 returned a signed document consenting to the resident's participation in this survey. In addition, 106 residents from the other three facilities were included in the survey following facility directors' agreement based on previous consent for the use of personal information completed by residents and their family members at the time of their admission. This consent enabled the use of personal information for surveying long-term care service improvement; our study was considered to meet this purpose. Of the 348 available residents, we excluded 36 residents who were not suffering from dementia or who moved out/were hospitalized before this study began. In total, 312 residents from 10 long-term care facilities were included in the baseline study and 237 participants were followed-up. Seventy-five participants were lost to follow-up because of hospitalization, death, or moving to other facilities. Of those followed-up, we excluded 16 residents who had severe disability in daily living with symptoms of dementia or were almost bed-ridden at baseline or follow-up, and one for whom no BPSD severity data were available. Finally, 220 participants were included in the present analyses.

Measures

The study questionnaire covered sociodemographic characteristics, health conditions

(including underlying causes of dementia and medication), and BPSD. The questionnaires were completed by the care staff that generally cared for/were close to the participants, with reference to medical and care records. The level of long-term care need included care stages 1 (low) to 5 (high). The underlying cause of dementia was classified as Alzheimer's disease, vascular dementia, frontotemporal lobar degeneration, dementia with Lewy bodies/Parkinson's disease dementia, mixed dementia, other types of dementia, or dementia-like symptoms without a diagnosis. We were unable to determine the diagnostic criteria used, and therefore described participants who were considered to have dementia as "residents with dementia or similar symptoms."

Activities of daily living (ADL) were evaluated using the Physical Self-Maintenance Scale, [31] which comprises six items: toileting, feeding, dressing, grooming, physical ambulation, and bathing. Responses are on a 5-point Guttman rating scale (1–5). The item scores are summed to provide a total score from 6 to 30. A higher score indicates more dependence in ADL. The Japanese version of this scale has well-established interrater reliability. [32] The internal consistency of the six items in our baseline study as assessed by the Cronbach's alpha coefficient was 0.89.

Cognitive function was assessed using a seven-item subscale from the Mental Function Impairment Scale, which has been demonstrated to have good validity and reliability. [33, 34] This subscale covered orientation in space, orientation in time, recent memory, distant memory, discourse comprehension, indication of intention, and decision making. Responses are on a seven-point scale (0–6). The item scores are summed, providing a total score from 0 to 42. A higher score indicates more impaired cognitive functioning. In our baseline study, this subscale had a Cronbach's alpha coefficient of 0.97.

The brief form of the Neuropsychiatric Inventory (NPI-Q), which is well validated

for examining psychopathology in dementia, [35] was used to assess BPSD. The Japanese version of the NPI-Q was developed by Matsumoto et al. [36] The NPI-Q includes 12 items related to types of BPSD: delusions, hallucinations, agitation/aggression, dysphoria/depression, anxiety, euphoria/elation, apathy/indifference, disinhibition, irritability/lability, aberrant motor behaviors, night-time disturbances, and appetite/eating disturbances. Each item is rated using three options: yes, no, or not applicable for medical reasons. We further assessed the severity of BPSD items on a four-point scale (0–3). In this severity assessment, people who did not appear to have BPSD symptoms were rated as 0. The severity scores were summed across items, giving a total score from 0 to 36. Higher scores indicated greater severity of BPSD. Night-time disturbances and appetite/eating disturbances are generally not included in severity assessments. However, we included both items in the calculation of total severity in this study because they are considered important components of BPSD. The Cronbach's alpha values for severity at baseline and follow-up were 0.70 and 0.74, respectively. This indicated a high level of internal consistency reliability.

Social interaction was determined by: 1) participation in leisure and recreational activity programs over the past month, such as birthday/seasonal events, physical exercise, music therapy, walking, playing games, movie watching, cooking, reading, going shopping, and other creative activities (often/sometimes/rarely/never); 2) close friends among residents (yes/no); 3) residents with poor relationships (yes/no), meeting or talking by phone with family and relatives (more than once a week/several times a month/several times a year/rarely); and 4) meeting or talking by phone with friends outside facilities (more than once a week/several times a month/several times a year/rarely).

Statistical analysis

We examined associations between baseline social interaction and changes in the number

and severity of BPSD symptoms using a generalized linear mixed effect model. In this model, repeated measures of BPSD variables (at baseline and follow-up) were used as the longitudinal outcome. These response variables were countable data with only a small variance from the mean; therefore, we applied a Poisson distribution with a log-link function. A random intercept and a random slope for time were assumed, meaning the model accounted for individual variation in the baseline response variables and variation in changes in the response variables over time. The model also included potential confounding factors such as sex, age group (<88 or ≥88 years, based on the median for age), facility type, disease underlying dementia (Alzheimer's disease, vascular dementia, other, not identified), level of long-term care need, baseline ADL function score (<15 or ≥15, based on the median for this score), baseline cognitive function score (<17 or ≥17, based on the median for this score), and the interaction between baseline ADL and cognitive function scores. This interaction was found to be a BPSD-related factor reported in our previous study. [37] The interaction term for social interaction represented the cross-sectional effect; that is, a difference in baseline response variables for every category of social interaction. The interaction term for social interaction and time represented the longitudinal effect; that is, an increase in change of response variables over 1 year for every social interaction category. No over-dispersion was observed in the models. The predicted outcome variables and their 95% confidence intervals (CI) were computed by 100 bootstrap iterations without considering random effects. We also calculated R-squared to assess the goodness-of-fit of the model. [38] All calculations were performed using R version 3.5.3. [39]

Results

Participants' characteristics at baseline

In total, 220 participants were eligible for analysis. The mean follow-up period was 474 (standard deviation = 32) days. As shown in Table 2, more than 80% of participants were women. On average, participants were aged 87 years and had spent almost 3 years in long-term care facilities. About 40% had Alzheimer's disease, and dementia type was not identified in 30%.

Change in BPSD prevalence, number of symptoms, and severity over 1 year

As shown in Table 3, the prevalence of any BPSD symptom did not significantly change over the follow-up year (63.6% at baseline, 61.8% at follow-up; $p = 0.699$, McNemar's test). The number of BPSD symptoms (median [interquartile range]: 1 [0–2] at baseline, 1 [0–3] at follow-up) and severity of symptoms (2 [0–4] at baseline and follow-up) did not significantly change between baseline and follow-up ($p = 0.079$ and $p = 0.296$, respectively, Wilcoxon's paired test).

Effects of baseline social interaction on baseline BPSD and BPSD change over 1 year

The left column in Table 4 shows the frequency of social interaction at baseline among participants. About a half of the participants often joined activity programs and 40% had close friends among residents; however, 13% had poor relationships with residents in their facility. Many participants had communication with family and relatives more than several times a month, but rarely communicated with outside friends.

As shown in Table 4, after adjustment for confounding factors, residents that rarely participated in activity programs at baseline showed greater BPSD severity at baseline, but the severity tended to decrease over the year compared with those who often participated in activity programs. Those with poor relationships with other residents at baseline had a greater number of symptoms and severity in BPSD at baseline compared

with those that did not have poor relationships. However, these associations were not found in the changes in number of BPSD symptoms and severity at follow-up. Frequency of communication with family and relatives was not associated with baseline BPSD but was associated with change in BPSD. We observed an association between residents with low communication with family and relatives (i.e., less than several times per year) and increased BPSD severity over the follow-up year, compared with those with communication with family/relatives more than once a week. Close friends among residents and communication with friends outside the facility were not associated with baseline BPSD or change in BPSD over the 1-year follow-up.

As shown in Figure 1-A, the predicted BPSD severity score at baseline among those who rarely participated in activity programs was 1.2 (95% CI = 0.4–3.6) points, which was twice as high as that of those who often participated at 0.6 (95% CI = 0.2–1.1) points. However, the severity scores for these groups at follow-up were not significantly different: 1.0 (95% CI = 0.4–1.9) and 0.8 (95% CI = 0.4–1.6) points, respectively. Among those with poor relationships with other residents (Figure 1-B), the severity score was 1.9 (95% CI = 0.8–4.4) points at baseline and 2.1 (95% CI = 1.1–3.9) points at follow-up; among those without poor relationships, these scores were 0.6 (95% CI = 0.3–1.2) and 0.7 (95% CI = 0.4–1.1) points, respectively. The disparity in severity scores between the groups remained for 1 year. The severity scores at baseline for residents with low communication with family/relatives (several times per year or rarely) and those with frequent communication (more than once a week) were almost the same: 0.8 (95% CI = 0.4–2.0) and 0.7 (95% CI = 0.3–1.6) points, respectively (Figure 1-C). However, in the group with less communication, the severity increased to 1.3 (95% CI = 0.5–2.6) points at follow-up, whereas that in the frequent communication group was maintained at 0.7 (95% CI = 0.3–1.4) points.

Discussion

Our 1-year follow-up study among long-term care facility residents with dementia or similar symptoms showed that baseline rare activity participation and poor relationships with other residents were associated with baseline high prevalence of BPSD. We also found that baseline less communication with family and relatives was associated with increased BPSD over 1 year. Therefore, our findings partly confirmed our hypothesis that any low social interactions at baseline were associated with high BPSD at baseline and increased BPSD over 1 year. In addition, we found that different types of social interactions were differently associated with BPSD in the cross-sectional and longitudinal observations.

In terms of participation in activity programs, residents that rarely participated had greater severity of BPSD at baseline compared with those that often participated. Casey et al. [20] showed that residents spent most of their time stationary and expressed little emotion during free time, but were more activated and expressed positive emotion during structured activity. Our results partly supported this finding. Since the frequency of activity participation did not predict BPSD change over 1 year in our results, activity participation might not have long-term effect on BPSD. We did not find a monotonically increasing relationship by frequency of activity participation. This was likely attributable to the small numbers of participants who never engaged in activities and subjective assessment of frequency of participation, which made detection of a linear association with severity of BPSD difficult. Previous literature suggested that the effect of interaction on positive and negative affect may be moderated by other factors. [17] This could have happened in this study. Implementation of activity programs in facilities depends on environmental factors, such as season and institutional resources. Moreover, we did not

differentiate activity participation in various programs because of the small number of participants in each program. These factors might have biased our results.

Having poor relationships with residents at baseline was associated with a greater number of BPSD symptoms and greater BPSD severity at baseline. Although this association was reported in our previous cross-sectional study, [37] the present study found this association did not change over 1 year. A study of social networks in older adult care institutions revealed that residents with narrow relationships that became ill or frail may be increasingly isolated and depressed, and more likely to need professional interventions. [40] It is also possible that poor relationships between residents could be caused by BPSD. Therefore, care staff may need to implement interventions to understand the root causes of BPSD that affect relationships between residents.

Residents with less communication with family and relatives at baseline were more likely to experience progression of BPSD deterioration (especially in the severity of BPSD) over 1 year compared with those with frequent communication. A previous cross-sectional study demonstrated that estimated frequency of weekly visits from family members over the previous year was negatively correlated with psychosocial impairment (e.g., agitation and depression) among nursing home residents. [41] It was also reported that among nursing home residents with moderate dementia, those with family visits more than 10 times per month over a 1-year period showed lower rates of increase in BPSD than those with family visits ≤10 times per month. [42] Even after adjusting for confounding factors, our results corresponded with these previous findings. A prior study showed that being a spouse was a factor related to visiting frequently and for longer time their loved one with dementia residing in nursing homes. [43] Another study noted that the impact of visits with family members was likely to be influenced by previous relationship quality and the visitors' behavior; however, that study reported no significant differences

between visits by spouses or adult children in terms of the behaviors of residents' in dementia special care units. [44] Although our study did not identify the type of family members or relatives contacted, the results suggest that considering frequency of communication with any family member or relative may be important. Furthermore, an intervention study with a 9-month follow-up among nursing home residents with Alzheimer's disease and related dementias showed that family involvement in residential care was associated with less global deterioration throughout the study than in a control group without family involvement. [45] It is therefore suggested that communication with family and relatives could be a potential resource for BPSD prevention in long-term care facilities. Our findings add to the literature emphasizing the implications of involvement of family/relatives in residential care settings.

We did not observe any cross-sectional or longitudinal associations between having close friends among residents and frequency of communication with friends outside facilities and BPSD. Most participants in our study had less communication with outside friends. Cheng [46] reported that nursing home residents in Hong Kong had few sources of social support, and rarely included outside friends in their social networks. These findings suggest that outside friends may not be a main form of supportive social relationships that affect psychosocial well-being in facility residents. Although a poor relationship with residents was associated with a high prevalence of BPSD, good relationship between residents did not have much impact on BPSD. From our longitudinal observation and personal communication with facility staff, residents' good relationships with specified persons were likely to be more unstable than poor relationships with unspecified persons. Good relationships are built over time; however, they can easily change because of the cognitive and physical function condition of either party. A prior study demonstrated that social stimulus comprising one-to-one live human interaction had the most impact on

increased pleasure among nursing home residents. [47] Previous literature suggests that nursing home staff should facilitate activity sessions that focus on promoting interaction and engagement. [17] Therefore, facility staff may need to encourage residents' positive relationships to continue and broaden through targeted interventions.

There were a number of limitations in this study. Many participants were lost to follow-up because of hospitalization or death. It is therefore possible that those with severe BPSD might have been excluded from our study. Additionally, the facilities in our study were not randomly selected and our sample was relatively small. Compared with national statistics on long-term care facility residents with or without dementia, participants in our study were more likely to have mild level of long-term care need. Therefore, our sample might not represent the general population of care facility residents. Ideally, every individual should have been clinically diagnosed, but this was not possible in the facilities we observed. Consequently, some participants might have been incorrectly classified, which could have biased the results. The presence of BPSD was assessed by care staff close to the participating residents, including care workers, nurses, and social workers. The variety of job types and subjective evaluation might have resulted in underestimation or overestimation of the frequency of BPSD. However, during the baseline study, we confirmed that there were no differences in BPSD prevalence by care staff sex, age, job type, or duration of care experience. With limited assessments, it was difficult to capture the dynamic nature of BPSD over time and also the dynamic nature of social interactions within long-term care facilities and outside of the facility. These should be considered to interpret the results. We could not control for changes in social interactions over the 1-year follow-up period. Finally, other possible confounding factors might have biased the results. Despite these limitations, we found some evidence for the effect of social interaction on prevalence and change of BPSD.

Conclusions

This study focused on the association between the social interaction that is commonly observed in long-term care facilities and BPSD. Activity participation and relationships with other residents were associated with existing BPSD at cross-sectional view. Longitudinally, communication with family/relatives was associated with 1-year change of BPSD. Our findings suggest that different types of social interactions could differently influence BPSD, and active interaction with family and relatives could potentially prevent exacerbation of BPSD severity over at least 1 year.

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Captions of Tables and Figure

Table 1. Eight Levels of Dementia by Severity of Disability in Daily Living as Influenced by Symptoms of Dementia

Level	Dementia and daily living disability
None	No symptoms of dementia.
I	Some symptoms of dementia, but almost independent in daily living.
II	Some dementia-related symptoms, behaviors, and communication difficulties leading to trouble in daily living; can be independent with some assistance.
IIa	These conditions observed outside the home.
IIb	These conditions observed both inside and outside the home.
III	Occasional dementia-related symptoms, behaviors, and communication difficulties leading to trouble in daily living; needs some care.
IIIa	These conditions observed mainly during the daytime.
IIIb	These conditions observed mainly during the night.
IV	Frequent dementia-related symptoms, behaviors, and communication difficulties; requires constant care.
M	People rated at the above levels that need specialized medical care because of marked BPSD or severe physical diseases.

Note. BPSD, behavioral and psychological symptoms of dementia.

Table 2. Participants' Characteristics at Baseline (*N* = 220)

	n (%)		*Mean (SD)*	
Sex, female	186	(84.5)		
Age, years			87.5	(7.2)
Marital status				
Married	45	(20.5)		
Widowed	163	(74.1)		
Divorced	7	(3.2)		
Single	5	(2.3)		
Period of residence, years			2.7	(2.6)
Current place of residence				
Intensive care homes for the elderly	135	(61.4)		
Long-term care health facility	62	(28.2)		
Adult group homes for people with dementia	23	(10.5)		
Level of LTC need				
Care st1	26	(11.8)		
Care st2	49	(22.3)		
Care st3	71	(32.3)		
Care st4	50	(22.7)		
Care st5	24	(10.9)		
Underlying cause of dementia				
AD	83	(37.7)		
VaD	42	(19.1)		
FTLD, DLB, and other diseases[a]	19	(8.6)		
Not identified	76	(34.5)		
Psychotropic drugs used	96	(43.6)		
ADL[b], total score			15.1	(5.6)
Cognitive function[c], total score			17.7	(11.1)

Note. AD, Alzheimer's disease; ADL, activities of daily living; BPSD, behavioral and psychological symptoms of dementia; FTLD, frontotemporal lobar degeneration; DLB, dementia with Lewy bodies; LTC, long-term care; SD, standard deviation; VaD, vascular dementia. [a]Other represents rare types of dementia such as FTLD, DLB, mixed-type, and other types of dementia. [b]ADL evaluated by the Physical Self-Maintenance Scale. Total scores range from 6 to 30; higher scores indicate more dependence. [c]Cognitive function assessed by total the Mental Function Impairment Scale. Subscale total scores range from 0 to 42; higher scores indicate more impairment.

Table 3. Annual Change in BPSD regarding Prevalence, Number of Symptoms, and Severity of Symptoms (*N* = 220)

	Baseline		Follow-up		p
	n (%)	*Med (IQR)*	*n (%)*	*Med (IQR)*	
Prevalence of any symptom	140 (63.6)		136 (61.8)		0.699
Number of symptoms [range: 0-12]		1 (0−2)		1 (0−3)	0.079
Severity of symptoms [range: 0-36]		2 (0−4)		2 (0−4)	0.296

Note. BPSD, behavioral and psychological symptoms of dementia; Med (IQR), median and interquartile range; P values were calculated by McNemar's test for prevalence and Wilcoxon's paired test for number of symptoms and severity of BPSD.

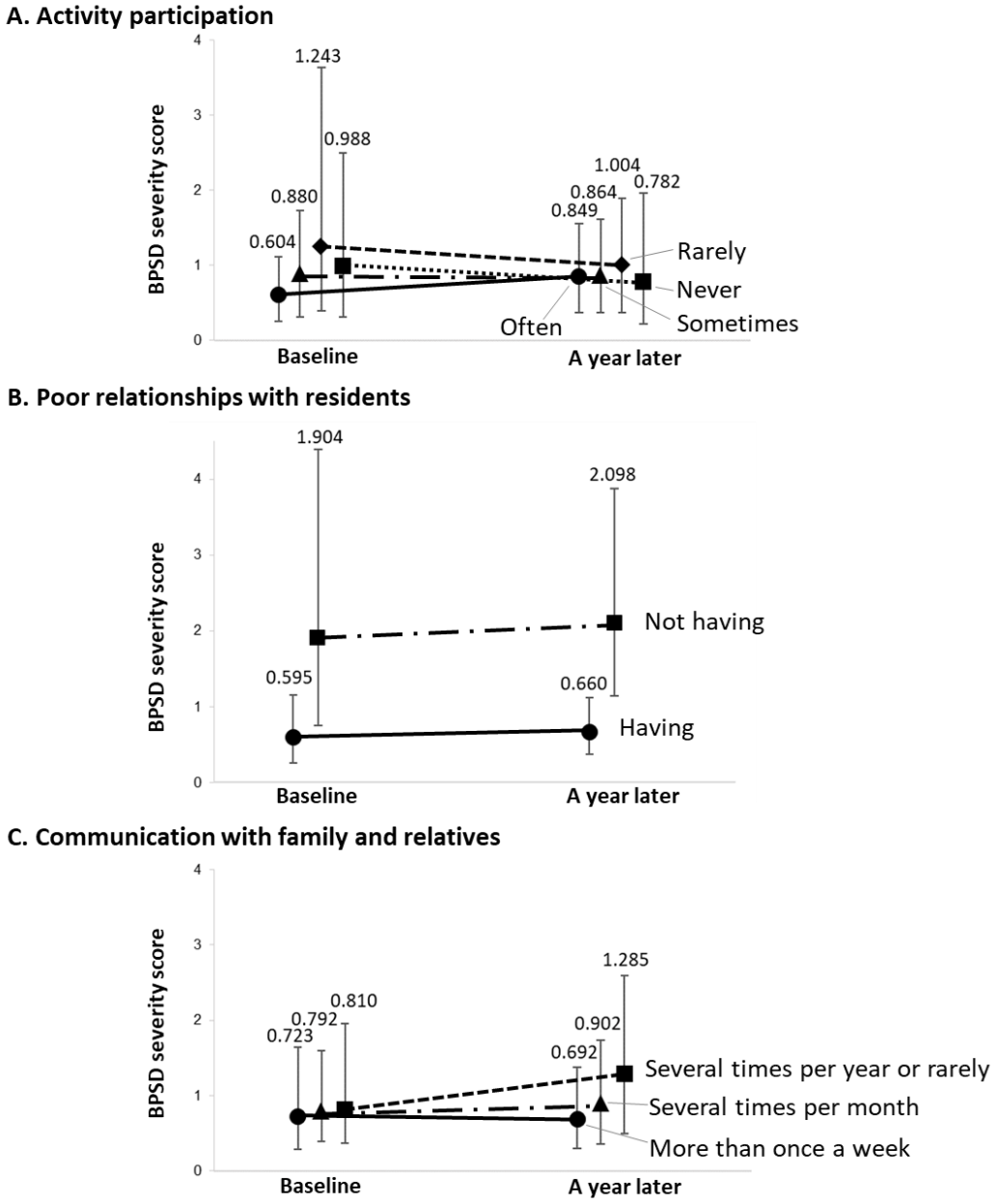
Table 4. Effects of Social Interaction at Baseline on Baseline BPSD and Change in BPSD over 1 Year (N = 220)

		No of symptoms				Severity			
		Estimated effects on baseline BPSD		Estimated effects on 1-year BPSD change		Estimated effects on baseline BPSD		Estimated effects on 1-year BPSD change	
Social interaction at baseline, n (%)		β (SE)	p	β (SE)	p	β (SE)	p	β (SE)	p
Activity participation									
Often	115 (52.3)	Ref		Ref		Ref		Ref	
Sometimes	65 (29.5)	0.314 (0.180)	0.082	−0.258 (0.171)	0.130	0.377 (0.229)	0.100	−0.360 (0.212)	0.090
Rarely	25 (11.4)	0.448 (0.260)	0.084	−0.308 (0.254)	0.225	0.722 (0.322)	0.025	−0.554 (0.300)	0.065
Never	15 (6.8)	0.150 (0.332)	0.652	−0.333 (0.346)	0.336	0.492 (0.400)	0.219	−0.575 (0.378)	0.129
Fit statistics, R^2		0.306				0.529			
Close friends among residents									
Yes	89 (40.5)	Ref		Ref		Ref		Ref	
No	131 (59.5)	0.132 (0.177)	0.456	−0.036 (0.157)	0.816	0.197 (0.223)	0.376	−0.088 (0.194)	0.649
Fit statistics, R^2		0.304				0.526			
Poor relationships with residents									
No	190 (86.4)	Ref		Ref		Ref		Ref	
Yes	30 (13.6)	0.865 (0.181)	<0.001	0.032 (0.179)	0.856	1.164 (0.240)	<0.001	−0.007 (0.240)	0.977
Fit statistics, R^2		0.286				0.509			
Communication with family and relatives									
More than once/week	82 (37.3)	Ref		Ref		Ref		Ref	
Several times/month	98 (44.5)	0.007 (0.181)	0.970	0.129 (0.175)	0.459	0.092 (0.227)	0.685	0.173 (0.208)	0.407
Several times/year or rarely	40 (18.2)	0.128 (0.219)	0.558	0.385 (0.205)	0.060	0.114 (0.280)	0.684	0.505 (0.255)	0.048

Fit statistics, R^2				0.307					0.528			
Communication with outside friends												
More than once/week or several times/month	29 (13.2)	Ref			Ref			Ref			Ref	
Several times/year	36 (16.4)	−0.041	(0.332)	0.901	0.342	(0.361)	0.343	−0.120	(0.398)	0.762	0.459	(0.404)	0.256
Rarely	155 (70.5)	0.355	(0.286)	0.214	0.010	(0.314)	0.976	0.520	(0.338)	0.124	−0.070	(0.343)	0.838
Fit statistics, R^2				0.304					0.525			

Note. BPSD, behavioral and psychological symptoms of dementia; Ref, reference; SE, standard error. Generalized linear mixed effects models were used to assess the association between social interaction and change in the number and severity of BPSD symptoms over time. The Poisson distribution with a log-link function for BPSD variables was applied. A random intercept and random slope for time were assumed. The models included each social interaction item at baseline, time, the interaction term for social interaction and time, and other baseline information (sex, age group, type of facility, underlying cause of dementia, level of long-term care need, activities of daily living [ADL] function, cognitive function, and the interaction of ADL and cognitive function). Estimated effects on baseline BPSD or change of BPSD over 1 year: β indicates the estimate of the regression coefficient of the social interaction category and the interaction of assessment time and social interaction category, respectively.

Figure 1. Predicted BPSD Severity Scores at Baseline and Follow-Up by Activity Participation, Poor Relationship with Residents, and Communication Frequency with Family/Relatives



Note. *N* = 220; BPSD, behavioral and psychological symptoms of dementia. The predicted values of BPSD severity scores at baseline and follow-up by categories of social interaction (A. activity participation, B. poor relationships with residents, C. communication with family and relatives) were calculated by generalized linear mixed effects models and shown in the figure. Error bars indicate 95% confidence intervals.