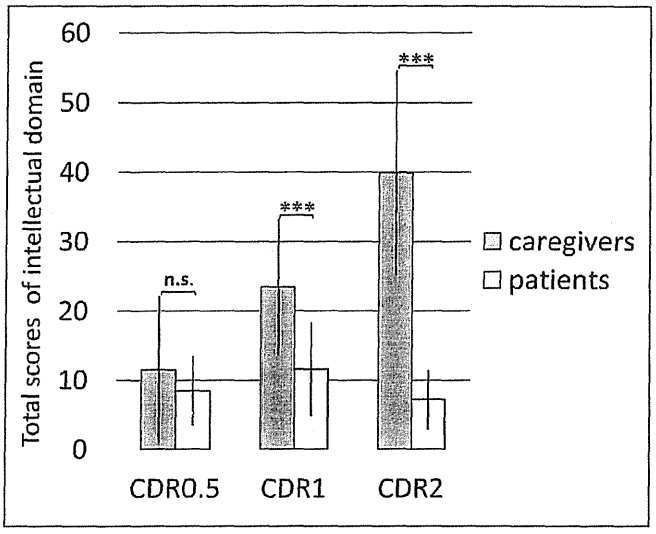

Figure 1. Discrepancy between patients' and caregivers assessment in intellectual functioning domain. Discrepancy was evident in CDR, Clinical Dementia Rating scale (CDR) 1 and 2 groups ($P < .001$ in both), but not in CDR 0.5 group ($P = .389$). Caregivers assessment was aggravated as the disease progressed ($P < .001$). Patients' self-assessment in CDR 1 was worse than that in CDR 2 group ($P = .045$), and there were no significant differences between patients' self-assessment in CDR 2 and that in CDR 0.5. Significant level: ***$P < .001$, ns: not significant.

groups) but not in the CDR 0.5 group ($P = .389$). The findings for each item are shown in Table 2. In CDR 0.5, discrepancy was significant only in mislaying (#8). In CDR 1, discrepancy was observed in 16 items except 6items: problems with signing one's name (#5), orientation inthe neighborhood (#11), mental calculation (#15), and bladder control (#17), orientation in the house (#19), and feeding oneself(#21). Concerning the last 2 items (#19 and #21), the caregivers answered that the patients were capable of these activities. In CDR 2, discrepancy was observed in all 22 items (Table 2 and Figure 1).

In mood and behavior domains, discrepancy between caregivers' and patients' assessment was significantly different among groups ($P = .022$), and post hoc analysis showed that caregivers' assessments were significantly higher than patients' assessment in the CDR 1 and CDR 2 groups ($P < .001$), but not in the CDR 0.5 group ($P = .768$). The findings for each item are shown in Table 2.

Patients' Perspective and Caregivers' Perspectives of Patients' Distress

In CDR 0.5, according to patients' perspectives, problems with remembering appointments (#12) were predictors of distress defined as patients' scores of mood and behavior domain, whereas according to caregivers' perspective, problems with remembering where things were left (#8) and doing clerical work (#22) were predictors.

In CDR 1, according to patients' perspectives, problems with remembering appointments (#12), writing (#9), mental calculation (#15), and understanding the newspaper (#6) were predictors. Problems with writing (#9) were common predictors in assessment of patients and caregivers. According to caregivers' perspectives, problems with remembering where things were left (#8) were a positive predictor, whereas problems with practicing favorite hobbies (#13) were a negative predictor.

In CDR 2, according to patients' perspectives, problems with mental calculation (#15) and doing clerical work (#22) were predictors. Problems with doing clerical work (#22) were common predictors in the assessment of patients and caregivers. According to caregivers' perspectives, problems with feeding oneself (#21) and bladder control (#17) were positive predictors, and problems with communicating with people (#14) was a negative predictor (Table 2).

Discussion

From patients' perspectives, awareness of deficits remained until CDR 2, although awareness diminished as disease progressed. In CDR 0.5, patients' assessments of function and those of caregivers were similar. In CDR 1, the patients were generally aware of their deficits even if their assessment was insufficient. In CDR 2, insufficient awareness of deficits remained and was related to the elemental cognition such as memory (#8, #12, and #16), and time and spatial orientation (#1 and #2). At the same time, it was also shown that the patients no longer retained self-awareness in many aspects. They lost awareness of deficits in activities requiring executive function such as handling money (#10), practicing favorite hobbies (#13), and doing home activities (#20). Metacognition is considered to be closely related to executive functions,[32,33] and it should be noted that self-awareness concerning executive function could deteriorate before self-awareness related to memory or orientation.

In CDR 2, deficits in self-awareness were also apparent in the activities regarding communication and social interaction: understanding conversations (#4), communicating with people (#14), understanding the newspaper for accessing information on society (#6) and understanding the plot of a movie that involves communication of characters (#18). Unawareness of communication deficits could be partly explained by a defense mechanism[34] in the desire to cling to social interaction.

Discrepancy was observed between patients' and caregivers' perspective in what patients felt distressed, adding to the difference between patients' and caregivers' assessment of patients' deficits. From the patients' perspective, patients in CDR 0.5 and 1 might feel distressed due to attenuated social interaction; difficulty with remembering appointments (#12) was chosen as a predictor of distress in CDR 0.5 and in CDR 1. Social interaction and network tend to become limited due to the disease,[35] and the patients may be aware of the difficulties in maintaining social

interaction. Problems with writing (#9) and understanding the newspaper (#6) were also chosen in CDR 1. Those 2 are intellectual tasks related to communication. Writing is an important measure of communication, especially for patients who may have difficulty with face-to-face communication because of the deterioration of comprehension and language abilities. Newspapers are one of the useful tools to catch up with the world. Home delivery service of newspapers is common in Japan, and many elderly individuals habitually read newspapers.

Patients with AD might also be annoyed with awareness of deficits in intellectual tasks.[31] Patients in CDR 1 and 2 felt distressed as a result of awareness of problems with mental calculation (#15). Patients in CDR 2 also felt distressed as a result of awareness of deficits in clerical work (#22); in the Japanese version, the clerical work was limited to household budget management. The caregivers understood the patients' distress concerning deficits in writing (#9, CDR 1) and deficits in doing clerical work (#22, CDR 2); however, they imagined that the patients in CDR 0.5 and 1 only felt distressed by awareness of deterioration of memory (#8 difficulties in remembering where things were left) and those in CDR 2 felt distressed by awareness of deterioration of basic activities of daily living in bladder control (#17) and feeding oneself (#21). Caregivers also thought that patients did not care about problems in practicing favorite hobbies (#13, CDR 1) or communicating with people (#14, CDR 2).

The results indicated that patients felt distressed by awareness of deficits, especially deficits in social interaction and intellectual work. The results also suggested that the patients would prefer to satisfy social needs rather than basic physiological need, which caregivers assumed to be patients' concerns in CDR 2. Misunderstanding of these needs could lead to BPSD. The BPSD is not triggered solely by physiological factors, but rather reflects social environments in which the behavior occurs.[36-38] Thus, modifying environmental factors could be beneficial approach to managing BPSD. As the relationship with caregivers is one of the most influential social environmental factors for the patients, modifying caregivers' behaviors should be beneficial treatment of BPSD.[39] To the contrary, modifying patients' awareness, for example, awareness-raising approaches would be inappropriate. Decline of abilities is inevitable for patients with AD, and the approach forces the patients to confront their deficits and could lead to adverse effects such as anxiety and lowering of self-esteem and motivation.[31,40] The essence of care as nonpharmacological intervention is interpersonal empathetic relationship. Empathy involves cognitive processes to understand others and situations analytically,[41] and cognitive empathy focuses on understanding what the patient needs based on the patients' perspective. It could be an effective tool for cognitive empathy to analyze why patients feel distressed due to self-awareness of disease.

This study had some limitations. The questionnaire discrepancy method recognizes caregivers' assessment as an objective standard, which could be biased by patient–caregiver relationship and caregivers' factors such as depression and health status. This research was conducted in a small number of participants. For the next step, we are planning an interventional study to enhance the coping resources of caregivers with a larger number of participants.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Pleasant physical exercise program for prevention of cognitive decline in community-dwelling elderly with subjective memory complaints

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Aim: Japan is one of the most rapidly aging societies in the world. Measures to prevent dementia are urgently required in Japan, although such strategies have not yet been established. This study investigated the effectiveness of a pleasant physical exercise intervention on the prevention of cognitive decline in community-dwelling elderly participants with subjective memory complaints. In this intervention, a pleasant atmosphere was emphasized to enhance the participants' motivation.

Method: We administered a 12-week intervention program consisting of pleasant physical exercise. This program for the prevention of cognitive decline was carried out as a service of Maebashi city. The service targeted elderly residents aged 65 years and older who had subjective memory complaints. After a control period of 12 weeks, 42 participants, aged between 65–86 years, received intervention once a week at community centers. Participants carried out group exercise, and were encouraged to perform home exercise and walking during the intervention period. The program was carried out by co-medical professional staff, with the help of senior citizen volunteers.

Results: A total of 30 participants were included in the analysis. There was significant improvement on the Wechsler digit symbol substitution test ($P = 0.01$).

Conclusion: Participants with subjective memory complaints who continued the pleasant physical exercise programs for 12 weeks showed improvement in some aspects of cognitive function. Participation of senior citizen volunteers enabled smooth implementation of the program, and alleviated the burden on the professional staff. The pleasant physical exercise intervention described in the present study could be regarded as a community-led intervention to prevent cognitive decline. **Geriatr Gerontol Int 2012; ○○: ○○–○○.**

Keywords: community-dwelling elderly, physical exercise intervention, senior citizen volunteer, service for prevention of cognitive decline, subjective memory complaints.

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Introduction

It is estimated that 24.3 million people have dementia worldwide, with 4.6 million new cases every year.[1] Japan is one of the most rapidly aging societies in the world, and the number of demented elderly people who require nursing care is predicted to be 2.5 million in 2015 and 3.2 million in 2025.[2] Measures to prevent dementia are urgently required in Japan, although such strategies have not yet been established.

Physical exercise intervention for individuals with subjective memory complaints (SMC) is expected to be one of the efficient strategies to reduce the risk of cognitive decline. Several studies have suggested that SMC are associated with increased risk of dementia, even in persons with normal cognitive function.[3–5] A meta-analysis focused on older adults with dementia and related cognitive impairments suggested that physical exercise increases fitness, physical function, cognitive function and positive behavior.[6] In non-demented subjects, the results of a recent meta-analysis showed that subjects who carried out physical activity had a significantly reduced risk of cognitive decline.[7] A randomized controlled trial in older adults with SMC showed that physical activity programs were associated with an improvement in cognition.[8]

Physical activities in a pleasant atmosphere can be more effective for the prevention of cognitive decline. It has been proven in an animal study that exercise in enriched environments has a suppressive effect on the accumulation of amyloid β protein.[9] We have proposed the efficacy of intervention carried out in a pleasant atmosphere with an emphasis on communication (brain-activating rehabilitation).[10] Therefore, it could be meaningful to facilitate a pleasant atmosphere, and form a group where participants enjoyed mutual communication.

In Japan, public concern about care prevention has been growing since the Long-Term Care Insurance system was revised in 2008. Many municipalities have already started services for preventing cognitive decline. The services focus on maintaining and/or improving the cognitive functions of those who do not require care at present. However, the effectiveness of these services is currently insufficient. Furthermore, it remains necessary to prove the effectiveness of such services in preventing cognitive decline, if the services are to be provided as a public service.

We carried out a pleasant physical exercise intervention, which was conducted as a service of Maebashi city, in elderly with SMC. The programs were administered by co-medical professional staff along with senior citizen volunteers. The present study investigated the effectiveness of this service for preventing cognitive decline in elderly residents with SMC.

Method

Participants

The intervention program was carried out for the prevention of cognitive decline as a service of the municipality of Maebashi city in 2010. The service targeted elderly subjects aged 65 years and older residing in two districts of Maebashi city. Participants were recruited from these districts by the following methods.

1 Lectures on the prevention of cognitive decline for community residents were held twice.
2 Leaflets were distributed to each household, 1958 in total.
3 Public health nurses and local welfare commissioners visited door-to-door to invite elderly residents to the program.

The Medical Ethics Committee of Gunma University approved this study (21–47), and written informed consent was obtained from all participants.

Initial screening

Participants ($n = 100$) were screened by a questionnaire and medical interview (Fig. 1). They were examined by a clinician specializing in dementia. Those who met the two criteria below were excluded, and 87 participants remained.

1 Diagnosed as having dementia according to the criteria of International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).
2 Having a medical condition that made them unable to engage in physical activity.

Evaluation

The change in cognitive function was evaluated using Five-cog test, which evaluates the following cognitive domains: attention, memory, visuospatial function, language and reasoning. The Five-cog test consists of five items: (i) "character position referencing task" for evaluating attention; (11) "category cued recall task" for evaluating memory ability; (iii) "clock drawing task" for evaluating visuospatial function; (iv) "animal name listing task" for evaluating language ability; and (vi) "analogy task" for evaluating abstract reasoning ability.[11,12] Participants were also evaluated using the Wechsler digit symbol substitution test (WDSST).

To evaluate the physical function of each participant, grip strength test, one-leg standing duration test, timed up and go test, and 5 m maximum walking times test were carried out.

Participants were required to complete a questionnaire consisting of questions regarding age, sex, education and previous/current medical history. Their

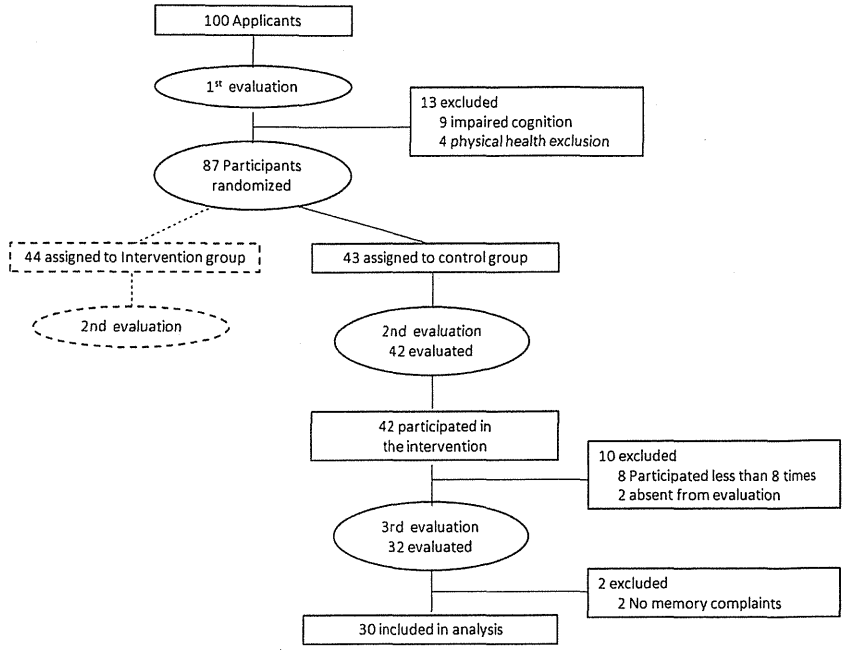

Figure 1 Flow of participants through the study.

subjective health status was evaluated with the question "How is your health in general?" using a rating scale from 1 = excellent to 4 = poor. The level of social support was evaluated with the Lubben Social Network Scale Revised (LSNS-R), which gauges social isolation in older adults by measuring the perceived social support received by family, friends and neighbors.[13] Functional capacity was determined using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC).[14] TMIG-IC is a multidimensional 13-item index of competence comprising three dimensions; that is, instrumental self-maintenance, intellectual activity and social role. The index was designed to measure higher level competence in community-dwelling elderly.[14,15] The Satisfaction in Daily Life (SDL), a simple measurement of subjective quality of life (QOL), was used to evaluate the life satisfaction of participants.[16,17] The SDL consisted of 11 items; that is, physical health, mental health, self-care, gait, housework, house facilities, partner and family relationships, hobby and leisure activities, social intercourse, economic state and social security, and having a job. Each item was rated from 1 = dissatisfied to 5 = satisfied. The 15-item short version of the Geriatric Depression Scale (GDS)[18] was used to evaluate depressive symptoms.

Study design

Evaluation was carried out three times (Fig. 1). After receiving the initial screening and evaluation (first evaluation), 87 eligible participants were randomly divided into two groups of 43 and 44. Participants in the present study ($n = 43$) were allocated to the control group of another randomized controlled trial (RCT), which is still continuing by adding participants in another district of Maebashi city. The participants in the present study received an educational lecture about nutrition during the control period. After the 12-week control period, 42 participants were evaluated for baseline condition (second evaluation). Effects of the intervention were evaluated at the end of the intervention period (third evaluation). At each evaluation, cognitive and physical function tests and questionnaires were administered to participants. Participants were examined by the questionnaire administered in the first evaluation as to whether they had SMC or not on the following two questions: "Are you concerned about forgetfulness?" and "Have you experienced any memory problems over the past 1 month?". Participants were considered to have SMC if they answered yes to both of the questions.

Participants were considered as having amnestic mild cognitive impairment (aMCI) by a clinician specializing in dementia according to the following criteria:[19] reported memory complaint; objective memory impairment for age; essentially preserved general cognitive function; largely intact functional activities; and not demented. They were included in SMC in accordance with a previous research on SMC.[20] Participants without SMC were excluded from analysis. However, they participated in the intervention program, because the intervention was carried out as a community service that should be available to all community dwellers.

Intervention

We administered the 12-week intervention program consisting of pleasant physical activity for 42 participants (Fig. 1). The exercise program includes muscle-stretching exercise in a sitting position (17 items), muscle-strengthening exercise in a sitting position (3 items), muscle-strengthening exercise in a standing position (7 items) and aerobic exercise (3 items). These exercises require comprehensive ability in physical activity consisting of body flexibility, muscle-strength, balance and endurance. The mean duration of the exercise program was 45 min. Participants were encouraged to carry out home exercise based on the exercise program. Walking was recommended to participants as regular exercise. Leisure activities and educational lectures were included in the program in order to motivate participation; for example, cooking, handcraft activity, lectures on physical activities and dental health. Participants received programs once a week in community centers located in the districts where they resided. The program was carried out in two groups of 26 and 16. The program was provided by the following co-medical professional staff: physical therapist, occupational therapist, public health nurse, dietitian and dental hygienist.

Senior citizen volunteers also participated in every program. Maebashi city has promoted participation of the elderly in volunteer activities focusing on long-term care prevention in the community. In the present intervention, 27 senior citizens participated as volunteers. They received training sessions on brain-activating rehabilitation, which emphasized a comfortable atmosphere; empathetic communication with each other; praising each other; having a social role; and errorless learning.[10] They were expected to facilitate communication among the participants and maintain a pleasant atmosphere. In each program, three to seven volunteers participated in assisting the professional staff in carrying out the program.

Statistical analysis

Statistical analysis was carried out using the Japanese version of SPSS, 17th edition (IBM, Armonk, NY, USA). Analyses were carried out with all the participants, and with those having aMCI and those not having aMCI separately. All results were analyzed by repeated-measures analysis of variance (ANOVA) and Bonferroni's correction post hoc test. We regarded $P < 0.05$ as showing significance.

Results

Flow of participants through the study

Figure 1 shows the flow of participants through the study. In the present study, 42 participants underwent the program after the control period of 3 months. The attendance rate during the intervention was 77.4%. A total of 10 were excluded from the analysis; eight attended the program less than eight times and two were absent from the third evaluation. Two participants were considered to not have SMC based on their answers on the questionnaire. Finally, 30 were included in analysis. Table 1 shows the demographic and clinical characteristics of 30 included participants and those of 12 excluded participants.

Analysis of all the participants

In the control period (between the first and second evaluation), there was no significant increase in the scores on cognitive and motor tests, except for the "Cued recall task" on the Five-cog test ($P = 0.001$) (Table 2). In the intervention period (between the second and third evaluation), significant improvement was seen on the "Cued recall task" of the Five-cog test ($P < 0.001$) and WDSST ($P = 0.01$) on the cognitive tests (Table 2). There were no significant changes between

Table 1 Demographic data of the participants

Characteristic	Participants included ($n = 30$)	Participants not included ($n = 12$)	P-value‡
Age† (years)	73.7 ± 5.5	75.0 ± 7.7	0.593
Female, n (%)	26 (86.7)	10 (83.3)	0.561
Years of education†	11.6 ± 3.8	11.4 ± 2.9	0.881
MMSE score†	28.4 ± 1.5	27.3 ± 2.0	0.067
SMC with aMCI, n (%)	7 (23.3)	6 (50.0)	0.095

†Results are expressed as: mean ± standard deviation. ‡Significance was tested using independent Student's t-tests for continuous variables, and χ^2-tests for categorical variables. aMCI, amnestic mild cognitive impairment; MMSE, Mini-Mental State Examination; SMC, subjective memory complaints.

Table 2 Results of the test scores (all participants, $n = 30$)

Scale	Ev. 1† (before Control period)	Ev. 2† (before intervention period)	Ev. 3† (after intervention period)	*F*-value	*P*-value	Ev.1 *vs* 2	Ev.2 *vs.* 3
Five-cog test							
Character position referencing task	21.3 ± 8.3	21.9 ± 9.1	23.7 ± 8.0	4.171	0.020*	1.000	0.107
Cued recall task	14.1 ± 4.9	17.0 ± 5.5	21.0 ± 6.2	53.189	<0.001***	0.001**	<0.001***
Clock drawing task	6.5 ± 1.4	6.8 ± 0.61	6.9 ± 0.4	3.093	0.084	0.490	0.130
Animal name listing task	15.9 ± 4.7	17.6 ± 5.4	19.0 ± 5.4	8.361	0.001**	0.071	0.173
Analogy task	10.1 ± 2.8	10.8 ± 3.1	10.9 ± 2.9	3.788	0.028*	0.046*	1.000
WDSST	52.7 ± 14.8	56.3 ± 14.2	60.4 ± 15.2	10.050	<0.001***	0.192	0.010*
Subjective health status	2.1 ± 0.5	2.2 ± 0.5	2.1 ± 0.4	0.693	0.504	0.791	1.000
LSNS-R	17.3 ± 5.5	16.4 ± 6.1	17.5 ± 5.6	1.154	0.316	0.975	0.253
TMIG-IC	11.9 ± 1.9	12.1 ± 1.5	12.0 ± 1.7	0.931	0.385	0.249	1.000
SDL	20.9 ± 4.2	20.6 ± 4.1	21.1 ± 4.2	0.254	0.776	1.000	1.000
GDS	3.5 ± 2.9	3.3 ± 2.3	2.7 ± 2.4	2.238	0.116	1.000	0.377
Grip strength	24.9 ± 6.2	26.3 ± 5.7	26.0 ± 6.2	4.212	0.028*	0.072	1.000
One-leg standing duration	34.7 ± 20.0	39.5 ± 21.3	39.8 ± 22.5	2.036	0.140	0.247	1.000
Timed up and go test	5.9 ± 0.8	6.2 ± 1.0	6.1 ± 0.9	3.388	0.041*	0.034*	0.613
5 m maximum walking time	2.7 ± 0.4	2.6 ± 0.4	2.6 ± 0.3	0.081	0.922	1.000	1.000

†Results are expressed as: mean ± standard deviation. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. Ev., evaluation; GDS, 15-item short version of the Geriatric Depression Scale; LSNS-R, Lubben Social Network Scale Revised; SDL, The Satisfaction in Daily Life; TMIG-IC, Tokyo Metropolitan Institute of Gerontology Index of Competence; WDSST, Wechsler digit symbol substitution test.

participants on any item on the questionnaire. None of the physical function tests showed significant changes after the intervention.

Subanalysis of participants without aMCI and with aMCI

When seven participants who were considered to have aMCI were excluded, results of subanalyses in 23 participants were similar to those of the analyses in all participants. There were no significant changes shown on analyses of seven participants with aMCI.

Discussion

The present study investigated the effectiveness of pleasant physical exercise intervention, provided as a service for the prevention of cognitive decline in community-dwelling elderly with SMC. Findings were objectively investigated using cognitive, physical, functional, social and behavioral outcome measures. Through the 12-week intervention, participants with SMC showed improvement in some aspects of cognitive function. In the evaluation carried out after the intervention, significant improvement was seen on the "Cued recall task" of the Five-cog test and on WDSST. Concerning the "Cued recall task", the effects of repeated learning could not be ruled out, as significant improvement was also seen on baseline evaluation.

WDSST is the test of attention and executive function. A previous study suggested that WDSST score is the best cognitive measure to detect unsafe drivers with early dementia of the Alzheimer type and non-demented drivers.[21] Improvement shown on WDSST score suggests that participants have increased abilities to carry out activities of daily living that require attention and executive function.

Although the present study program did not include direct cognitive stimulation, participants showed improvement in cognitive tests scores. The efficacy of intervention carried out in a pleasant atmosphere with an emphasis on interactive communication has been proposed.[10] Throughout the program, the staff and the volunteers were expected to facilitate communication among the participants and maintain a pleasant atmosphere. It is possible that physical activity carried out in the pleasant atmosphere and interactive communication enhanced motivation, which led to improvement of cognitive function.[22]

Preventive programs as municipally-sponsored measures against cognitive decline among community-dwelling elderly have not yet been established. In order to provide appropriate and effective services to prevent cognitive decline, determination of participants and the promotion of effective programs are critical issues. The present study targeted people with SMC. The majority of elderly participants report SMC,[23,24] and the presence of SMC is considered to be an important first sign or indicator of imminent dementia.[3–5] Participation of elderly subjects with SMC is recommended, because they need such an intervention, and benefits can likely be obtained.

We administered a 12-week intervention of pleasant physical activity program. It has been suggested that physical activity reduces the risk of cognitive decline among demented and non-demented elderly participants.[6,7] Therefore, physical activity should be one of the preferred programs for preventing cognitive decline. Furthermore, physical activity programs have several advantages; it is labor- and time-saving, and cost effective. It might be a competent program to offer as a community service.

Use of volunteers was emphasized in our intervention. It is important to develop human resources who can continuously attend preventive care activities in the community, as the shortage of professional staff has become obvious in an aging society. Participation of volunteers enabled smooth implementation of the program, and alleviated the burden on professional staff. Senior volunteers who joined in the intervention played important roles in facilitating a pleasant atmosphere and smooth communication among participants. Involvement of senior citizen volunteers could be effective for a community-based intervention program for the prevention of cognitive decline.

The present study had several limitations. The number of participants was small; the present study first targeted 42 participants, and 30 participants were finally included in analysis as a result of the 77.4% attendance rate of the intervention. The period of the intervention was relatively short; the intervention was carried out for just 3 months. These factors might limit the ability to generalize the results of the study.

In conclusion, participants with subjective memory complaints who continued the pleasant physical exercise programs for 12 weeks showed improvement in some aspects of cognitive function. Participation of senior citizen volunteers enabled smooth implementation of the program, and alleviated the burden on the professional staff. Thus, the present study showed a community-led intervention for care prevention.

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Author contributions: Tadahiko Kamegaya prepared the manuscript mainly, the intervention program described in the present study was provided by a physical therapist, an occupational therapist, public health nurses, a dietitian, and dental hygienists of Long-Term-Care Prevention Team of Maebashi City. Tetsuya Yamagami and Yohko Maki contributed to the preparation of the manuscript. Tomoharu Yamaguchi and

Tatsuhiko Murai contributed to the collection of data. Haruyasu Yamaguchi made the final approval of the manuscript to be published.

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EXTRA
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Original Research Article

A Randomized Controlled Trial of Brain-Activating Rehabilitation for Elderly Participants with Dementia in Residential Care Homes

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Key Words
Alzheimer's disease · Brain activity · Dementia care · Non-pharmacological therapies · Randomized clinical trials · Rehabilitation · Reminiscence therapy

Abstract
Background/Aims: We aimed to prove the effectiveness of brain-activating rehabilitation for dementia, which consisted of 5 principles: pleasant atmosphere, communication, praising, social role, and supportive care. ***Methods:*** The design was a randomized controlled trial that was not blinded. Fifty-four elderly participants with dementia (mean age: 85.2 years) were selected. Intervention based on the 5 principles of brain-activating rehabilitation was conducted for 1 h, twice a week, for 12 weeks (24 sessions). The control group had no treatment. Outcome measures consisted of two observation scales, namely sum of boxes in clinical dementia rating (CDR-SB) and the multidimensional observation scale for elderly subjects (MOSES), and two cognitive tests: the Hasegawa dementia scale revised (HDS-R) and trail making test A. ***Results:*** Repeated measure ANCOVA showed a significant interaction for total score of CDR-SB ($F = 7.190$, $p = 0.015$) and MOSES ($F = 4.525$, $p = 0.038$). There were no significant changes in the two cognitive test scores. ***Conclusion:*** Intervention based on the principles of brain-activating rehabilitation was effective in maintaining and improving daily life functions in elderly participants with dementia in residential care homes.

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Introduction

Rehabilitation for dementia, such as reminiscence therapy, reality orientation, cognitive rehabilitation, and physical activity, has an important role in delaying disease progression and functional decline. Studies on rehabilitation for dementia have focused on the differentiation of each technique (e.g. reminiscence therapy, reality orientation) and a comparison of their effects. However, Cochrane reviews on non-pharmacological interventions have highlighted the insufficiency of the available evidence [1–3]. We thought that the principles of intervention are much more important than each technique of intervention because intersubjectivity between participants and therapists/care staff has a much greater influence than each technique used. When the effects of three kinds of interventions, namely group reminiscence therapy, individual reminiscence therapy, and a group games, were compared in residential care homes, group reminiscence therapy improved memory performance and group games improved well-being, whereas individual reminiscence therapy was less effective. These findings suggested that group membership plays an important role in maintaining and promoting health and well-being [4]. We proposed a new principle of rehabilitation for dementia, brain-activating rehabilitation (BAR) [5], which consists of 5 principles: (1) enjoyable and comfortable activities in an accepting atmosphere; (2) activities associated with empathetic two-way communication between staff and participant, as well as between participants; (3) praising participants to enhance motivation; (4) offering social roles to participants that enhance their remaining abilities, and (5) supportive care to prevent failure, which causes confusion of participants. In fact, BAR was conducted as a combination of several techniques (e.g. reminiscence therapy, reality orientation, games, physical activity, crafts, cooking, and singing) to suit the participants based on these 5 principles. BAR was expected to enhance participants' motivation and maximize the use of their remaining functions and prevent the disuse of functions [5]. BAR was expected to enable participants to recover both a desire for life and their self-respect. Enhanced motivation induced by BAR can lead to amelioration of the behavioral and psychological symptoms of dementia and improvements in activities of daily living [6]. Improvements in cognitive function would also be expected through BAR [7].

In this study, we conducted intervention based on the principles of BAR for elderly participants with dementia as a randomized controlled trial to prove the effectiveness of BAR.

Methods

Participants

Fifty-four elderly participants in four residential care homes (group living homes) were selected on the basis of the following criteria: (1) being diagnosed with dementia; (2) without severe auditory and visual impairments, and (3) being able to engage in a simple activity or a brief conversation.

Randomization

At the end of the initial baseline assessment, we randomly divided participants into intervention and control groups in each residential care home, so that each intervention or control group was composed of four small groups. We used stratified randomization according to the Hasegawa dementia scale revised (HDS-R) [8], which is similar to mini-mental state examination (MMSE) and has a total score of 30, to equalize the severity of dementia between the two groups. Finally, 54 participants were randomly allocated to the intervention group (n = 28) or control group (n = 26) (fig. 1).

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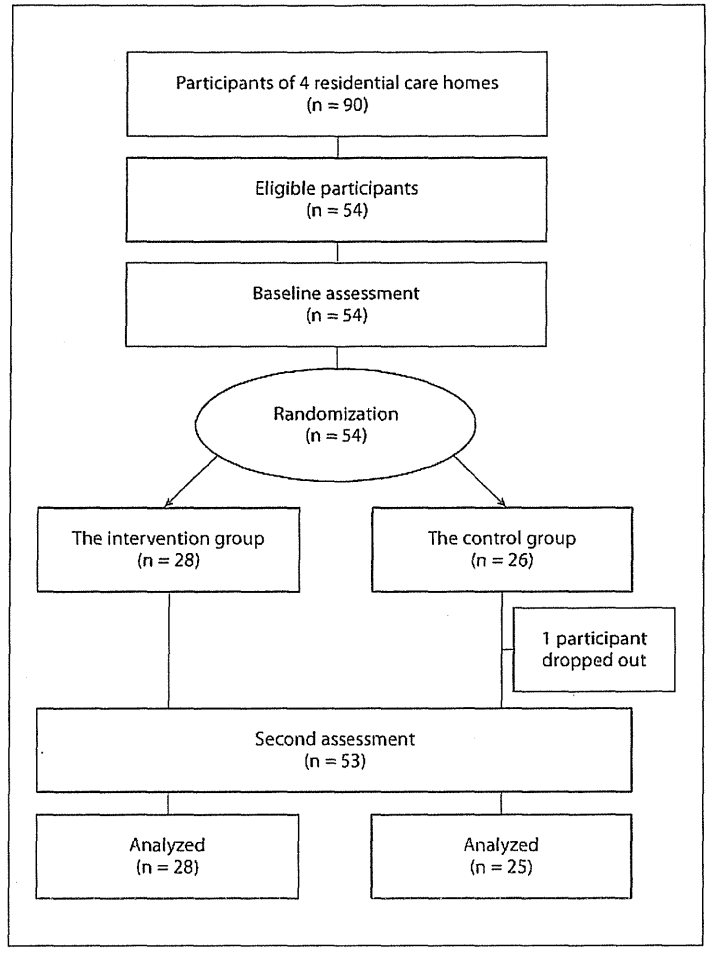

Fig. 1. Participant flow diagram.

Intervention

A total of 24 sessions were conducted in each group for 1 h, twice a week, for a 12-week period. In this study, intervention based on principles of BAR combined reality orientation and various activities (e.g. cooking, singing, and sewing) along with reminiscence therapy. In the baseline assessment, we collected information on life histories and specialties from the participants to select enjoyable topics in the sessions (table 1). The intervention staff consisted of one leader and two vice-leaders for each group. The staff of each residential care home had studied the principles of BAR and specifically learned the guidelines about attitude and communication for 4 h, and they played the roles of leader and vice-leaders by rotation. The researcher contributed to serve the same contents of the sessions for four groups. Throughout the session, staff had to accept and share the world of the participants, regardless of whether it was true or not (the first principle: pleasant atmosphere). At the same time, they organized the participants so that each participant could socially interact with other participants (the second principle: communication). When a participant seemed to make a mistake, or not to understand, staff acted to prevent the mistake (the fifth principle: supportive care). After each session, an evaluation meeting was held to improve the skills of the staff. In total, 41 members of staff were involved in the intervention (mean age: 30 years; duration of work experience: 4.9 years; mean number of sessions: 4.5).

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Table 1. Topics of BAR sessions

Topics	Tools
Cooking rice	rice kettle, furnace, measure, charcoal
Traditional games	beanbag for juggling, cup-and-ball toy, propeller
Pickled vegetables	rice bran, earthenware pot, salt, water
Washing	tub, washing board, washing powder
Sewing duster	cloth, stitch, thread, pincushion
Making rice cakes	mortar, mallet, steam pot, glutinous rice
Rice bran	rice bran, rice bran bag, washbowl
Mortar and pestle	mortar and pestle, taro potato, sesame
Handmade snack	barley flour, rice bowl, spoon
Weaving	silkworm, reel, shuttle
Elementary school	old textbook, pencil, school bag
Making noodles	knead pot, rolling pin, board

In the beginning, the reality orientation method was executed, which provided hints and signs to reconfirm the subjects' orientation in terms of time and date. Then, the reminiscence therapy method was executed. In reminiscence therapy, old-style tools such as a rice kettle, beanbags for juggling, and old textbooks were used, and staff asked the participants about the names of the tools and how to use them. Tools that are familiar to participants provide visual support for enhancing reminiscence. In addition, these tools encompass many activities, from housework to recreation, such as handiwork. These activities using old-style tools recruit procedural memories, which remain after the loss of episodic memory. Therefore, participants gain peace of mind, as they can easily relate to and describe these tools (the fifth principle: supportive care). The participants teach staff how to use these old-style tools. This is role reversal: the participants are teaching the staff who help them in daily living. Through this process, participants were expected to recover their self-confidence and the social function of passing on knowledge to younger generations (the fourth principle: social role). Because of this role reversal, the staff took care to praise the participants naturally (the third principle: praising). Thus, it is expected that participants enjoy the conversations. The control group had no treatment.

Outcome Measures

Care staff who did not participate in the intervention primarily evaluated participants using two observation scales which were primary outcomes: clinical dementia rating (CDR) [9] and multidimensional observation scale for elderly subjects (MOSES) [10]. CDR is reported to have high reliability (internal consistency: 0.68–0.88). Global severity of dementia was evaluated by the sum of boxes in CDR (CDR-SB) [11]. The CDR-SB sums the ratings in each of six domains ('boxes') of CDR to provide a consensus-based global clinical measure. MOSES is reported to have high reliability (internal consistency: 0.78–0.87). The scale is comprised of 40 parameters in 5 categories of daily life functions: (1) self-care; (2) disorientation; (3) depression; (4) irritability, and (5) withdrawal. Each category's score distribution ranges from 8 to 32 points (1 = not at all; 2 = seldom; 3 = at times; 4 = often) with higher scores indicating more severe disorders [10].

The participants underwent two cognitive tests, which are secondary outcomes: HDS-R and trail making test A [12]. HDS-R was performed to assess global cognitive function. HDS-R correlates well with MMSE, and it is more accurate than MMSE in diagnosing Alzheimer's disease [13]. In addition, HDS-R was shown to be more robust to demographic influences

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(age, education level, and gender) than MMSE [14]. Trail making test A was used to evaluate psychomotor speed. Participants were asked to draw a continuous line connecting 25 numbered circles.

After the intervention period, we prepared two questions for staff members: did the participants change after intervention and, if so, how? Did your daily care with the participants change in terms of both physical care and social contact?

Procedure

This study was approved by the Institutional Research Board of Takasaki University of Health and Welfare (No. 2201). Written consent was obtained from each participant and their families after providing full information regarding the purpose of this study, the risks and benefits, confidentiality, anonymity, and freedom of participation. Participants in the control group were assured that they would receive the same intervention after the intervention period.

Statistical Analysis

Data of outcome measures before and after intervention were analyzed using the Japanese version of SPSS Statistics for Windows version 18.0 (IBM Corporation, New York, N.Y., USA). Mann-Whitney U test and Fisher's exact test were used for comparison of the two groups at baseline. The primary and secondary statistical hypothesis was that the two observation scales and two cognitive tests would be improved in the intervention group compared with the control group after the intervention period. Repeated measures analysis of covariance (ANCOVA) with the covariates of age and sex was used to analyze the participants at the end of the study. Post hoc analysis for 'between participants' and 'within participants' was conducted with Bonferroni correction.

'Yes' and 'no' answers from the staff were analyzed. Free descriptions were separated into clauses to extract relevant words. We categorized similar words as the same opinion. We counted the number of words in each category.

Results

Baseline Characteristics of the Participants

The study participants were 54 elderly people with dementia (28 in the intervention group and 26 in the control group). No significant difference was found at baseline in any of the demographic variables (table 2).

In the intervention group, no participants dropped out and all took part in ≥20 of the total of 24 sessions. They looked cheerful and the average attendance rate was high (95.5%). In the control group, 1 participant dropped out due to sickness during the intervention period. Finally, outcome measures were analyzed in 53 participants: 28 participants in the intervention group and 25 in the control group, who completed the second evaluation.

Change in the Outcome Measures (table 3)

Repeated measure ANCOVA showed a significant interaction for total score of CDR-SB ($F(1, 49) = 7.190$, $p = 0.015$). The control group showed significant deterioration of CDR-SB ($p = 0.016$). On the other hand, the intervention group showed maintenance of this score.

Repeated measure ANCOVA showed a significant interaction for the total score of MOSES ($F(1, 49) = 4.525$, $p = 0.038$), subscale of disorientation ($F(1, 49) = 6.453$, $p = 0.014$) and withdrawal ($F(1, 49) = 4.955$, $p = 0.031$) in daily life functions. In the post hoc analysis, the

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Table 2. Demographics of the study participants (n = 54)

	Intervention group (n = 28)	Control group (n = 26)	p
Age, years	85.5 ± 4.0	84.9 ± 6.5	0.652
Gender			
Male	1 (3.6)	4 (15.4)	0.153
Female	27 (96.4)	22 (84.6)	
Diagnosis[a]			
AD	18 (64.3)	16 (61.5)	
VD	1 (3.6)	3 (11.5)	
AD and VD mixed	2 (7.1)	0 (0.0)	0.334
FTD	0 (0.0)	2 (7.7)	
Unspecified dementia	7 (25.0)	5 (19.2)	
Donepezil prescribed	9 (32.1)	12 (46.2)	0.403
Psychotropics prescribed	5 (17.9)	10 (38.5)	0.131
Mobility			
Independence	14 (50.0)	15 (57.7)	
Walking aids	9 (32.1)	5 (19.2)	0.314
Wheelchair	5 (17.9)	6 (23.1)	
CDR			
0.5 (questionable)	4 (14.3)	5 (19.2)	
1 (mild)	15 (53.6)	9 (34.6)	0.557
2 (moderate)	7 (25.0)	10 (38.5)	
3 (severe)	2 (7.1)	2 (7.7)	

Values are means ± SD or numbers with percentages in parentheses. Mann-Whitney U test or Fisher's exact test were used. AD = Alzheimer's disease; VD = vascular dementia; FTD = frontotemporal dementia. [a] Clinical diagnosis assigned according to the notes of participants' consultant physicians.

control group showed a tendency of deterioration (subscale of disorientation, p = 0.054, and withdrawal, p = 0.095), but there was no significant difference. The intervention group had significantly lower scores for total score of MOSES (p = 0.048) and subscale of withdrawal (p = 0.008) than the control group after intervention.

There were no significant effects on the two cognitive tests of HDS-R and trail making test A.

Staff Interview

In terms of changes seen in the intervention group, 26 (63.4%) of the 41 staff members noticed a positive change. Staff opinions were as follows: 'improved peer relationships' (n = 12), 'a more cheerful and positive outlook' (n = 11), 'positive anticipation of session' (n = 6), and 'co-operative attitude toward the care staff' (n = 4). In terms of changes in staff, 31 (75.6%) of the 41 staff members noticed a change. Staff opinions were as follows: 'I began to listen to the participants' recollections of their younger days' (n = 16), 'I learned how to communicate with the participants in a positive manner' (n = 10), 'I learned the importance of role reversal by being taught new things by the participants' (n = 6), 'I noticed for the first time the abilities of the participants' (n = 4), and 'I learned the importance of expressing appreciation when tasks are completed well' (n = 3).

Table 3. Change in outcome measures for the intervention (n = 28) and control groups (n = 25)

Outcome variable	Time period				Interaction		Post hoc analysis
	before test		after test				
	mean ± SD	p	mean ± SD	p	F	p	p
CDR-SB							
Intervention	8.0 ± 3.8	0.684	7.6 ± 3.5	0.200	7.190	0.015*	0.296
Control	8.5 ± 4.5		9.3 ± 4.8				0.016*
MOSES total							
Intervention	71.4 ± 12.7	0.200	69.3 ± 15.4	0.048*	4.525	0.038*	0.105
Control	76.8 ± 16.4		78.7 ± 16.6				0.168
MOSES self-care							
Intervention	14.0 ± 4.1	0.226	13.8 ± 5.2	0.186	0.405	0.527	0.692
Control	15.7 ± 5.7		15.9 ± 5.8				0.612
MOSES disorientation							
Intervention	18.8 ± 4.1	0.964	18.2 ± 4.6	0.407	6.453	0.014*	0.105
Control	18.6 ± 6.1		19.4 ± 6.4				0.054
MOSES depression							
Intervention	11.2 ± 3.4	0.394	10.9 ± 3.2	0.521	0.101	0.752	0.602
Control	12.0 ± 4.9		11.5 ± 5.0				0.353
MOSES irritability							
Intervention	11.0 ± 2.7	0.926	10.8 ± 3.2	0.488	1.159	0.287	0.630
Control	11.3 ± 2.8		11.7 ± 3.3				0.303
MOSES withdrawal							
Intervention	16.4 ± 5.4	0.104	15.5 ± 5.7	0.008*	4.955	0.031*	0.146
Control	19.1 ± 5.4		20.2 ± 5.4				0.095
HDS-R							
Intervention	13.1 ± 4.5	0.768	13.4 ± 4.6	0.903	0.078	0.781	0.722
Control	12.6 ± 5.8		13.0 ± 6.2				0.470
TMT-A							
Intervention	177.9 ± 94.7	0.300	171.2 ± 96.6	0.252	0.128	0.722	0.901
Control	218.2 ± 118.5		229.6 ± 145.1				0.707

Repeated measures ANCOVA with the covariates of age and sex was used, and post hoc analysis with Bonferroni correction was conducted. TMT-A = Trail making test A. * $p < 0.05$.

Discussion

The results indicate the effect of intervention based on the principles of BAR on the improvement or maintenance of two observation scales, CDR-SB and MOSES, especially disorientation and withdrawal, although no improvement was shown in terms of the two cognitive tests of HDS-R and trail making test A. In a previous randomized controlled trial, the effect of a group care program, which consisted of reminiscence and reality orientation, was examined using an observation scale (MOSES) and a cognitive test (MMSE) as outcome measures [15]. The study found improved orientation and withdrawal subscales of MOSES, agreeing with our current study. In a randomized controlled trial on 168 demented elders in nursing homes, a comprehensive program of counseling, life review, interpersonal therapy, behavioral therapy, and rehabilitation reduced multiple psychiatric symptoms, suggesting the importance of a person-oriented approach [16]. Activities adjusted to 'personality style of interest' reduced agitation and passivity of demented elders. Furthermore, the activities adjusted to both functional level and personality style of interest brought greater pleasure

than activities partially adjusted or non-adjusted to individual preferences and needs [17]. In the current study, we tried to adapt the contents of the sessions to each participant by collecting information on life history, although intervention sessions were conducted in a group setting.

Due to the basis of the 5 principles of BAR, participants looked cheerful and the average attendance was extremely high (95.5%). When the staff took care of the participants by following the principles of BAR, staff became more receptive and provided care that encouraged demonstration of each participant's abilities. The responses to questions by the staff also supported these findings. Intervention with BAR principles enhanced understanding between staff and participants, as well as between participants [6]. The benefit was generalized to participants' daily life. Therefore, participants may gain a sense of self-worth and a desire to live, and the behavioral and psychological symptoms of the participants may be reduced. In fact, in this study, withdrawal was alleviated. Intervention following the BAR principles also improved apathy and social ability in elderly participants with mild cognitive impairment and mild dementia [18]. The concept of person-centered care can be described as follows: it acknowledges that the individual is a person who can experience life and relationships, despite progressive disease; involves inclusion of the person's past life and history in their care, and it focuses on what the person can do, rather than abilities that have been lost owing to the disease [19]. The concept of person-centered care is widely accepted in the field of dementia care. BAR is also a concept but not a technique. We expect BAR to be widely accepted in the field of dementia rehabilitation.

Our randomized controlled trial revealed that intervention based on BAR principles promoted intersubjectivity between participants and therapists/care staff and was effective for maintaining and improving emotional and daily life functions in the current study. Participants may regain their confidence. BAR principles of enjoyable stimulation, communication, and role reversal contribute to providing an environment where elderly participants with dementia can laugh and be themselves.

We revealed the effectiveness of dementia rehabilitation based on the principles of BAR by a randomized controlled trial. A pleasant atmosphere, communication, praising, social role, and supportive care are essential in rehabilitation for dementia.

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Disclosure Statement

The authors declare that they have no conflicts of interest.

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Communicative Competence in Alzheimer's Disease: Metaphor and Sarcasm Comprehension

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Abstract

The purpose of this study was to evaluate the deficits of metaphor and sarcasm comprehension in Alzheimer's disease (AD), as pragmatic interpretation such as metaphor and sarcasm comprehension is required in social communication. A total of 31 young normal controls, 104 aged normal controls (ANC), 42 patients with amnesic mild cognitive impairment (aMCI), and 30 patients with mild AD were evaluated by Metaphoric and Sarcastic Scenario Test, which consists of 5 metaphoric and 5 sarcastic questions with 5 answer choices. Scores were analyzed using the repeated measures analysis of variance (metaphor/sarcasm vs 4 participant groups). Sarcasm comprehension, which requires second-order Theory of Mind (ToM), started to deteriorate in ANC, and metaphor comprehension, which requires first-order ToM, started to deteriorate in aMCI, and both deteriorated as disease progressed. Literal interpretation of pragmatic language is characteristic in patients with mild AD. Such misinterpretation would result in social miscommunication, even if they still retained semantic-lexical competence.

Keywords

Alzheimer's disease, theory of mind, empathy, communication difficulties, pragmatic competence

Introduction

Communicative competence occupies a central place in participation in social activities and it can be impaired in patients with Alzheimer's disease (AD). In AD, lexical-semantic competence is deteriorated as a result of cognitive decline.[1] However, patients could also have communicative difficulties even from the stage where lexical-semantic competence is still preserved. In social communication, literal lexical-semantic comprehension is not sufficient.[2] Comprehension of nonliteral implication is often required to infer a speaker's intended meaning (Theory of Mind [ToM]),[3] which is not always expressed explicitly.

Theory of Mind is considered to consist of 2 stages, first-order ToM is the ability to grasp the intentions of the speaker and second-order ToM is the ability to infer the speakers' evaluation for an attributed thought.[4-7] Metaphor and sarcasm comprehension are considered to be appropriate materials of ToM.[8] First-order ToM is sufficient for metaphor comprehension.[9] Metaphor suggests meanings through mental linkage and comparison of similarities between different expressions normally not related to each other.[10,11] Second-order ToM is required for sarcasm comprehension.[5] Sarcasm expresses something other than explicitly stated and especially the opposite of the literal meaning of the utterance.[12] Thus comprehension of sarcasm requires the ability to reflect on the speakers' evaluation about the attributed thought, adding to utterance intention.[4]

Metaphoric and sarcastic competence has been mainly studied to evaluate the social communicative competence in the phases of development and its disorders,[13] as interaction with other people is critical for normal neurocognitive development.[14] In the phase of aging and degeneration, it is also meaningful to evaluate the decline of social communicative competence. However, a recent review on nonliteral language in AD noted a severe lack of evidence.[15] Furthermore, previous reports on metaphor and sarcasm comprehension are inconsistent; for example, deficits in metaphor comprehension were reported from early stages of AD,[16-18] whereas concerning irony and sarcasm, previous studies did not find a significant impairment relative to an aged control group,[19,20] which is surprising because irony involves more cognitive processes than metaphor.[21]

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