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ORIGINAL ARTICLE

Effects of a progressive muscle relaxation intervention on dementia symptoms, activities of daily living, and immune function in group home residents with dementia in Japan

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Abstract

Aim: To evaluate the effects of progressive muscle relaxation on the behavioral and psychological symptoms of dementia, activities of daily living, and immune function of elderly patients with dementia in group homes.

Methods: The participants were ranked by their group home unit. Odd ranks were assigned to the intervention group and even ranks to the control group. The intervention group participated in progressive muscle relaxation for 15 min each day for 90 days in the group environment; the control group members continued with their normal routine. All the participants' secretory immunoglobulin A was measured and they were assessed with the Neuropsychiatric Inventory-Nursing Home version, Nishimura Mental State Scale for the Elderly, and Nishimura Activities of Daily Living Scale.

Results: The intervention group comprised 18 participants from six units and the control group comprised 19 participants from five units. After the intervention, the Neuropsychiatric Inventory scores were significantly better in the intervention group, particularly for Agitation and Anxiety. The intervention group also showed significantly lower Apathy and Irritability scores and significant improvement in the Interest, Volition, and Social relationships scores on the Mental State Scale, with improvement in the activities of daily living total. However, there was no difference in the secretory immunoglobulin A level between the groups.

Conclusion: The results suggest that progressive muscle relaxation improves the behavioral and psychological symptoms of dementia and activities of daily living in group home residents with dementia, but does not affect their immune function.

Key words: activities of daily living, behavioral and psychological symptoms of dementia, immune function, progressive muscle relaxation.

INTRODUCTION

Japan is facing a rapid increase in the aging population. According to the Japanese Ministry of Health, Labour, and Welfare (2014), the average life expectancy in 2014 for Japanese men was 80.5 years and 86.8 years for women. By the year 2025, 30% of the total Japanese population will be aged ≥65 years (Hotta, 2007; Tsuji, 2007). About 15% of individuals aged >65 years have dementia and ~4.39 million persons in Japan suffer from the disease (Ministry of Health, Labour, and Welfare, 2013).

Dementia is a progressive syndrome. There are several behavioral and psychological symptoms of dementia (BPSD), such as cognitive function decline, functional impairment, delusions, hallucinations, depression, anxiety, and aggression (Van Zadelhoff, Verbeed, Widdershoven, van Rossum, & Abma, 2011).

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In Japan, the government introduced a long-term care insurance (LTCI) program to the elderly care system in April 2000 (Traphagan & Nagasawa, 2008). A system was established in Sweden in 1986 (Hozumi, 2007), whereby elderly patients with dementia often live in group homes (Saiga & Saeki, 2012), which provide an environment for proactive and collaborative daily living with similar individuals (Yamada, 2010). In Japan, the number of group homes has increased following the LTCI program; in 2012, there were an extra 10,000 group homes and 160,000 elderly residents (Asakawa, 2012; Ministry of Health, Labour, and Welfare, 2012). Although the main focus of group homes is daily living, rehabilitation is also necessary for such residents (Funaki, Kaneko, & Okamura, 2005). In many group homes, elderly persons carry out daily recreational activities, including swallowing and gymnastic exercises, that maintain bodily functions.

Pharmacological therapy often shows incomplete efficacy for complex BPSD; therefore, non-pharmacological options have been developed. These include validation treatment, reality orientation, reminiscence therapy, music therapy, cognitive stimulation therapy, and exercise. Of these, cognitive stimulation therapy has a reasonable evidence base (Japanese Society of Neurology, 2011), which suggests that other non-pharmacological therapies for dementia might have beneficial effects on the cognitive symptoms and BPSD (Yamaguchi, Maki, & Yamaguchi, 2010). Improvements in BPSD can decrease the suffering and disease burden of patients and their family (Finkel, 2000) and improve individuals' daily life (Kinoshita, 2008). For patients with mild-to-moderate dementia, non-pharmacological therapies should be considered early in the disease course because the therapies could become more difficult to administer as the disease progresses (Japanese Society of Neurology). Some non-pharmacological therapies have been used in clinical practice and research, such as aromatherapy, music therapy, touching, doll therapy, and progressive muscle relaxation (Fujii *et al.*, 2008; Mariko, Matsuda, Takahashi, Fujii, & Sasaki, 2015; Mitchell & O'Donnell, 2013; Suhr, Anderson, & Tranel, 1999; Suzuki *et al.*, 2010), in order to help conditions like BPSD and to improve activities of daily living (ADLs).

Progressive muscle relaxation is one such therapy. The method is used to control muscle tension and the physical and psychological symptoms of anxiety (Jacobson, 1974). Progressive muscle relaxation promotes the relaxation of the major muscle groups, such as the face, arms, legs, neck, and back, and is combined with deep breathing. Relaxation helps to reduce stress in the body and restores homeostasis (Gustainiene, Perminas, Peciuliene, & Jarasiunaite, 2015). Most individuals find progressive muscle relaxation easy to learn and can use it to attain a state of relaxation (Sheu, Irvin, Lin, & Mar, 2003; Suhr *et al.*, 1999). Previous studies have found good evidence for the beneficial effects of relaxation. Arena, Hightower, and Chong (1988) found that an 8 week relaxation intervention improved headaches in 10 elderly persons. Renfroe (1988) used progressive relaxation to treat dyspnea and anxiety in 20 outpatients with chronic obstructive pulmonary disease. Rankin, Gilner, Gfeller, and Katz (1993) found that progressive muscle relaxation reduced the level of state anxiety in their elderly participants and Peck (1998) showed that progressive muscle relaxation had beneficial effects on pain, tension, mood, and satisfaction in elderly persons with arthritis. Moreover, progressive muscle relaxation is helpful in the management of anxiety and memory complaints in elderly persons (Brooks, Friedman, & Yesavage, 1993; Rickard, Scogin, & Keith, 1994; Scogin, Rickard, Keith, Wilson, & McElreath, 1992; Yesavage, Rose, & Spiegel, 1982). According to Suhr *et al.*, patients with Alzheimer's disease showed a significant decrease in psychiatric and behavioral disturbances from baseline to the 2 month follow-up testing. Progressive muscle relaxation is an effective technique for managing BPSD in Alzheimer's disease, especially for patients with mild-to-moderate dementia. However, most previous research has not included control groups and has not evaluated the long-term effect of progressive muscle relaxation.

There is a great need for research on ADLs in elderly persons with dementia (Cummings & Mega, 2003). In order to precisely evaluate the potential of non-pharmacological therapy, its effects on BPSD and ADLs need to be measured separately (Takeda, 2013). The main purpose of this study was to clarify the effects of progressive muscle relaxation on BPSD, but its effects on ADLs and immune function also were measured because elderly persons are at increased risk of infections and ADL impairments (Okuno & Ohnishi, 2009). This study aimed to determine the effects of progressive muscle relaxation on BPSD, ADLs, and immune function.

METHODS

Study environment and participants

The research was conducted in group homes in Nagoya, Japan. Group home participation in the research was

requested by sending a letter to group home associations between March and September 2012. The participants were required to meet the selection criteria and to provide informed consent. Exclusion criteria also were applied.

The selection criteria were: (i) aged ≥65 years; (ii) diagnosis of dementia; (iii) resident of a group home for ≥3 months; (iv) mild-to-moderate dementia with a Mini-Mental State Examination (MMSE) total score of between ≥11 and ≤23 points; (v) the ability to participate in recreational activities; (vi) the ability to sit during vital sign measurements and progressive muscle relaxation; and (vii) the presence of BPSD, as defined by a total score of >1 on the Neuropsychiatric Inventory-Nursing Home version (NPI-NH). The pre-intervention exclusion criteria were: (i) the presence of acute disease; and (ii) the presence of musculoskeletal diseases. In addition, the participants were excluded on observation of any of the following situations: (i) any initiation or change in the type or dose of oral antipsychotics, anti-anxiety drugs, or antidepressants; (ii) any change from normal in their care, such as oral care or foot care; or (iii) the initiation of another type of recreation with the potential to induce a relaxation response, such as aromatherapy, massage, or music therapy.

Intervention

Those patients and their family who met the selection criteria and provided consent participated. They then were ranked according to their group home unit. Odd ranks were assigned to the intervention group and even ranks were assigned to the control group. The intervention group participated in progressive muscle relaxation for 15 min each day for 90 days in the group environment; the control group members continued with their normal routines. All the intervention group participants completed every session and a researcher and trained group home staff encouraged the participants to follow the instructions correctly. The following conditions had to be met for participation in progressive muscle relaxation: (i) a willingness to participate; (ii) stable vital signs; (iii) no viral symptom; and (iv) no acute pain.

A simple method of progressive muscle relaxation was adopted that divided the muscles into seven groups: forearm and upper arm; lower leg and front thigh; lower leg and rear thigh; chest; shoulder; forehead; and periorbital area and lower jaw. This simplified method has been found to have positive psychological and physiological effects in patients with cancer (Kondo, Koitabashi, Kaneko, & Kobayashi, 2011). Progressive muscle relaxation always was conducted by between three and five researchers and group home staff, comprising nurses, care managers, and care workers, with ~30 group home staff in total. The researcher, a nurse-with a Master's qualification and skilled in the method, was always present. When directions were provided for tension and relaxation behaviors, clear verbal instructions and gestures were used that were easily mimicked. When the participants found the instruction difficult (e.g. because of hearing loss), either the group home staff or the researchers provided individual assistance. In order to aid facilitation, the group home staff members were taught progressive muscle relaxation by using digital media (i.e. a DVD) and a brochure. In addition, the technique that was used by the staff was checked and corrected when necessary, both before and during the intervention period.

Data collection

Data on the participants' age, sex, level of care required (scored between 1 and 5 based on an assessment of care requirements), and MMSE scores were collected from interviews with the group home staff and participants in the pre-intervention stage in order to obtain the baseline characteristics of all the participants.

Scores for the NPI-NH, the Nishimura Mental State Scale for the Elderly (NM scale), and the Nishimura Activities of Daily Living Scale (N-ADL) were obtained through interviews with the group home staff who were involved in the day-to-day care of the participants. The scores were recorded at pre-intervention, 30 days after the intervention's initiation, and 90 days after the intervention's initiation. As a physiological measurement, the participants' secretory immunoglobulin A (S-IgA) was measured pre-intervention and 90 days after the intervention's initiation.

Measures

Neuropsychiatric Inventory-Nursing Home version

The BPSD was evaluated by using the internationally validated NPI-NH that was developed by Cummings *et al.* (1994). This measure includes 10 questions that are related to mental symptoms that are found often in patients with dementia, such as delusions, hallucinations, agitation, depression, anxiety, euphoria, apathy, disinhibition, irritability, and aberrant motor behavior (Shigenobu, Tabuse, Hirono, & Ikeda, 2008). The

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respondents, group home staff, and those who were connected with the participants' daily well-being rated the frequency of the symptoms from 1 to 4 as follows: 1 = "sometimes" (less than once per week) to 4 = "very often" (several times per day or always). The level of symptom severity was graded from 1 to 3 (1 = "mild" to 3 = "severe"). The sum of the frequency and severity scores could range between 0 and 120 points.

Nishimura Mental State Scale for the Elderly and Nishimura Activities of Daily Living Scale

The NM scale is a behavior rating scale that is used to evaluate mental status in daily life. Its items are rated on a 0–10 point scale and include Housework and the Arrangement of personal belongings, Interest, Volition, and Social relationships, Conversation, Memory, and Orientation (Fukunaga, Ukai, Kobayashi, & Nishimura, 2006). The N-ADL is a behavioral assessment scale that is used in conjunction with the NM scale and helps to capture the overall practical capabilities of elderly persons in daily life (Kobayashi, Hariguchi, Nishimura, Takeda, & Hukunaga, 1988). This scale assesses functional status with five items that measure walking, living area, bathing, putting on and taking off clothes, feeding, and excretion. The possible scores are between 0 and 10 points, according to the severity level.

Secretory immunoglobulin A

The S-IgA has an important role in host defense (Lamm, 1998) and it can indicate prolonged stress and immune function (Izawa *et al.*, 2007). The S-IgA was used in this study as a long-term indicator of stress. The sample collection is simple and uninvasive, as only a small volume of saliva is required for testing. Hence, this method is regarded as the gold standard of stress measurement in elderly persons (Sugiyama, 2011). The S-IgA is central to oral cavity immune function and prevents viral and bacterial infection of the upper respiratory tract (Kawai, 1973). In order to control for the effects of dietary intake and diurnal variation, the saliva was collected between 10.00 hours and 11.00 hours and the participants were asked to rinse their mouth ~30 min prior to its collection. With the patient in a sitting position and at rest, the sample was obtained over 1 min by using an oral cotton saliva collection device (Salivette; Sarstedt, Nümbrecht, Germany) and it was stored immediately in a cooling box. Later, the samples were separated from the sterile cotton in a centrifuge (5 min at 3500G) and freeze-stored at −30°C. All the samples were analyzed by Corporation SRL, Tokyo, Japan.

Statistical analyses

After testing for normal distributions, the unpaired *t*-test and the χ^2-test were used to compare the baseline differences between the intervention group and the control group. In addition, the NPI-NH, NM scale, and N-ADL scores, as well as the S-IgA levels, were analyzed by using a one-way ANOVA with repeated measures, followed by a Bonferroni post-hoc test, at the three time points of pre-intervention, 30 days after the intervention's initiation, and 90 days after the intervention's initiation. Tests of normal distribution and equal variance were carried out in order to confirm the use of parametric analyses. All the *P*-values that were <0.05 were considered to be statistically significant.

Ethical considerations

The purpose of this research was explained both in writing and verbally. Consent then was obtained from the participants, family members, and group home staff. The autonomy of the patients was respected as to whether to choose to participate or not in the study and their personal information was protected. This study was approved by the ethical review boards at the authors' institutions.

RESULTS

Sample characteristics

In total, patients from seven group homes with 11 units were assigned randomly to the intervention group ($n = 21$) or the control group ($n = 23$). However, three participants in the intervention group and four in the control group were excluded because of changes in oral medications or after fractures following falls. Therefore, the final analysis included 18 participants in the intervention group and 19 in the control group (Fig. 1). There was no significant difference between the two groups in age, sex, and level of care required, the NPI-NH, NM scale, and N-ADL scores, or in the S-IgA levels at baseline (Table 1).

Changes in the measures

Neuropsychiatric Inventory-Nursing Home version scores

There was a difference between the intervention group and the control group in the total NPI-NH score. With

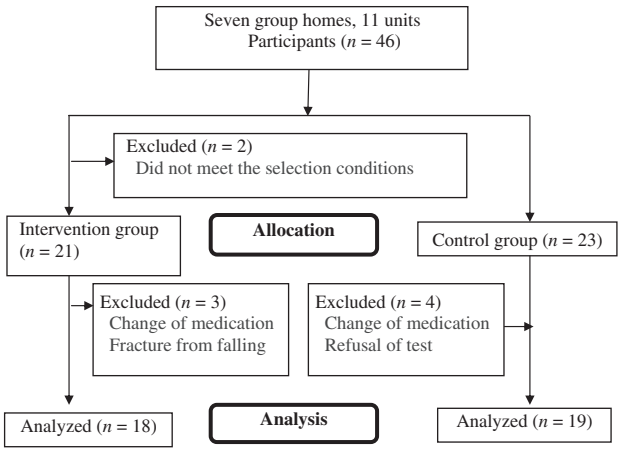

Figure 1 Flow chart showing the participants, group allocation, and analysis.

intervention. A significant improvement in scores also was observed between 30 days after the initiation of the intervention and 90 days after the initiation. However, the control group showed no significant difference in scores between the two periods. For the NPI-NH subscores, the intervention group's Agitation scores were significantly better 90 days after the intervention's initiation than 30 days after initiation of the intervention. Similarly, there was a significant improvement in their Anxiety scores between pre-intervention and 90 days after the intervention's initiation and between 30 days after the intervention's initiation and 90 days after the initiation of the intervention (Tables 2, 3). There was a significant improvement in NPI-NH scores in the intervention group, particularly for Agitation, Anxiety, Apathy, and Irritability.

Table 1 Participants' characteristics

Item	Intervention group (n = 18) Mean ± SD or N (%)	Control group (n = 19)	t-Value	χ^2-Value	P-value
Age	86.89 ± 4.19	86.74 ± 6.68	0.082	–	0.935
Sex					
Male	4 (22)	3 (16)	–	0.249	0.618
Female	14 (78)	16 (84)	–		
Level of care required					
1	7 (39)	5 (26)	–	1.485	0.686
2	7 (39)	8 (42)	–		
3	4 (22)	5 (26)	–		
4	0 (0)	1 (5)	–		
Type of dementia					
Alzheimer's	5 (28)	3 (16)	–	–	–
Cerebrovascular	0 (0)	1 (5)	–	–	–
Mixed type	0 (0)	1 (5)	–	–	–
No definitive diagnosis	13 (72)	14 (74)	–	–	–
Measure					
NPI-NH	8.94 ± 6.74	7.63 ± 6.22	0.616	–	0.542
NM scale	31.67 ± 8.24	31.11 ± 9.77	0.188	–	0.852
N-ADL	37.94 ± 7.37	37.68 ± 10.12	0.089	–	0.930
S-IgA	178.20 ± 129.72	123.47 ± 49.18	1.714	–	0.095
MMSE	16.61 ± 3.47	16.84 ± 3.20	–0.211	–	0.834

MMSE, Mini-Mental State Examination; N-ADL, Nishimura Activities of Daily Living Scale; NM, Nishimura Mental State Scale for the Elderly; NPI-NH, Neuropsychiatric Inventory-Nursing Home version; SD, standard deviation; S-IgA, secretory immunoglobulin A.

regard to the NPI-NH subscores, there was a significant difference between the intervention and the control groups in the Apathy and Irritability scores. For the intervention group, the scores 30 days after the initiation of the intervention and 90 days after the initiation of the intervention were significantly better than at pre-

Nishimura Mental State Scale for the Elderly and Nishimura Activities of Daily Living Scale scores

There was a significant difference between the intervention group and the control group in the total NM scale scores and a significant interaction between the two

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Table 2 Changes in the scale scores in the intervention group

Subscale	Intervention group (n = 18)		
	Pre-intervention	30 days after intervention initiation	90 days after intervention initiation
NPI-NH total score	8.94 ± 6.74	7.28 ± 6.50	4.78 ± 5.07
		** * **	
Delusions	0.83 ± 1.58	0.78 ± 1.52	1.00 ± 2.28
Hallucinations	0.17 ± 0.71	0.22 ± 0.73	0.39 ± 0.98
Agitation	1.94 ± 2.41	1.89 ± 2.17	1.00 ± 1.28
		*	
Depression/dysphoria	0.94 ± 1.21	0.39 ± 0.61	0.33 ± 0.69
Anxiety	1.22 ± 1.70	0.83 ± 1.25	0.28 ± 0.67
	*	* *	
Euphoria/elation	0.56 ± 1.65	0.22 ± 0.73	0.22 ± 0.94
Apathy/indifference	1.17 ± 3.00	0.94 ± 2.92	0.44 ± 1.42
Disinhibition	0.61 ± 1.42	0.83 ± 1.47	0.67 ± 1.03
Irritability/lability	1.22 ± 2.02	0.89 ± 1.75	0.28 ± 0.57
Aberrant motor behavior	0.28 ± 0.96	0.28 ± 0.96	0.17 ± 0.51
NM scale total score	31.67 ± 8.24	32.06 ± 8.29	33.56 ± 7.91
Housework and arrangement of personal belongings	4.78 ± 2.26	4.94 ± 2.13	5.11 ± 2.00
Interest, volition, and social relationships	6.06 ± 2.29	6.22 ± 2.37	7.22 ± 1.90
	**	*	
Conversation	8.17 ± 2.46	8.17 ± 2.46	8.22 ± 2.32
Memory	5.67 ± 2.06	5.67 ± 2.06	6.33 ± 1.94
Orientation	7.00 ± 2.03	7.00 ± 2.03	6.67 ± 2.17
N-ADL total score	37.94 ± 7.37	38.00 ± 7.86	39.00 ± 7.22
		*	

Values are the mean ± standard deviation. N-ADL, Nishimura Activities of Daily Living Scale; NM, Nishimura Mental State Scale for the Elderly; NPI-NH, Neuropsychiatric Inventory-Nursing Home version.

groups on the NM scale's Interest subscores. For the intervention group, the NM scale's Interest, Volition, and Social relationships subscores improved significantly from pre-intervention to 90 days after the intervention's initiation and from 30 days after the intervention's initiation to 90 days after the initiation of the intervention. There was a significant difference in the N-ADL total scores between the intervention and the control groups. In the intervention group, the N-ADL total score significantly improved between 30 days after the initiation of the intervention and 90 days after the initiation of the intervention (Tables 2, 3).

For the intervention group, there was a significant improvement in the NM scale scores and in the NM scale subscores for Interest, Volition, and Social relationships. There was a significant difference in the N-ADL scores between the two groups.

Secretory immunoglobulin A

For both the intervention group and the control group, the S-IgA levels decreased from pre-intervention to 30 days after the initiation of the intervention, but then increased at 90 days after initiation (Table 4). There was no significant change in the S-IgA levels between the two groups.

Table 3 Changes in the scale scores in the control group

	Control group (n = 19)		
Subscale	Pre-intervention	30 days after intervention initiation	90 days after intervention initiation
NPI-NH total score	7.63 ± 6.22	8.37 ± 7.27	8.58 ± 7.37
Delusions	0.63 ± 1.50	0.63 ± 1.54	0.68 ± 1.53
Hallucinations	0.16 ± 0.37	0.26 ± 0.93	0.11 ± 0.32
Agitation	1.58 ± 2.19	1.37 ± 1.89	1.37 ± 1.89
Depression/dysphoria	1.26 ± 1.63	1.32 ± 2.06	0.95 ± 1.65
Anxiety	1.32 ± 1.49	1.21 ± 2.04	1.00 ± 1.45
Euphoria/elation	0.00	0.11 ± 0.46	0.05 ± 0.23
Apathy/indifference	1.11 ± 2.13	1.21 ± 2.27	1.63 ± 2.67
Disinhibition	0.16 ± 0.50	0.26 ± 0.81	0.42 ± 1.12
Irritability/lability	0.53 ± 0.84	0.74 ± 1.24	1.16 ± 1.38
Aberrant motor behavior	0.89 ± 1.76	1.26 ± 2.62	1.21 ± 2.18
NM scale total score	31.11 ± 9.77	30.95 ± 9.56	30.00 ± 10.88
Housework and arrangement of personal belongings	4.68 ± 1.92	4.68 ± 1.92	4.68 ± 1.80
Interest, volition, and social relationships	6.05 ± 2.25	6.16 ± 2.24	5.53 ± 3.04
Conversation	7.42 ± 2.52	7.37 ± 2.48	7.26 ± 2.70
Memory	6.16 ± 2.14	6.05 ± 2.04	5.84 ± 2.61
Orientation	6.79 ± 2.30	6.68 ± 2.24	6.68 ± 2.24
N-ADL total score	37.68 ± 10.12	37.84 ± 9.87	37.21 ± 10.55

Values are the mean ± standard deviation. N-ADL, Nishimura Activities of Daily Living Scale; NM, Nishimura Mental State Scale for the Elderly; NPI-NH, Neuropsychiatric Inventory-Nursing Home version.

DISCUSSION

The present study evaluated the effects of progressive muscle relaxation in elderly persons with mild-to-moderate dementia in group home environments. Continuing the practice of progressive muscle relaxation tended to improve the NPI-NH scores, particularly for Anxiety and Agitation. In addition, there was a significant difference in the scores on Apathy and Irritability between the intervention group and the control group. The NM scale scores and N-ADL scale scores tended to be better in the intervention group; the NM scale's Interest, Volition, and Social relationships subscores improved in the intervention group, compared with the control group.

Characteristics of the participants

According to the Japanese Dementia Group Home Association (2010), the average age of residents in 2010 was 84.9 years; 81.8% of these were women. In this study, the participants were 2 years older on average than the national trend, but overall, the group was considered to be average. The Japanese Dementia Group Home Association reported that level 3 long-term care was most prevalent in this group, with 29.4% of the group home residents in Japan receiving such care. In this study, there were many residents receiving long-term care at level 1 and level 2 in both the intervention and the control group. As the participants had to be able to participate recreationally unaided to take part in

Table 4 Changes in the secretory immunoglobulin A (S-IgA) levels of the participants

	Intervention group (n = 18)			Control group (n = 19)		
Subscale	Pre-intervention	30 days after intervention initiation	90 days after intervention initiation	Pre-intervention	30 days after intervention initiation	90 days after intervention initiation
S-IgA	178.20 ± 129.72	122.16 ± 40.28	190.49 ± 127.42	123.47 ± 49.18	111.29 ± 56.11	138.79 ± 69.09

Values are the mean ± standard deviation.

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the study, it is likely that there was a selection bias toward patients with low-care needs.

Changes in the measures

Neuropsychiatric Inventory-Nursing Home version scores

The total NPI-NH score significantly improved in the intervention group following progressive muscle relaxation, which appeared to suppress BPSD. Progressive muscle relaxation aims to recreate a relaxed state and the perception of comfort, attenuation of habitual strain reactions, and to strengthen the relaxation response. Significantly better scores were observed on Agitation and Anxiety at both 30 and 90 days after the initiation of the intervention, which is consistent with research on progressive muscle relaxation for mental anxiety and physical tension (Koitabashi, 2001). In this study, a downward trend was observed for both the Agitation and Anxiety levels, as expected with this technique. Progressive muscle relaxation produces gradual relaxation and relief from stress and enhances coping ability in stressful situations (Molassiotis, 2000). The Progressively Lowered Stress Threshold model has been used for planning individualized care for elderly persons with dementia (Hall & Buckwalter, 1987) and this model can help to manage BPSD, control the factors related to stress, minimize catastrophic reactions, and improve the daily functions of patients with dementia (Suhr *et al.*, 1999). The present findings suggest that progressive muscle relaxation improved BPSD. This suggests that relaxation in elderly persons with dementia can change stress thresholds, relieve stress progressively, and reduce BPSD.

Nishimura Mental State Scale for the Elderly and Nishimura Activities of Daily Living Scale scores

There was a difference between the intervention group and the control group in the NM scale's total scores and a tendency for the scores in the intervention group to improve from pre-intervention to 30 and 90 days after the initiation of the intervention. For the NM subscales, there were differences between the intervention and the control groups on the Interest, Volition, and Social relationships scores and between the three time points (for the intervention group) following progressive muscle relaxation, suggesting different reactions in each group.

Takemura (2007) found that color therapy that was used for 60–90 min twice per month for nine group home residents did not cause postintervention improvement; however, it improved their housework, interest, conversation, and memory domains. The color therapy probably encouraged interaction (smiles, mutual recognition, and connection with others), resulting in a greater sense of security and confidence. It is believed that the Interest, Volition, and Social relationships scores improved because progressive muscle relaxation was carried out in a group setting within each unit. The participants had the opportunity to relax their muscles and decrease tension (Sun, Kang, Wang, & Zeng, 2013).

There was a significant improvement in the N-ADL scores between 30 days and 90 days after the initiation of the intervention. It is possible that the stress response decreased through the incorporation of progressive muscle relaxation into daily life, which improved the participants' mental health, relaxed their body, and helped in maintaining and improving ADLs. According to Norton, Malloy, and Salloway (2001), BPSD is associated with poorer ADL levels. Hence, the improvement in BPSD resulting from progressive muscle relaxation probably improved the ADL levels in the group home residents with dementia.

Secretory immunoglobulin A levels

No significant change was observed in the S-IgA levels between the two groups. According to Valdimarsdottir and Stone (1997), chronic stress can reduce the S-IgA level and progressive muscle relaxation is an effective way to increase it (Lowe, Bland, Greenman, Kirkpatrick, & Lowe, 2001). However, the participants' levels decreased 30 days after the initiation of the intervention in both the intervention and the control groups, before recovering to just above baseline at 90 days after the intervention's initiation. At pre-intervention, the levels for the intervention group were higher than those for the control group and therefore a greater decrease was observed in the former group. However, the S-IgA levels only decreased after progressive muscle relaxation in nine participants of the intervention group, making it difficult to determine causality. The results also were limited by the fact that the individual variation was large and there was a change in the individual comparison values between the groups. The S-IgA is a simple biochemical index of the stress response in elderly patients with dementia, which requires only a small amount of saliva (Sugiyama, 2011), thus decreasing the burden on participants. However, when used as an indicator, the saliva test should reflect both interindividual

and intra-individual variabilities (Sawada, Inamizu, Taitou, Sekikawa, & Kawaguchi, 2008). The present findings did not provide clear evidence of increases in S-IgA levels and immune system effects following progressive muscle relaxation in the elderly persons with dementia.

Implications for the care of patients with dementia in group homes

Incorporating progressive muscle relaxation into the daily recreational activities of patients with dementia in group home environments is useful and easily achieved. It was found that a daily routine of progressive muscle relaxation suppressed the appearance of BPSD and reduced anxiety and agitation.

In order to promote the continuation of progressive muscle relaxation and to motivate the participants, care workers need to develop methods of persuasion and promote the recreational and enjoyable aspects of the exercises. Sometimes, individual attention was given to a participant in order to concentrate their mind on the procedure. It was important to encourage the participation and cooperation of the group home staff members who were involved with the participants on a daily basis.

Limitations of the study

As a result of the group home staff, acting as evaluators, and the researchers who assigned the participants into the respective intervention and control groups, maintaining a double-blind study design was difficult. This could have affected the changes in the NPI-NH, NM scale, and N-ADL scores. As the intervention group members received an additional recreational activity, progressive muscle relaxation, they had a greater opportunity to communicate with the researchers and group home staff. The relationships between the participants and the group home staff and/or the researchers in this study might have affected the results. However, it is difficult to control the amount of communication in this type of intervention study.

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CONFLICTS OF INTEREST

No potential conflict of interest was disclosed.

AUTHOR CONTRIBUTIONS

S. I. conducted the whole study; Y. M. supervised the study process.

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