

Research Report

Effects of different horticultural activities on the mental stress of older people with dementia in Japan

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Objective: Horticultural activity has been found to reduce mental stress and affect psychosocial aspects of older people with dementia, but there is little information about which activities are most effective.

Methods: This study examined the effects of different horticultural activities in 13 older people with dementia, irrespective of previous horticultural experience, using level of salivary chromogranin A (CgA) before and after activity as an objective measure of stress.

Results: Horticultural activity reduced stress in all participants, but the effect differed depending on horticultural experience. The greatest reduction in stress in those with previous horticultural experience was from harvesting summer vegetables. Those without experience showed the greatest stress reduction after the first session of planting vegetables.

Conclusion: These findings have the potential to affect the design of activity programs for older people with dementia, including those without previous horticultural experience. Further work is needed to validate the findings in a larger sample.

Keywords: older people with dementia, horticultural activities, mental stress

Introduction

In recent years, the proportion of older people in the Japanese population has increased substantially. The government has introduced various policies promoting healthy lifestyles to prevent older individuals from developing dementia and becoming bedridden. Worldwide, the prevalence of dementia among those over 60 years old is estimated to be 3.9%¹⁾.

However, in 2012 Japan, the prevalence was estimated to be 15% among those aged over 65 years²⁾. Caring for older people with dementia has therefore become a serious social problem.

Psychiatric symptoms and behavioral disorders associated with dementia (known as behavioral and psychological symptoms of dementia [BPSD]) make the care situation even more difficult³⁾. BPSD are caused by physical and mental stress resulting from anxiety and discomfort. It is therefore necessary to provide appropriate care to reduce such stress⁴⁾.

Cerejeira et al⁵⁾, suggested that both drug and non-drug interventions may be necessary from an early stage in dementia patients. In Japan, alongside the development of therapeutic agents, various non-drug therapies have been introduced, including music therapy, reminiscence therapy and horticultural activity (HA). These aim to slow or prevent the progression of dementia. By providing opportunities for creative activities and self-expression, these therapies appear to have an effect on psychosocial aspects of dementia⁶⁾. In Japan, existing research on the effect of HA in older people with dementia⁷⁾⁻¹³⁾ has reported effects on psychosocial aspects, such as the opportunity for activities to demonstrate creativity and express themselves, release of aggressiveness and relaxation effect. However, observations of the presence or absence of mental stress of older people with dementia are difficult to make, and may be incorrect¹⁴⁾. While the benefits of HA are well known, the types of activity that provide the most benefit in reducing stress in those with and without previous horticultural experience have

not previously been explored.

So in this research we evaluated different HA using biochemical indicators to assess their impact on participants' state of mental stress. In addition, we defined in this paper "HA" as activities involving plants, focusing on supporting emotional and physical development¹⁵⁻¹⁷⁾ and social utility, particularly improved physical and mental health. The participants were actively involved, and all HA in this study were carried out in a group.

Methods

Subjects

The subjects were older people with dementia, residing in one of two similar nursing homes for older people included in this study. Staff selected participants among the residents aged 65 years or older, who had a diagnosis of dementia or with a level of more than II according to the "Criteria for determination of the daily life independence level of the elderly with dementia" created by Ministry of Health, Labor and Welfare of Japan. The type of dementia was not specified for this study. Study participants also had to be able to maintain a sitting position, and to use tools for horticultural tasks.

Intervention methods

To obtain patients' consent, and to assess their ability to perform ADL, their cognitive function, and the extent of their disease and symptoms, we used data collected from records at each facility. We also interviewed each participant to find out more about previous lifestyle, and to set individual HA goals.

One hour of HA was provided approximately twice per month as a recreational activity at the facility grounds. We planned the HA together with each facility's fixed staff. Each session included 10 people. Fixed staff and author managed each session with two or three staffs who working on that day. We used summer vegetables with which we expected the participants would be familiar.

In addition, we consulted with participants about plants that they would like to cultivate and we selected plants other than summer vegetables based on cultivation methods and timing. In total, we provided seven sessions after the introduction (Table 1). We prepared several contents for each session, so that participants could select the activity contents themselves.

The management of the HA was based on previous studies¹⁸⁾. To avoid alienating participants, we did not use questioning techniques. We were also conscious of the need to include all of the study participants, including those with no previous horticultural experience or with low cognitive function. Together with the facility staff, we managed each session and observed the participants. We focused on empowering the participants to ensure that they could be proactively involved in the activities.

Evaluation methods

To assess whether the program was effective in reducing mental stress, we evaluated the effect of each HA by measuring changes in the level of salivary chromogranin A (CgA). Samples were collected before and after each HA, using a recording sheet that also included details of each person's participation in the session.

Objective assessment of mental stress using CgA

We decided to use an objective measure CgA to avoid any misunderstanding or misinterpretation of behavior, because it is difficult to accurately assess the thoughts of older people with dementia¹⁴⁾. CgA¹⁹⁾ is used to measure sympathetic activity, including cortisol and catecholamine levels. It does not react to physical stress from exercise, but it can capture weak changes in stress levels. CgA gives an objective assessment of the level of mental stress, reduction of CgA value shows a decrease in mental stress. We measured the CgA value by collecting the saliva of all subjects at the same time, at the place where we gathered before and after each HA.

Eating and drinking was prohibited at least 30 minutes before CgA value measurement. Saliva samples were collected by chewing until softened two tampons that threaded cotton yarn to prevent an erroneous swallowing during saliva sampling. The collected samples were frozen preserved and sent to external specialist agency to analyze the CgA values.

We were able to use changes in CgA value during each session to understand each participant's state of mental stress, and evaluate the impact of a particular HA on an individual. Enjoyment of

Table 1. Details of the seven horticultural activities

Round	Activity content	Planting & sowing	Care of plants	Harvest
Introduction	Meeting together, introductions, decisions about what plants to grow during the program			
1	Planting of summer vegetables	○	○	
2	Care of summer vegetables, sowing of flowers and vegetables (Japanese mustard spinach and Hatsuka radish)	○	○	
3	Care of summer vegetables		○	
4	Care of summer vegetables, harvest of vegetables (Japanese mustard spinach and Hatsuka radish)		○	○
5	Planting of flowers, care of summer vegetables	○	○	
6	Harvest and care of summer vegetables, care of flowers		○	○
7	Harvest of vegetables, discussion (review and future plans)			○

HA can also be affected by previous horticultural experience; therefore, we also analyzed changes in CgA value according to previous horticultural experience (e.g., previous experience of growing or cultivating plants, including agricultural and horticulture work).

CgA values before and after each HA for each participant were recorded as a pair. Some specimens were shortage of saliva these were excluded from the analysis. We used the Wilcoxon signed-rank test to evaluate the variation in CgA value.

Teraoka et al.¹⁸⁾ showed that mental stress increased in those with level IV dementia as a result of HA. It is therefore possible that mental stress may vary by the degree of cognitive function. We aimed to examine the effect of HA on mental stress regardless of the degree of dementia. We therefore did not assess whether the degree of cognitive function affected mental stress.

Evaluation of psychosocial aspects, including participation

After each activity, we discussed with the staff each participant's facial expressions, behavior and comments throughout the session, as well as their overall attitudes towards participation. This information was recorded on an A4 sheet. The recording sheet was developed especially for this study and in order to record the participation status of each subject in each HA. We then extracted a description of the psychological and social situation of each participant from the sheet to evaluate the psychosocial aspects.

Ethical considerations

All the participants had dementia. Staff therefore described the aim of the research to participants and their families in writing and face-to-face. Signed consent to participate by participants or families was obtained before the start of the study. The explanation covered the duration of each session (about 60 minutes), and the process of checking mental and physical

condition. Participants were told that the resulting data would be used only for research purposes, that individuals would not be identified, and that data would be kept locked away. They were also told that results would be published as academic articles and conference presentations, and that the data would be shredded thereafter. Participants were told that they could withdraw from the study at any time.

Ethical approval for this study was obtained from Research Ethics Committee of Hiroshima University Graduate School of Health Sciences Division of Nursing Sciences (approval No. 240).

Results

Subjects

In total, 13 people (one man, 12 women) participated in HA. The participants ranged in age from 70 to 90 (mean age 86.9 ± 4.4 years), and the level of dementia ranged from I up to IV according to the "Criteria for determination of the daily life independence level of the elderly with dementia". In total, five of the remaining 13 participants had previous horticultural experience. Their targets and aims for the HA were different, but many were focused on the benefits of improved interaction with others.

Fluctuations in CgA measured before and after HA

Changes in CgA before and after each activity are shown in Table 2. There were three participants whose pre- and post-HA CgA was measurable at six sessions, three at seven sessions, five at five sessions, three at four sessions, and three at two sessions. CgA values were significantly reduced after the activity for all participants and all activities in the first session, planting of summer vegetables ($p < 0.05$). Regardless of whether they had horticultural experience, the participants were able to guess the names of the vegetables from the shape of the plant or the smell. We observed that they appeared engaged in the activity. Also, there were some cases in which the CgA values

increased. One person had an extremely high CgA values after a session, when she could not remember how to use scissors passed for harvesting. But in any of cases did not show behavioral and psychological symptoms after HA.

A significant difference in changes in CgA levels was seen between those with and without horticultural experience in the sixth session, which comprised harvest and care of summer vegetables, and care of flowers ($p < 0.05$). Those with horticultural experience expressed gratitude at being able to participate in HA, and enjoyed harvesting the vegetables. One person seemed to

derive satisfaction from conversation with others throughout the activity.

In those without horticultural experience, there was a significant reduction in CgA levels in the first session, involving planting of summer vegetables ($p < 0.05$). Some of the work in this session was difficult, but they were able to participate (e.g., cleaning up after the activity). Two of the participants without horticultural experience, CgA value was reduced at all times that could be measured. In addition, we noted that one person, who has a tendency to go to the bathroom and not return when her interest faded, returned quickly from the bathroom and worked

Table 2. CgA values measured before and after each activity (pmol/ml) (— : absent)

Subject (number of sessions attended)	Round	1st		2nd		3rd		4th		5th		6th		7th	
		pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
Horticultural experience	A (6)	Unmeasurable		1.861	1.799	1.317	2.922	—		1.363	1.626	2.841	2.212	2.277	3.417
	B (5)	—		3.011	8.662	16.486	2.545	4.749	6.412	—		10.353	10.296	4.671	4.366
	C (7)	Unmeasurable		10.38	5.312	12.088	3.430	2.113	2.080	3.008	9.156	18.055	2.152	3.646	1.788
	D (6)	1.123	0.529	Unmeasurable		0.833	0.341	—		0.370	0.399	1.759	1.170	Unmeasurable	
	E (7)	4.693	2.355	2.363	2.143	2.075	1.474	2.064	2.081	1.987	1.319	3.896	3.837	2.687	2.344
No horticultural experience	F (6)	3.117	1.692	4.760	2.426	—		6.338	3.635	10.960	4.585	6.055	4.900	4.907	1.855
	G (7)	2.015	1.742	3.646	2.575	4.568	1.899	2.631	5.109	2.447	2.394	2.186	2.735	1.863	0.603
	H (7)	Unmeasurable		2.277	2.211	Unmeasurable		5.789	3.569	Unmeasurable		Unmeasurable		Unmeasurable	
	I (7)	3.285	1.083	2.698	2.040	1.149	0.521	1.288	1.053	2.385	1.937	Unmeasurable		2.394	3.100
	J (7)	Unmeasurable		9.811	9.273	Unmeasurable		2.065	5.291	3.449	3.990	11.678	5.284	5.125	4.606
	K (7)	Unmeasurable		6.345	4.287	Unmeasurable		14.211	8.551	2.581	5.297	17.263	41.738	14.022	10.365
	L (7)	1.316	1.041	1.678	2.477	2.805	3.429	1.638	2.116	3.224	1.065	1.096	2.268	2.099	2.156
	M (5)	1.994	1.647	2.503	2.519	2.230	1.433	3.842	2.800	—		4.564	3.031	—	
p-value* (all subjects)		0.02 [†]		0.14		0.11		0.72		0.88		0.29		0.06	
Horticultural experience p-value*		0.18		0.72		0.23		0.59		0.47		0.04 [†]		0.47	
No horticultural experience p-value*		0.04 [†]		0.09		0.14		0.58		0.60		0.92		0.08	

* : Wilcoxon signed-rank test † : $p < 0.05$

until the end of the session.

Status of the participants during HA

We observed and recorded facial expressions, attitudes toward participation, and patients' comments and actions (i.e., "planting and sowing", "care of plants" and "harvesting"; Table 3) during the sessions.

Planting and sowing

At the HA of planting and sowing seeds, participants were observed to be active regardless by the presence/absence of horticultural experience. Those with horticultural experience spent time explaining the names and cultivation methods of vegetables. Some of those without experience guessed the name of the vegetables from the shape of the leaves, or from the smell – saying, for example, "It smells like tomato". Others talked about memories of having flowers in the house. All the participants were observed to be working, or trying to work.

Care of plants

Those with horticultural experience participated happily, and showed others how to work with the plants. They clearly enjoyed talking to others. Those without experience enjoyed talking to others, watching how they worked, and looking at the flowers. Some seemed comfortable sitting without working, but others seemed distracted, stating that they wanted more work or going to the restroom and not returning.

All of the participants seemed to enjoy caring for plants, and commented on their growth. Those with experience tended to comment differently. For example, one experienced person said "Don't pick the tomato leaves like that." Inexperienced participants commented "Watering will make the soil firm", and "[The staff] you will be tired after this" or asked the staff "May I pull out the grasses around here?". They seemed to be looking for things to do, but did not comment on care methods.

Those with horticultural experience focused on work like disbudding, and often did it without advice. Those without experience could either imitate others, or follow the advice from the staff. Those without experience did not do any work on thinning buds, but were able to do some watering and weeding, or they conversed with others in the group.

Harvesting

Those with horticultural experience seemed to enjoy the harvest, but those without experience seemed to value the chance to chat with others more. Those with horticultural experience were grateful to be involved, and one person inquired about the cost and the next activity. They also told stories about their previous horticultural experience, recalling memories and knowledge. Among those without experience, there were some who never mentioned any specific plants, although most talked about specific plants that they wanted to grow.

Those with horticultural experience were able to harvest using secateurs. Those without experience did not know how to use them, but could harvest tomatoes with the staff or arrange flowers in a vase.

Discussions

Effective HA to reduce mental stress

Overall, changes in CgA values and the status of the participants during the activity, suggest that HA could reduce mental stress, regardless of whether the participants had previous horticultural experience. This is consistent with the results of Yasukawa et al.²⁰⁾.

We found, however, that there was a significant difference in stress levels in those with horticultural experience in the sixth session, harvesting vegetables. Those without experience seemed to derive the most benefit from the first session. This suggests that different HA may be necessary to reduce mental stress in those with and without previous horticultural experience.

Reducing the mental stress of those with horticultural experience

The most significant difference in CgA value seemed to be in the sixth session, on harvesting and caring for plants. The same broad categories of activity were carried out in the fourth session, but no significant difference was seen then. Tamaki et al.⁷⁾ reported that people prefer to discuss rice and vegetables than flowers and herbs. It may therefore be that harvesting familiar summer vegetables was more effective in reducing stress in those with horticultural experience than flowers or vegetables that could be grown easily. Okamoto et al.²¹⁾ reported that prediction of the reward reduce stress. Therefore, we thought that sowing and harvest to lead prediction of the reward, reduce stress. We also noticed that many of those with horticultural experience actively enjoyed harvesting vegetables. We therefore considered that harvesting was more effective in reducing mental stress than the care process.

Effective HA to reduce mental stress in those without horticultural experience

Those without horticultural experience showed a significant difference in CgA value during the first session. They were observed to look at the shapes of leaves and to smell them in order to identify the vegetables. Wada²²⁾ reported that older people with Alzheimer's disease often remembered events from the past by smell, often leading them into a lively conversation. In planting summer vegetables, and guessing the vegetable from the smell, they may have recalled memories, helping to reduce their stress levels.

Limitations and challenges of this study

This study had only a few participants, so generalization is difficult. We found that some participants without horticultural experience, CgA values were reduced at all HA that could be measured. Therefore, we considered that it is necessary to examine the influence, not only the presence/absence of horticultural experience

but also the participants' individuality, degree of ability to use tools such as IADL (Instrumental Activities of Daily Living) and staffs' intervention methods. In addition, we want to consider how to interpret the value when the CgA values increase, duration of effect on HA's mental stress, changes before HA introduction and after all sessions. In the future, we will further accumulate the sample, we want to explore effective HA for reducing mental stress in older people with dementia.

Conclusion

This study examined the effectiveness of different types of HA in reducing the mental stress of older people with dementia. We found that:

- 1) In those with horticultural experience, CgA value was reduced significantly by harvesting summer vegetables.
- 2) In those without horticultural experience, CgA value was reduced significantly by planting summer vegetables.
- 3) During planting and sowing activities, participants all worked actively, regardless of their level of previous horticultural experience.
- 4) In caring for plants, those with horticultural experience could work without advice. Those without experience watched others or listened to the explanation provided.
- 5) Those with horticultural experience were able to harvest using secateurs, and enjoyed the harvesting activity. They told stories about their previous experiences. Those without experience did not know how to use secateurs, and therefore assisted staff with other aspects of the HA.

Our findings suggest that HA reduce the mental stress of older people with dementia, regardless of whether they have any previous horticultural experience. Different activities had different effects depending on experience. In particular, planting summer vegetables reduced stress in those without previous horticultural experience, and harvesting summer vegetables had a greater

effect on those with previous experience.

We suggest this study can contribute toward the design of recreational programs in facilities for older people with dementia.

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