The Psychological Changes of Horticultural Therapy Intervention for Elderly Women of Earthquake-Related Areas

Yuka Kotozaki*
Smart Ageing International Research Center, Institute of Development, Aging, and Cancer, Tohoku University, Sendai, Japan

Abstract

Despite the passage of time, some people who experienced the Great East Japan Earthquake are still living with the emotional trauma and stress. We provided horticultural therapy as an intervention to 39 elderly women with earthquake stress living in the affected areas of the coastal areas of the Great East Japan Earthquake. The participants were divided into two groups, an intervention group (n=20) and a control group (n=19). The intervention group underwent eight weeks of horticultural intervention. On the other hands, the control group underwent eight weeks of stress control education. After two months of horticultural therapy intervention, the Clinician-Administered PTSD Scale (CAPS) total score, Geriatric Depression Scale (GDS) score, the Posttraumatic Growth Inventory (PTGI-J) score, and the WHO Quality of Life 26 (WHO-QOL26) score in the intervention group improved significantly, and salivary cortisol level in the intervention group also improved significantly. After follow up, CAPS score, GDS score, PTGI-J score, and WHO-QOL26 score (psychological QOL score, social QOL score, environmental QOL score, and global QOL score), and salivary cortisol level in the intervention group were improved or almost the same as the post-intervention scores in the intervention group. These findings suggest that horticultural therapy has an effect on the symptoms of earthquake stress in elderly women, and that this effect may sustain.

Keywords: Earthquake; Earthquake-related stress; Horticultural therapy; Intervention; Elderly women

Introduction

The Great East Japan Earthquake that occurred on March 11, 2011 was the earthquake and tsunami of the largest in the earthquake that occurred in Japan. Despite the passage of time, some people living of the Pacific coast of Tohoku have complained about the mental and physical condition such as insomnia and anxiety. This means that some people who experienced the Great East Japan Earthquake are still living with the emotional trauma and stress. Previous studies report that prevalence of Posttraumatic Stress Disorder (PTSD) ranging from approximately 5 percent to 60 percent is seen in the first 1-2 years after a disaster [1,2]. It suggest that mental health problems of survivors are most evident a certain amount of time after a disasters [3]. Additionally, previous studies reported about mental health problems after disaster. It is often the case that important question of medium- to long-term psychological care for the people who live in the disaster area. In this study, as a method of medium- to long-term psychological care for them, we focused on the horticultural therapy.

Horticultural Therapy (HT) is a psychological care method for Post-Traumatic Stress Disorder (PTSD) that was developed in the United States for the psychological care and social rehabilitation of disabled soldiers and war veterans with PTSD symptoms after World War II [8]. HT interventions are led by professionals trained to incorporate the use of plants and horticultural education into rehabilitation therapies [8]. The therapy in a group setting improves the participant’s communication skills through collaborative horticultural activities [8]. It has been reported that participants begin to identify with plant growth, regain health and motivation. Through such experiences and their association with nature, participants are thought to experience improvement [9]. It has mainly been developed for elderly adults and people with disabilities [10,11].

Previous studies suggested that HT and exposure to nature can have cognitive [12,13], psychological [13-17], social [18,19], and physical [20] benefits. It also suggested that HT has a positive effect on physiological factors, such as heart rate and salivary cortisol levels [20]. Previous HT studies have utilized psychological measures and observational data. Recently, the study on the effects of HT for earthquake stress reported by our group [21]. However, the person targeted for the study was an adult woman and was not able to examine the elderly woman. Previous studies suggest that women are easy to feel anxiety of post-disaster than men [21] and Women are more likely than men to have PTSD after natural disasters [22-25], and low social support is associated with a higher likelihood of PTSD [26,27]. Other studies reported that the elderly people were more likely to develop PTSD and general psychiatric morbidity compared with the young people [25,28-30]. We performed an experimental study aimed at elderly woman from 60 to 75 years old because there was no study of effect verification of horticultural therapy for elderly woman who live in disaster area. We hypothesize that HT may help elderly women with earthquake-related stress improve their mental and physical functioning affected due to the traumatic experience.

The purpose of this study was to verify the reduction in the symptoms of earthquake-related stress in elderly women who live in disaster areas of the Pacific coast through HT intervention using psychological measures and salivary cortisol level. Additionally, we investigated the effect of HT on the symptoms of earthquake-related

*Corresponding author: Yuka Kotozaki, Smart Ageing International Research Center, Institute of Development, Aging and Cancer, Tohoku University, 4-1 Seiryomachi, Aoba-ku, Sendai 980-8575, Japan, Tel: +81 (0) 22 717 7988; E-mail: kotoyuka@idac.tohoku.ac.jp

Received November 30, 2013; Accepted December 23, 2013; Published December 26, 2013


Copyright: © 2013 Kotozaki Y. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
stress and the maintenance of its effect after a two-month Follow-Up (FU) period using psychological measures and salivary cortisol level.

**Methods**

**Participants**

The participants were women aged 60-75 years old who were residents of the coastal areas of Miyagi Prefecture and had experienced the Great East Japan Earthquake of March 11, 2011. They were recruited through newspaper advertisements distributed in the earthquake-affected areas, to which 100 residents of the coastal areas (from Kesennuma City to Watari town) responded. These 100 applicants were screened for PTSD using a combination of the Mini-International Neuropsychiatric Interview (M.I.N.I.) [31,32] and the Clinician-Administered PTSD Scale (CAPS) [33-35]. In the CAPS, the F1/2 method was used for evaluation, with applicants regarded as symptomatic if they scored ≥ 1 on frequency and ≥ 2 on intensity. After the exclusion of 61 applicants who had no PTSD symptoms and a CAPS score of ≥ 40, 39 healthy, right-handed elderly women participated in this study as part of our ongoing project to investigate the associations between brain structure and mental health. All participants who took part in this study also participated in our interventional studies and underwent psychological measures and MRI scans that are not described in this study but were performed together with those described in this study.

All participants were diagnosed with a symptom of PTSD on the M.I.N.I., and they had one to two symptoms of all three PTSD symptom clusters, including re-experiencing the event, avoidance, and hyperarousal. The CAPS and M.I.N.I. were administered before and after the intervention and FU. This study was approved by the Research Ethics Committee of Tohoku University Graduate School of Medicine after an ethical screening.

**Horticultural intervention (Intervention group):** The HT intervention was designed in collaboration with a horticultural therapist and clinical psychologists. This intervention comprised a total of eight weekly sessions (60 min each) at a university lab and 15 minutes per day at participants’ homes. The sessions at a university lab were comprised of interactive lectures and practical horticultural training. The participants then attended six horticultural lessons, including topics such as designing a garden planter, seeding, watering, weeding, and picking flowers. Participants filled out an HT intervention session checklist after each session as a self-assessment. Participants took care of plants for 15 min per day at their convenience with horticulture kits provided by the experimenters, and recorded the completion of this task daily on forms provided by the experimenters at the intervention sessions. The participants submitted these forms to the experimenters at the HT intervention session each week.

**Stress control education intervention (Control group):** The SE intervention session was a 60-minute session consisting of a lecture regarding stress education, and it was managed by psychological tester studied psychology in college as a whole-time teacher of this intervention. The participants in the control group attended the SE intervention sessions once each week (a total of eight lessons). The video series used in the SE intervention sessions taught participants about the human body, such as stress mechanisms, psychology, and stress management. Participants filled out an SE intervention session checklist after each session. The 2nd session and the 6th session of the HT intervention session and the SE intervention session used the same teaching aid.

**Follow-up (Intervention group):** At the end of the two-month horticultural intervention, the participants allocated to the intervention group entered a two-month FU period. During this period, they did not receive any specific instructions from the investigators and were asked to lead their normal lives.

**PTSD screening: M.I.N.I. and CAPS**

In this study, structured interviews, M.I.N.I. and CAPS, were performed by three psychologists who underwent training before carrying out the actual interviews.

**Psychological measures:** The following questionnaires were administered three times (pre-intervention, post-intervention, and FU): (a) short version of the Geriatric Depression Scale (GDS) [36,37], (b) the Posttraumatic Growth Inventory (PTGI) [38,39], (c) the World Health Organization Quality of Life 26 instrument questionnaire (WHO-QOL26) [40]. We used the Japanese version of these psychological measures.

**Saliva sampling**

We collected saliva samples from participants to measure the salivary cortisol levels. Distressing psychological stimuli are associated with an increased cortisol level [7,41]. In consideration of the participants’ circadian cortisol rhythms, we collected all saliva samples...
at 4:00 p.m. on weekdays both before and after the intervention. We selected 4:00 p.m. because humans are less affected by circadian cortisol rhythms at this time of day [42]. Participants were asked to refrain from drinking, eating, and exercising [43] for two hours before saliva sampling. This method was same method as our previous studies [7,21].

**Measure of salivary cortisol:** To assess physiological stress, we used the same technique to measure salivary cortisol as described in a previous study [7,21]. Saliva samples were collected using the salivette apparatus (Sarstedt, Nümbrecht, Germany). We stored the supernatant solutions in airtight containers at -80°C and measured salivary cortisol using the solutions. We measured salivary cortisol with a semi-microcolumn high-performance liquid chromatography (HPLC) system (Shiseido, Tokyo).

**Analytical methods**

The psychological and salivary data were analyzed using the PASW statistical software package (ver. 18 for Windows; SPSS Inc., Chicago, IL, USA). Demographic and clinical data were subjected to the one-way analyses of variance. The one-way analyses of covariance (ANOVA) were conducted with the differences between the pre- and post-intervention scores included as dependent variables and pretest scores as covariates of each psychological measure. Because our primary endpoint of interest was the beneficial effect of intervention training, test-retest changes were compared between the intervention and control groups using one-tailed tests (p<0.05), in the same manner as in previous studies [7,21].

Moreover, changes in the intervention group were confirmed by the analysis of variance of psychological measure scores and salivary cortisol level at three points (pre-intervention, post-intervention, and FU) using repeated-measures ANOVA. A post hoc analysis was carried out by using the Bonferroni’s multiple comparison. The significance was established at a level of p<0.05.

**Results**

**Comparison of an intervention group with a control group (Pre vs. Post)**

**Psychological measures:** The demographic and clinical data for the study participants are given in Table 1. The age and Clinician-Administered PTSD Scale (CAPS) scores did not differ significantly between the intervention group and control group. Comparisons of the psychological changes before and after the intervention between the two groups are shown in Table 2. The intervention group was a significant decrease in the post-intervention CAPS score [1,37] (F= 4.47, p<0.05), and the GDS score [1,37]=5.12, p<0.05) compared with the control group. The intervention group also showed a significantly improve in the post-intervention Posttraumatic Growth Inventory (PTGI)-J total scores (F[1,37]=6.36, p<0.01), WHO-QOL26 Psychological score (F[1,37]=5.95, p<0.01), WHO-QOL26 Social score (F[1,37]=8.96, p<0.01), WHO-QOL26 Emotional score (F[1,37]=4.46, p<0.05), and WHO-QOL26 Global score (F[1,37]=10.98, p<0.001) compared with the control group.

**Salivary cortisol level:** The results of comparisons of salivary cortisol levels measured pre- and post-intervention are shown in Table 2. The intervention group was a significant decrease in salivary cortisol [1,37] (F= 4.83, p<0.05), indicating a reduction of stress in this group compared with the control group.

**Psychological changes of an intervention group (The effectiveness of HT intervention)**

**Psychological measures:** Changes in the various psychological measures of the intervention group are shown in Table 3. CAPS scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant [F(2,38)=78.73, p<0.001]. The Bonferroni’s multiple comparison showed a significant decrease in the post-intervention score compared with the pre-intervention score (p<0.001), with the FU score also significantly lower than the pre-

![Table 1: Baseline demographic and clinical data of the participants.](image1)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Intervention group</th>
<th>Control group</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean: 65.15</td>
<td>Mean: 67.21</td>
<td>0.158</td>
</tr>
<tr>
<td>SD: 3.65</td>
<td>5.18</td>
<td>4.83</td>
<td>0.351</td>
</tr>
<tr>
<td>CAPS score</td>
<td>23.50</td>
<td>21.84</td>
<td></td>
</tr>
<tr>
<td>SD: 6.03</td>
<td>21.84</td>
<td>4.83</td>
<td></td>
</tr>
</tbody>
</table>

*One-way analysis of variance.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPS score</td>
<td>23.50</td>
<td>6.03</td>
<td>6.60</td>
<td>5.25</td>
<td>21.84</td>
<td>4.83</td>
<td>0.05</td>
</tr>
<tr>
<td>GDS score</td>
<td>3.25</td>
<td>3.37</td>
<td>1.85</td>
<td>2.06</td>
<td>3.11</td>
<td>2.64</td>
<td>0.16</td>
</tr>
<tr>
<td>PTGI total score</td>
<td>66.35</td>
<td>66.37</td>
<td>75.95</td>
<td>64.26</td>
<td>6.86</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>WHO-QOL26 Physical QOL score</td>
<td>3.34</td>
<td>3.04</td>
<td>3.46</td>
<td>0.53</td>
<td>3.04</td>
<td>0.49</td>
<td>0.010</td>
</tr>
<tr>
<td>Psychological score</td>
<td>3.11</td>
<td>3.04</td>
<td>3.46</td>
<td>0.53</td>
<td>3.04</td>
<td>0.49</td>
<td>0.010</td>
</tr>
<tr>
<td>Social score</td>
<td>3.37</td>
<td>3.37</td>
<td>3.73</td>
<td>0.55</td>
<td>3.23</td>
<td>0.68</td>
<td>0.003</td>
</tr>
<tr>
<td>Environmental score</td>
<td>2.92</td>
<td>2.80</td>
<td>3.31</td>
<td>0.48</td>
<td>2.72</td>
<td>0.68</td>
<td>0.021</td>
</tr>
<tr>
<td>Global score</td>
<td>3.19</td>
<td>3.07</td>
<td>3.43</td>
<td>0.30</td>
<td>2.98</td>
<td>0.36</td>
<td>0.001</td>
</tr>
<tr>
<td>Salivary cortisol level</td>
<td>2.29</td>
<td>2.49</td>
<td>1.53</td>
<td>1.63</td>
<td>3.44</td>
<td>2.28</td>
<td>0.025</td>
</tr>
</tbody>
</table>

*One-way analyses of covariance with pre–post differences in psychological measures as dependent variables and pre-intervention scores as covariates (one-tailed).

**Table 2: Psychological measures pre- and post-intervention.**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPS score</td>
<td>23.50</td>
<td>6.03</td>
<td>6.60</td>
<td>5.25</td>
<td>21.84</td>
</tr>
<tr>
<td>GDS score</td>
<td>3.25</td>
<td>3.37</td>
<td>1.85</td>
<td>2.06</td>
<td>3.11</td>
</tr>
<tr>
<td>PTGI total score</td>
<td>66.35</td>
<td>66.37</td>
<td>75.95</td>
<td>64.26</td>
<td>6.86</td>
</tr>
<tr>
<td>WHO-QOL26 Physical QOL score</td>
<td>3.34</td>
<td>3.04</td>
<td>3.46</td>
<td>0.53</td>
<td>3.04</td>
</tr>
<tr>
<td>Psychological score</td>
<td>3.11</td>
<td>3.04</td>
<td>3.46</td>
<td>0.53</td>
<td>3.04</td>
</tr>
<tr>
<td>Social score</td>
<td>3.37</td>
<td>3.37</td>
<td>3.73</td>
<td>0.55</td>
<td>3.23</td>
</tr>
<tr>
<td>Environmental score</td>
<td>2.92</td>
<td>2.80</td>
<td>3.31</td>
<td>0.48</td>
<td>2.72</td>
</tr>
<tr>
<td>Global score</td>
<td>3.19</td>
<td>3.07</td>
<td>3.43</td>
<td>0.30</td>
<td>2.98</td>
</tr>
<tr>
<td>Salivary cortisol level</td>
<td>2.29</td>
<td>2.49</td>
<td>1.53</td>
<td>1.63</td>
<td>3.44</td>
</tr>
</tbody>
</table>

*One-way analyses of covariance with pre–post differences in psychological measures as dependent variables and pre-intervention scores as covariates (one-tailed).

HT: Horticultural Therapy; SE: Stress Education; SD: Standard Deviation; CAPS: Clinician-Administered Post-Traumatic Stress Disorder Scale; GDS: Geriatric Depression Scale; PTGI: Posttraumatic Growth Inventory; WHO-QOL26: World Health Organization Quality Of Life 26
intervention score ($p<0.001$) and post-intervention score ($p<0.01$), confirming that this effect was sustained. GDS scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant $[F(2,38)=8.70, p<0.01]$. The Bonferroni’s multiple comparison showed a significant lower in the post-intervention score compared with the pre-intervention score ($p<0.05$), with the FU score also significantly lower than the pre-intervention score ($p<0.05$), confirming that this effect was sustained. WHO-QOL26 psychological QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant $[F(2,38)=16.10, p<0.001]$. The Bonferroni’s multiple comparison showed a significant higher in the post-intervention score compared with the pre-intervention score ($p<0.01$), with the FU score also significantly higher than the pre-intervention score ($p<0.001$) and post-intervention score ($p<0.01$), confirming that this effect was sustained. WHO-QOL26 psychological QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant $[F(2,38)=13.20, p<0.001]$. The Bonferroni’s multiple comparison showed a significant higher in the post-intervention score compared with the pre-intervention score ($p<0.01$), with the FU score also significantly higher than the pre-intervention score ($p<0.001$) and post-intervention score ($p<0.05$), confirming that this effect was sustained. WHO-QOL26 psychological QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant $[F(2,38)=8.27, p<0.01]$. The Bonferroni’s multiple comparison showed a significant higher in the post-intervention score compared with the pre-intervention score ($p<0.01$), with the FU score also significantly higher than the pre-intervention score ($p<0.01$). WHO-QOL26 environmental QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant $[F(2,38)=11.43, p<0.001]$. The Bonferroni’s multiple comparison showed a significant higher in the post-intervention score compared with the pre-intervention score ($p<0.01$), with the FU score also significantly higher than the pre-intervention score ($p<0.01$).

Salivary cortisol level: Changes in salivary cortisol level in the intervention group are shown in Table 3. The main effects was significant $[F(2,38)=3.31; p<0.05]$. The Bonferroni’s multiple comparison showed that the post-intervention cortisol level was significantly lower than the pre-intervention cortisol level ($p<0.05$).

Discussion

The purpose of this study was to verify the reduction in the symptoms of earthquake-related stress in elderly women who live in disaster areas of the Pacific coast through HT intervention using psychological measures and salivary cortisol level, and to investigate the effect of HT on the symptoms of earthquake-related stress and the maintenance of its effect after a two-month follow-up period. The present study revealed that HT intervention affected the psychological changes and salivary cortisol level in elderly women with earthquake-related stress and psychological effects remain effective over a period. These results are consistent with our hypothesis that HT may help elderly women with earthquake-related stress improve their mental and physical functioning affected due to the traumatic experience.

The intervention group showed improved CAPS scores, indicating that HT reduced PTSD symptoms. Also, this effect is sustained for a certain period. This finding was similar results to a previous study [21] and will extend the previous findings of the effect of HT on severe PTSD, by showing its efficacy with elderly women with earthquake-related stress.

In the results of other psychological measures, the intervention group was improved GDS score, PTGI total scores, WHO-QOL26 score (psychological score, social score, environmental score, and global score), and salivary cortisol levels after HT intervention, indicating that HT reduced stress levels. This finding was related to salivary stress level are consistent with previous studies [20,21,44]. The intervention group showed improved GDS scores, indicating that HT decrease elderly depression. There are several HT studies for the elderly depression [45-47] and these studies reported that HT may reduce depression and stress. By our result, GDS score of intervention group decreased after HT intervention and GDS score almost sustained after FU. In other words, it is believed that HT is a method to improve a depression.

The intervention group showed improved PTGI-J scores, indicating that HT increased Posttraumatic Growth (PTG). The result of our previous horticultural intervention study reported PTGI total score in intervention group was improved and there is persistence of the effects for a certain period [21]. Previous study of PTG process suggests that people suffer emotional pain due to disruptions of their personal growth resulting from traumatic experiences [41]. However, people use PTG to cope in diverse ways, such as remembering their status before the event, referring to their own personality characteristics, relying on the support of others, and self-disclosing their own experiences with the negative event [48,49]. Previous study suggests that horticulture activity involves instinctive and creative action and leads to improvement of humanity [50]. Taking into consideration the factors mentioned above, it may be said that PTG and horticulture share a key feature. We think that participants of this intervention felt their own growth overlap with the growth process of the plant while cultivating the plants during two months. Additionally, this effect is sustained after FU periods. We also think that the result of PTG was reflected a psychological effect because horticulture work in our HT intervention was included fulfillment, pleasure, challenges, and a sense of accomplishment using plants such as flower and seedlings.

The intervention group showed improved WHO-QOL26 scores (psychological QOL score, social QOL score, environmental QOL score, and global QOL score) indicating that HT increased QOL.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTGI total</td>
<td>66.35</td>
<td>16.17</td>
<td>75.95</td>
<td>8.06</td>
<td>80.65</td>
<td>7.67</td>
</tr>
<tr>
<td>WHO-QOL26 Physical QOL score</td>
<td>3.34</td>
<td>0.44</td>
<td>3.21</td>
<td>0.46</td>
<td>3.20</td>
<td>0.46</td>
</tr>
<tr>
<td>Psychological score</td>
<td>3.11</td>
<td>0.30</td>
<td>3.48</td>
<td>0.53</td>
<td>3.59</td>
<td>0.41</td>
</tr>
<tr>
<td>Social score</td>
<td>3.37</td>
<td>0.36</td>
<td>3.73</td>
<td>0.55</td>
<td>3.75</td>
<td>0.47</td>
</tr>
<tr>
<td>Environmental score</td>
<td>2.92</td>
<td>0.48</td>
<td>3.31</td>
<td>0.48</td>
<td>3.36</td>
<td>0.48</td>
</tr>
<tr>
<td>Global score</td>
<td>3.19</td>
<td>0.24</td>
<td>3.43</td>
<td>0.30</td>
<td>3.42</td>
<td>0.30</td>
</tr>
<tr>
<td>Salivary cortisol level</td>
<td>2.29</td>
<td>2.45</td>
<td>1.53</td>
<td>1.63</td>
<td>1.66</td>
<td>1.62</td>
</tr>
</tbody>
</table>
During the preparation of the intervention program. This study was supported by Mr. Misaki Chiba for assisting with psychological testing. We also appreciate the Sato, Ms. Kana Ohkiri, Ms. Ayumi Goto, Ms. Rei Takamatsu, Ms. Mayu Fujita, and In addition, the authors thank Ms. Satomi Nishiyama, Ms. Ayaka Sato, Ms. Mio Development, Ageing, and Cancer and in Tohoku University for their support.

1. Hope that it spread HT as a psychological support over the medium to long term in the natural disaster areas.

2. In conclusion, this study suggests that HT improve earthquake-related stress such as depression of elderly women who live in disaster area of the Great East Japan earthquake and the psychological effects of HT was sustained. We believe HT may be able to suggest the possibility is one of the effective interventions for earthquake-related stress. We hope that it spread HT as a psychological support over the medium to long term in the natural disaster areas.

Acknowledgements

We thank study participants and all of our colleagues in Institute of Development, Ageing, and Cancer and in Tohoku University for their support. In addition, the authors thank Ms. Satomi Nishiyama, Ms. Ayaka Sato, Ms. Mio Sato, Ms. Kana Ohkiri, Ms. Ayumi Goto, Ms. Rei Takamatsu, Ms. Mayu Fujita, and Mr. Misaki Chiba for assisting with psychological testing. We also appreciate the contribution of Mrs. Taeko Shishido, a horticultural therapist who provided advice during the preparation of the intervention program. This study was supported by a Grant-in-Aid for Young Scientists (B) (KAKENHI 24730586) from the Ministry of Education, Culture, Sports, and Science to Dr. Y.K.

References


