画像を撮像した．MRI撮像はPhilips社の3.0テスラ・インテラ・アチーバにて行った．MPRAGE（Magnetization-Prepared Rapid Acquisition with Gradient Echo）シーケンス（240 × 240 matrix, repetition time＝6.5 ms, echo time＝3 ms, field of view＝24 cm, 162 slices, 1.0 mm slice thickness）によるT1強調画像，およびスピン・エコーEPIシーケンス（TE＝55 ms, FOV＝22.4 cm，2 × 2 × 2 mm^3 voxels, 60 slices）による拡散強調画像（32軸，b value=1,000s/mm^2）を用いて，脳白質統合性の指標となる拡散異方性（fractional anisotropy；FA）を算出した．

心理尺度としてPTSD臨床診断面接尺度（CAPS）[1]にてPTSD症状を，State Ttrait Anxiety Inventory（STAI）[14]を用いて状態／特性不安を評価した．さらに，精神疾患の合併の有無を精神疾患簡易構造化面接法（MINI）[17]で評価した．被験者のCAPSスコアは最大39点であり，MINIにおいてもPTSDの診断基準を満たすものは認めなかった．

T1強調画像の前処理には，VBM2[8]を使用し，脳画像統計解析には統計画像解析ソフトSPM5を使用した．前処理では，脳灰白質，脳白質，脳脊髄液腔の各分画を作成し，脳灰白質量を算出した．さらに，空間的標準化，半値幅8 mmで画像平滑化を行った．CAPSスコアを従属変数と，震災前の脳灰白質量および震災前後の脳灰白質変化量を独立変数とした重回帰分析解析を行った．共変量として，被験者の性別，全脳体積，震災前後の撮像間隔（日）を補正した．震災前の脳灰白質量と震災後のCAPSスコアが負相関を示す脳部位を震災後PTSD症状の脆弱性因子の神経基盤として，震災前後の脳灰白質量の変化量と震災後のCAPSスコアが正相関を示す脳部位を震災後PTSD症状の獲得因子として評価した．脳画像解析は各関心領域内（海馬，扁桃体，前帯状皮質，眼窩前頭皮質）での多重比較補正（スモール・ボリューム・コレクション；SVC）[25]を行い，統計閾値はp＝0.05とした．

拡散強調画像により算出したFAに関しても，SPM5を用いた脳画像統計解析を行った．空間的標準化，半値幅10 mmで画像平滑化を行った．状態不安スコアを従属変数と，震災前の脳灰白質量および震災前後の脳灰白質変化量を独立変数とした重回帰分析解析を行った．共変量として，被験者の性別，震災前後の撮像間隔（日）を補正した．震災前の脳灰白質量と震災後の状態不安スコアが負相関を示す脳部位を震災後不安症状の脆弱性因子の神経基盤として，震災前後の脳灰白質量の変化量と震災後の状態不安スコアが正相関を示す脳部位を震災後不安症状の獲得因子として評価した．脳画像解析は，全脳での検定を行い，多重比較補正はクラスターサイズによる補正を行い[6]，統計閾値はp＝0.05とした．

倫理的手続き

本研究は，東北大学大学院医学研究科倫理委員会の承認を得ている．また，ヘルシンキ宣言に則り，口頭および書面により実験の必要性，安全性について説明を行い，全被験者から書面による同意書を得た．また，震災前のデータの再利用に関しても，書面による同意を得ていた．

結　果

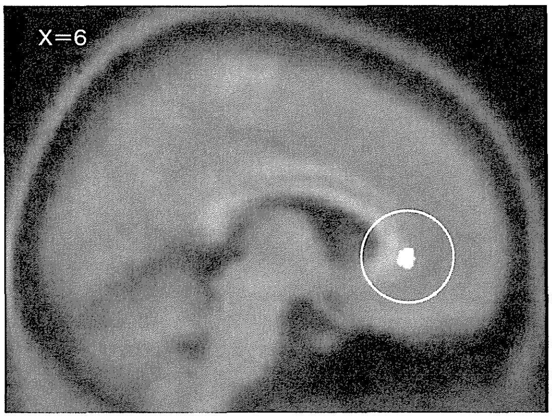
脳形態画像解析の結果，右腹側前帯状皮質においてCAPSスコアと震災前の脳灰白質量が有意な負相関を（**図1a**），左眼窩前頭皮質において震災前後の脳灰白質変化量と有意な負相関を示した（**図1b**）．また，右前帯状束において状態不安スコアと震災前のFAが有意な負相関を（**図2a**），左前帯状束および左鉤状束において震災前後のFA変化量と有意な正相関を示した（**図2b**）．

考　察

本研究により，震災後精神症状の脆弱性因子の神経基盤として，右前帯状皮質の脳灰白質体積減少および右前帯状束の脳白質統合性の低下が，震災後精神症状の獲得因子の神経基盤として左眼窩前頭皮質の減少および左帯状束・鉤状束の白質統合性の上昇が認められた．

前帯状束は前帯状皮質から延びる神経線維を含み，大脳辺縁系の一部の構成要因としても知られている[10]．その機能として，恐怖や不安の処理が知られており[5]，震災後の不安症状の病態にも

a）右前帯状皮質［6 32 0］



b）左眼窩前頭皮質［−20 52 −6］

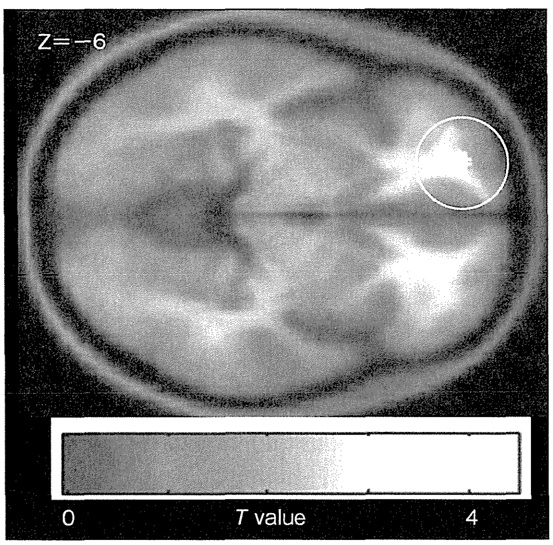
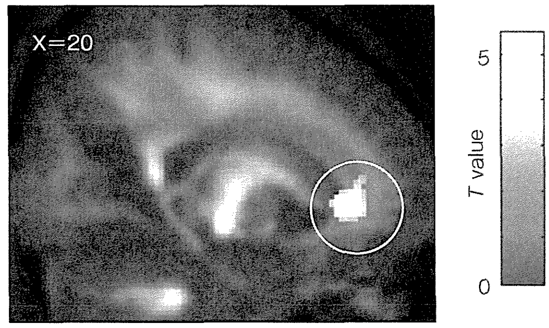


図１　震災後 PTSD 症状の脆弱性・獲得因子の神経基盤（文献[22]より改変）

a）PTSD 症状の脆弱性因子の神経基盤．震災前の右腹側前帯状皮質の局所灰白質量と震災後 CAPS スコアが有意な負相関を示した．b）PTSD 症状の獲得因子の神経基盤．震災前後の左眼窩前頭皮質の局所灰白質量の変化量と震災後 CAPS スコアが有意な負相関を示した．

a）右帯状束［20 36 0］



b）左帯状束［−22 34 18 ◯］
左鉤状束［−16 26 −8 ◌］

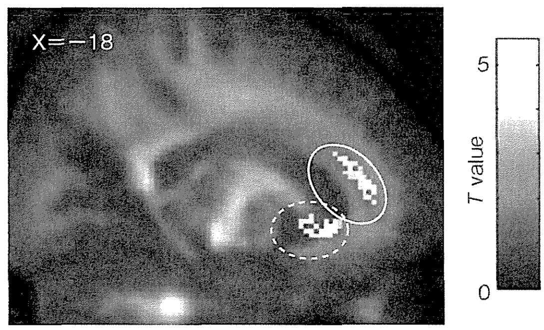


図２　震災後不安症状の脆弱性・獲得因子の神経基盤（文献[23]より改変）

a）震災後不安症状の脆弱性因子の神経基盤．震災前の右前帯状束の白質統合性と震災後の状態不安スコアが有意な負相関を示した．b）震災後不安症状の獲得因子の神経基盤．震災前後の左帯状束・鉤状束の白質統合性の変化量と震災後の状態不安スコアが有意な負相関を示した．

深く関与している[12]．本研究により，これら恐怖や不安の処理の機能不全が，震災後精神症状の脆弱性因子として関与することが示唆された．また，眼窩前頭皮質は，隣接する鉤状束を介して情動処理に関与する扁桃体の活動と協調し[9]，情動制御に重要な役割を果たしている[16]．PTSD 患者においても恐怖記憶の消去[2]や情動制御[15]の際に眼窩前頭皮質の活動が低下しているとの報告もある．さらに，左前帯状束／鉤状束の白質統合性の増加は，震災後不安症状の脆弱性因子として不安や恐怖の処理機能不全が存在し，情動制御の必要性が高まったことが震災後早期の不安症状の獲得の背景に存在していたことが示唆された[23]．

上述の脳形態変化は各々が隣接する領域であることから，解剖学的な位置関係は概ね一致していた．右前帯状皮質の灰白質量と，隣接する右帯状束の白質統合性はともに精神症状と負相関を示しており，灰白質量の減少と白質統合性の低下はともに当該領域の機能不全を示唆する所見として，震災後精神症状の脆弱性因子として解釈されている[22]．一方で，左側眼窩前頭皮質の灰白質変化

量と精神症状は負相関を示したが，隣接する左鉤状束，帯状束の白質統合性の変化量は精神症状と正相関を示しており，右前帯状皮質／帯状束の結果とは一見して矛盾する結果のように見える．これら不一致は，心理的ストレスにより引き起こされる生物学的変化が脳部位によって異なることに起因すると考えられる．前帯状皮質の脳灰白質量の低下は，ストレスホルモンとして知られるコルチゾールの影響で引き起こされることが報告されており[24]，組織学的には樹状突起の縮小が主な要因であるとされている[4,11]．樹状突起の縮小は，白質統合性の低下にも直結する変化であり前帯状皮質の灰白質量低下と前帯状束の白質統合性の低下は同一の生物学的背景に起因すると考えられる．一方，眼窩前頭皮質では，慢性ストレスにより樹状突起が増加するとの報告があり[21]，鉤状束における白質統合性の増加を支持する知見である．一見して相反する結果であるが，心理的ストレスに対する脳部位ごとの神経細胞の組織学的な反応の違いが，脳形態画像変化にも反映されていたものと考えられる．複数の脳画像データの検証により，画像所見として現れる生物学的変化についてより深い考察ができた好例であり，複数の脳画像データセットによる検証の重要性が示唆されたものと考えられる．

結　語

今回紹介した脳画像研究は，大規模災害前後の脳灰白質量，白質統合性の形態変化を報告した世界で初めての研究である．災害ストレスへの適応過程に対する理解を深め，災害後精神症状の早期発見，予防に資する基礎研究として意義深いものと考える．一方で，これらは比較的軽度な被災をした健常レベルの大学生の結果であり，より強烈なトラウマ体験をした被災者への応用は慎重を期する必要がある．今後，より広い世代に渡る，さまざまなレベルのトラウマ体験をした被災者を対象とした検証が待たれるところである．

現在筆者は，震災後に東北大学に新設された東北メディカル・メガバンク機構において，宮城県沿岸部および内陸部の住民を対象とした大規模なゲノムコホート調査の立ち上げに参加しており，一部対象者から脳形態画像および認知機能データを収集する計画に従事している．本コホート調査を通して，近い将来には，脳形態，認知機能，遺伝要因，生活習慣との関連が明らかとなり，災害ストレス暴露後の精神症状の増悪に対する個別化予防，個別化医療が可能になると期待している．

謝辞　本研究を行うに際し，ご指導・ご協力いただいた東北大学加齢医学研究所，脳機能開発研究分野，認知機能発達寄附研究部門，スマートエイジング国際共同研究センター・応用脳科学研究分野のメンバーに心より感謝を申し上げる．また，本研究は厚生労働省科学研究費補助金・障害者対策総合研究事業（精神障害分野），および東北大学・災害科学国際研究所・特定プロジェクト研究（共同研究）の助成を受けて行われた．本研究に関して，報告すべき利益相反は存在しない．

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Research Article | Open Access

Comparison of the Effects of Individual and Group Horticulture Interventions

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Abstract

Chronic stress adversely affects the body, and stress and negative emotions affect the development and progression of diseases. This study focuses on horticultural therapy (HT) as a method of stress reduction. Although previous studies have reported that HT has many benefits, the effects of HT in relation to differences in the intervention style have not been investigated. The purpose of this study was to clarify whether there is a difference in the effect due to the difference in intervention style in HT. The participants were divided into three groups, a group intervention (GI group; *n*=15), an individual intervention (II group; *n*=15), and a control group (C group; *n*=15). The GI and II groups underwent four weeks of a horticultural intervention, whereas the C group was provided with a gardening kit by an experimenter. The individuals in the C group cared for the plants by themselves for 15 min per day for one month. The GI group showed significant improvement in the WHO Quality of Life 26 (WHO-QOL26) subscore, the Emotional Intelligence Scale (EQS) subscore, the General Health Questionnaire (GHQ) score, and salivary cortisol level, as compared with the II group. These findings suggest that a group HT intervention might be more effective than an individual intervention.

Keywords: Horticultural therapy; Group intervention; Individual intervention

Introduction

Many Japanese people lead stressful lives, as do many people in other parts of the world. Previous studies suggest that the chronic stress adversely affects the body [1] and that stress and negative emotions can affect the development and progression of diseases [2]. The reduction of stress is important for maintaining and enhancing health. In recent years, methods of stress relief have been sought by many researchers. This study focuses on horticultural therapy (HT).

HT is a method of psychological care for treating post-traumatic stress disorder (PTSD) that was developed in the United States after World War II for the psychological care and social rehabilitation of disabled soldiers and war veterans showing PTSD symptoms [3]. HT interventions are led by professionals trained to incorporate the use of plants and horticultural education into rehabilitation therapies [3]. It has been reported that participants begin to identify with plant growth, and regain health and motivation. Through such experiences and their association with nature, participants are thought to experience improvement [4]. HT has mainly been developed for elderly adults and people with disabilities [5,6]. Previous studies have suggested that HT and exposure to nature can have cognitive [7,8], psychological [3,9-12], social [13,14], and physical benefits [10]. It has also been suggested that HT has a positive effect on physiological factors, such as heart rate and salivary cortisol levels [15]. Previous studies have reported many therapeutic effects of HT in care and education programs for disabled patients and the elderly [12,14,16-19]. However, the effects of HT in relation to difference in the intervention style, such as group versus individual interventions, have not previously been investigated.

The purpose of this study was to clarify whether there is a difference in the effect of HT in relation to a difference in the style of the HT intervention, using psychological measures and salivary cortisol level. We hypothesized that a group HT intervention may produce better psychological effects than an individual intervention. Although the content of the intervention was different from that used in previous studies, it has been reported that group interventions may produce greater improvement than individual interventions [20].

Materials and Methods

Participants

Forty-five healthy, right-handed university students or postgraduates (22 men and 23 women; age, 21.22 ± 2.42 years) participated in this study. They had normal vision and none had a history of neurological or psychiatric illness. Written informed consent was obtained from each participant in accordance with the Declaration of Helsinki (1991). Then, they were randomly allocated into group intervention (GI), individual intervention (II), and control (C) groups. The study was approved by the Ethics Committee of Tohoku University School of Medicine.

Procedure

Participants who were assigned to the GI and II groups participated in a horticultural intervention in the laboratory at a specified date and time. Participants in the GI group took the horticultural intervention in groups of five (total 3 groups). Before the start of the intervention, all participants were assessed on the basis of some psychological measures. The horticultural intervention was designed in collaboration with a horticultural therapist and clinical psychologists. This intervention comprised a total of four weekly sessions (60 min each) at a university lab and 15 min per day at participants' homes. The sessions at the university lab comprised interactive lectures and practical horticultural training. Participants attended four horticultural lessons, including topics such as designing a garden planter, seeding, watering, weeding, and picking flowers. They filled out a horticultural intervention session

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checklist after each session as self-assessment. Participants took care of plants for 15 min per day at their convenience, using 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 weekly horticultural intervention sessions. Participants who were assigned to the C group were provided with a gardening kit by an experimenter; they cared for the plants by themselves for 15 min per day for one month.

Psychological measures

We used Japanese versions of the following psychological measures.

Assessment of quality of life: The World Health Organization Quality of Life 26 (WHO-QOL26) is a 26-item, self-report measure designed to assess quality of life [21]. Twenty-four items measure the four domains of QOL: physical, psychological, social, and environmental, and the other two items measure overall QOL and general health. The score for each question ranges from 1 to 5, with higher scores reflecting higher QOL. The present study used the Japanese version of the WHO-QOL26 [21].

Assessment of depressive symptoms: The Center for Epidemiologic Studies Depressive Symptoms Scale (CES-D) is a 20-item, self-report measure designed to assess depressive symptoms [22,23]. Scores for each item are summed to give a range of total scores from 0 to 60. A higher score indicates a greater tendency toward depressive symptoms. A score of 16 points or higher suggests the presence of clinical depressive symptoms. The reliability and validity of the Japanese version of the CES-D have been confirmed [23]. In the Japanese version, the cutoff value of 16 was also optimal, as assessed by comparing the proportion of patients with CES-D scores of 16 points or higher in a normal control group with that in a group of patients with mood disorders [23].

Assessment of emotional intelligence: The Japanese version of the Emotional Intelligence Scale (EQS) is a 65-item, self-report measure designed to assess emotionally intelligent behavior, which provides an estimate of one's underlying emotional and social intelligence [24-26]. The scale was developed and standardized for use with Japanese subjects. A more detailed discussion of the psychometric properties of this instrument and how it was developed is found in the Emotional Intelligence Scale technical manual [26]. The participant's responses render the following three composite scale scores (factors): (a) Intrapersonal factor (comprising self-insight, self-motivation, and self-control), (b) Interpersonal factor (comprising empathy, altruism, and interpersonal control), and (c) Situation Management factor (comprising insight into and control of a situation). Each composite scale score comprises three subscale scores. All three factors of the EQS have been shown to be associated with better mental health, as measured by the General Health Questionnaire (GHQ). The Situation Management factor has been shown to be strongly associated with better mental health [24]. This result suggests that higher emotional intelligence leads to better mental health [27].

Assessment of mental health: The GHQ is a 30-item self-report measure designed to assess mental health [28,29]. This scale includes six subscales: "general illness," "somatic symptoms," "sleep disturbance," "social dysfunction," "anxiety and dysthymia," and "suicidal depression." The questionnaire uses a four-point Likert scoring method. The total score for the GHQ-30 is six or lower in 85% of healthy adults; in this study, we used only the total score.

Assessment of mood state: The Profile of Mood States (POMS) is a 65-item self-report measure designed to assess mood states [30,31]. It consists of the following six mood state scales: tension–anxiety (T–A), depression–dejection (D), anger–hostility (A–H), fatigue (F), confusion (C), and vigor (V). The reliability and validity of the POMS have been examined in the Japanese population [31].

Saliva sampling

We collected saliva samples from participants to measure their salivary cortisol levels. Distressing psychological stimuli are associated with an increased cortisol level [32,33]. Considering the participants' circadian cortisol rhythms, we collected all saliva samples at 4:00 pm on weekdays, before and after the intervention. We selected 4:00 pm because humans are less affected by circadian cortisol rhythms at this time of day [34]. Participants were asked to refrain from drinking, eating [35], and exercising [36] for two hours before saliva sampling. This method was same as that in our previous studies [32,37].

Measurement of salivary cortisol

To assess physiological stress, we employed the same technique to measure salivary cortisol as described in a previous study [32,37]. Saliva samples were collected using the Salivette apparatus (Sarstedt, Nümbrecht, Germany). Cortisol was measured in the supernatant solutions, which were stored in airtight containers at -80°C. 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). To examine the psychological effects, a mixed design was used to compare the difference between the three groups pre- and post-intervention. Additionally, as 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 [32,37].

Results

Differences between three groups

The participants' demographic data are shown in Table 1; the ages of the three groups did not differ significantly. Comparisons of the psychological changes pre- and post-intervention are shown in Table 2. The GI group showed significant improvement, relative to the C group, in the WHO-QOL26 Psychological score [$F(2,42)=4.37$, $p<0.01$], the WHO-QOL26 Social score [$F(2,42)=4.76$, $p<0.01$], the EQS Interpersonal score [$F(2,42)=2.80$, $p<0.05$], the EQS Empathy score [$F(2,42)=4.38$, $p<0.01$], and the EQS Altruism score [$F(2,42)=3.24$, $p<0.05$]. Furthermore, the GI group showed a significant decrease, relative to the C group, in the GHQ score [$F(2,42)=2.66$, $p<0.05$] and POMS vigor score [$F(2,42)=2.45$, $p<0.05$]. Additionally, the GI group showed a significant decrease in salivary cortisol level compared with the C group [$F(2,42)=5.03$, $p<0.01$]. The II group did not differ significantly from the C group.

Comparison of pre- and post-intervention scores in the GI and II groups

Comparisons of the psychological changes pre- and post-intervention between the GI and II groups are shown in Table 2. Relative to the II group, the GI group showed a significantly higher

Factor	GI group (N = 15)	II group (N = 15)	C group (N = 15)				
	Mean	SD	Mean	SD	Mean	SD	p^a
Age	20.53	2.45	21.60	1.54	21.53	3.00	0.410

aOne-way analysis of variance.
GI, group intervention; II, individual intervention; C, control; SD, standard deviation

Table 1. Demographic data of the participants

	GI group	II group			C group							
	Pre	Post	Pre		Post		Pre	Post				
Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
WHO-QOL26	3.23	0.53	2.93	0.58	3.23	0.4	3.01	0.69	3.07	0.57	3.18	0.55
Physical QOL score												
Psychological score	2.92	0.53	3.38	0.4	3.03	0.56	2.92	0.68	2.82	0.45	2.82	0.41
Social score	3.18	0.89	3.75	0.8	3.53	0.75	3.58	0.65	3.4	0.62	3.27	0.61
Environmental score	3.39	0.46	3.22	0.47	3.31	0.47	3.27	0.32	3.02	0.37	3.07	0.37
Global score	3.24	0.56	3.35	0.45	3.32	0.49	3.3	0.42	3.17	0.42	3.19	0.43
CES-D	13.53	10.32	7.67	3.64	9.53	5.28	8.87	6.67	14	11.77	13.73	4.04
EQS	46.6	11.87	49	13.52	54.67	11.88	56.93	12.5	42.4	7.43	46.4	9.3
Intrapersonal												
Self-awareness	12.07	3.65	12.73	4.06	15.47	4.93	16.33	4.55	11.33	3.7	12.33	3.92
Self-motivation	14.13	5.3	14.8	5.35	17.47	4.5	17.93	4.28	13.2	2.81	14.47	3.7
Self-control	20.4	4.52	21.47	6.6	21.73	6.32	22.67	6.11	17.87	4.73	19.6	4.5
Interpersonal	41.87	12.8	46.8	11.1	44.4	13.73	42.67	7.54	47.8	12.14	46.33	12.27
Empathy	13.67	4.12	15.53	3.4	16.53	5.57	14.87	3.62	15.87	3.6	15.87	3.46
Altruism	12.6	4.4	14.27	4.43	12.2	4.9	13.2	4.72	16.07	4.32	14.8	5.25
Interpersonal relationship	15.6	6.7	17	5.77	15.67	6.95	14.6	3.52	15.87	6.44	15.67	5.89
Situational	41.07	15.21	43.93	14.23	43.07	15.07	44	12.61	36.87	11.11	36.13	10.45
Situational awareness	18.53	6.65	19.13	5.78	18.4	8.64	19	6.11	17.07	4.28	16.6	5.49
Leadership	10.27	5.19	12.07	5.24	10.67	5.19	11.33	4.84	8.53	4.1	8.53	3.93
Flexibility	12.27	4.1	12.73	4.33	14	4.12	13.67	3.39	11.27	3.79	11	3.93
GHQ score	6	3.34	3.2	2.81	6.07	3.88	4.33	3.5	4.73	2.79	5.47	5.97
POMS Tension–Anxiety	6.53	4.42	6.07	2.89	8.73	4.32	7.4	4.27	8.2	4.9	7.93	4.35
Depression	5.87	5.58	2.73	2.55	6.4	4.03	4.87	3.85	5.67	6.5	5.6	5.96
Anger–Hostility	4.07	3.35	4	3.89	4.93	4.11	5.07	4.13	5	4.84	3.87	3.16
Vigor	8.87	3.52	10.47	3.72	8.73	4.42	9.93	3.9	9.73	4.04	9	4.02
Fatigue	8.27	4.1	5.73	3.41	8.2	3.88	6.13	3.2	8.8	5	7.07	5.23
Confusion	7.2	3.38	6.33	2.5	6.6	2.87	5.87	3.2	6.47	4.42	6.27	4.06
Total Mood Disturbance	23.07	19	14.4	13.68	26.13	15.25	19.4	15.78	24.4	22.03	21.73	19.87
Salivary cortisol level	3.96	0.96	2.15	0.79	4.54	3.21	3.97	1.74	3.97	1.41	4.21	0.94

[a]One-way analyses of covariance with pre–post differences in psychological measures as dependent variables and pre-intervention scores as covariates (one-tailed).
GI, group intervention; II, individual intervention; C, control; SD, standard deviation; WHO-QOL26, World Health Organization Quality of Life 26; CES-D, Center for epidemiologic studies depression scale; EQS, Emotional Intelligence Scale; GHQ, The General Health Questionnaire; POMS, Profile of Mood States.

Table 2. Psychological measures pre- and post-intervention

post-intervention WHO-QOL26 Psychological score [F(1,28)=5.92, $p<0.05$], WHO-QOL26 Social score [F(1,28)=3.97, $p<0.05$], EQS Interpersonal score [F(1,28)=4.15, $p<0.05$], and EQS Empathy score [F(1,28)=7.97, p<0.005]. The GI group also showed a significantly lower post-intervention GHQ score [F(1,28)=3.05, $p<0.05$] than the II group. Additionally, the GI group exhibited a significantly lower salivary cortisol level [F(1,28)=2.93, $p<0.05$] than the II group.

Discussion

The purpose of this study was to investigate whether there is a difference in the effects of an HT intervention due to the difference in intervention style, using psychological measures and salivary cortisol level. The study revealed that the GI group showed improved psychological measures (WHO-QOL26, EQS, GHQ, and POMS) and salivary cortisol levels post-intervention compared with the other two groups. Additionally, the GI group was also showed improved psychological measures (WHO-QOL26, EQS, and GHQ) and salivary cortisol levels post-intervention compared with the II group. These results are consistent with our hypothesis that HT may be more effective by group intervention compared with individual intervention.

The GI group showed improved WHO-QOL26 scores (psychological score and social score) than the II and C groups, indicating that the group HT intervention increased psychological and social QOL more than the individual intervention. Previous studies have reported that HT improved QOL [11,37,38]. The raising of plants in a group is thought to have brought new hope and stimulation to the participants, and this may have led to greater improvement of their QOL (in particular, psychological and social aspects), relative to an individual intervention, by synergy. The GI group showed improved EQS scores (interpersonal, empathy, and altruism scores) relative to the II and C groups, indicating that the group HT intervention increased interpersonal intelligence more than the individual intervention. Previous studies have suggested that HT improves emotional intelligence [39,40]. Conducting a multiple activity in a group is thought to have developed a sense of community, interpersonal relationship, empathy, altruism, and so on. These effects were reflected more in the EQS interpersonal factor score of participants in the GI group than the II group. The GI group showed improved GHQ scores in comparison with the other two groups, indicating that the group HT intervention improved mental health more than the individual intervention. Many previous studies have suggested that HT improves mental health [41-44]. Our results confirmed this effect, and show that the mental health of the participants in the GI group had significantly improved, relative to the II group, by the synergistic effect of interaction with people and plants.

The GI group showed an improved POMS vigor score in comparison with the other two groups. Additionally, the GI and II groups did not differ in the change from pre- to post-intervention. POMS is a well-established tool for assessing mood state and current emotional health. Previous studies suggest that various mood states are improved by HT [19,45]. In the results of the present study, the vigor score had improved, as in previous studies. Horticultural activity causes a positive change in life and mood. The results suggest that the horticultural intervention elicits positive mood changes. The GI group also showed improved salivary cortisol levels, in comparison with the other two groups, indicating that HT reduced stress. The group HT intervention reduced salivary cortisol levels more than the individual intervention. Previous studies suggest that HT reduced salivary cortisol levels, and was an effective means of stress reduction [15,37,44]. The group HT intervention is thought to have improved stress more than the individual intervention, as reflected in the reduction of salivary cortisol levels.

Finally, this study raises some issues for future research. This was a preliminary experiment, with a small number of participants. A possible future direction would be to conduct the study with a larger number of participants and extend those findings.

In conclusion, this study suggests that it is easier to obtain many effects of HT with a group intervention than with an individual intervention. The results of this preliminary experiment will be reexamined in a future study.

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Medium- to Long-term Psychological Support for Women Living in Areas Affected by the Great East Japan Earthquake: Empirical Studies on the Impact of Horticultural Therapy

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In the near future, three years will have passed since the Great East Japan Earthquake. Despite the passage of time, several residents living off the Pacific coast of Tohoku continue to suffer from mental and physical repercussions of the event. In other words, numerous survivors of the Great East Japan Earthquake continue to live with emotional trauma and stress. Previous studies suggest that mental health problems among natural disaster survivors are most pronounced within a specified period after the event [1]. Although recovery among survivors is progressing incrementally in the disaster area of Tohoku, one may argue that availability of medium- to long-term psychological care for these people is important. Immediately following the earthquake, our research team provided horticultural therapy as a medium- to long-term psychological support to the survivors. The motivation behind this study is based on previous research suggesting that women are more susceptible to experiencing anxiety in post-disaster environments than men [2], that women are more likely to be diagnosed with Post-Traumatic Stress Disorder (PTSD) than men after experiencing natural disasters [3], and that weak social support is associated with a higher susceptibility to PTSD.

Horticultural Therapy (HT) is a psychological care method for treating PTSD that was developed in the United States for psychological care and social rehabilitation of disabled soldiers and war veterans diagnosed with PTSD following World War II [2]. Previous studies have suggested that HT and exposure to nature can have cognitive [4,5], psychological [6,7], social [8], and physical [9] benefits. Since the earthquake, our research group has reported psychological effects of horticultural therapy on women living in the disaster areas [10,11]. The psychology scores that measured PTSD, post-traumatic growth (PTGI), and intervention group mood improved after horticultural therapy intervention in both studies. Furthermore, the intervention group exhibited improved salivary cortisol levels, an indicator of stress in both studies. In addition, the intervention effect on the intervention group was sustained for a certain period in both groups. These findings suggest that horticultural therapy has an effect on earthquake-related stress symptoms among women living in the disaster area, and that this effect may endure for a prolonged period. However, these studies were not conducted in the disaster areas, but in an experimental format in which intervention participants were studied in research facilities.

Based on these results, we are currently conducting an empirical intervention study in the coastal regions of the disaster areas of Miyagi Prefecture, where earthquake damage was considerable. Currently, the disaster areas of Tohoku are undergoing a period of rebuilding. However, for practical reasons rebuilding has progressed slowly, and limited reproduction within the disaster areas will become a serious future issue as victims move away from the vicinity. The purpose of this study is to understand the effect of horticultural therapy as a means of rebuilding local communities in disaster areas, and to establish a system of horticultural therapy as a regional community support that is available to these communities. This study has recently begun and the results have not yet been obtained; however, in the near future, it will provide information to the current state of knowledge in this field. We believe that HT may prove to be an effective intervention strategy for earthquake-related stress. We hope to spread awareness about HT as a source of psychological support for medium- to long-term natural disaster-related stress.

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

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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 was 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 of survivors after a disaster such as a temporary increase in cortisol level [4-7]. The recovery is progressing little by little in the disaster area of Tohoku and it may be said that it is important to 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 improvemen [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 study 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

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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. Informed consent in writing was obtained from the experimental participants before the start of the experiment. The intervention period was from October 2012 to May 2013.

The study was a randomized, open -label assessors are blinded, crossover trial (RCT), and it was registered in the University Hospital Medical Information Network Clinical Trials Registry (UMIN 000008936). Testers are blind to the study's hypothesis and the group membership of participants. The participants were divided into two groups, an intervention group (n=20) and a control group (n=19), by the permuted block method, and the intervention group underwent eight weeks of horticultural intervention followed by an eight-week FU period. The control group underwent eight weeks of stress control education, followed by eight weeks of horticultural intervention (Figure 1). Although the intervention group had a follow-up period after the intervention period, participants were allowed to keep growing plants during the follow-up period because it could have been stressful or created negative emotions, if we required participants to stop their horticultural activities. In addition, this study design used a design same as our previous study [21].

Description of interventions

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

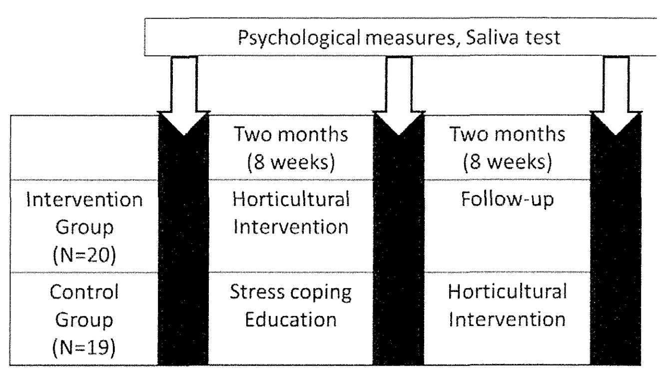

Figure 1: Intervention design.

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 ($F[1,37]=5.12$, $p<0.05$) 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 Environmental 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-

	Intervention group		Control group		
Factor	Mean	SD	Mean	SD	p^a
Age (years)	65.15	3.65	67.21	5.18	0.158
CAPS score	23.50	6.03	21.84	4.83	0.351

[a]One-way analysis of variance.
HT: Horticultural Therapy; SE: Stress Education; SD: Standard Deviation; CAPS: Clinician-Administered Post-Traumatic Stress Disorder Scale

Table 1: Baseline demographic and clinical data of the participants.

	Intervention group				Control group				p^a
	Pre		Post		Pre		Post		
Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
CAPS score	23.50	6.03	6.60	5.25	21.84	4.83	10.63	8.90	0.05
GDS score	3.25	3.37	1.85	2.06	3.11	2.64	3.42	2.67	0.016
PTGI total score	66.35	16.17	75.95	8.06	66.37	14.86	64.26	6.38	0.008
WHO-QOL26 Physical QOL score	3.34	0.44	3.21	0.46	3.23	0.47	3.17	0.39	0.334
Psychological score	3.11	0.30	3.46	0.53	3.04	0.49	2.99	0.62	0.010
Social score	3.37	0.36	3.73	0.55	3.23	0.68	3.02	0.59	0.003
Environmental score	2.92	0.48	3.31	0.48	2.80	0.56	2.72	0.68	0.021
Global score	3.19	0.24	3.43	0.30	3.07	0.39	2.98	0.36	0.001
Salivary cortisol level	2.29	2.45	1.53	1.63	2.49	1.94	3.49	2.28	0.025

[a]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

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

	Pre		Post		FU	
Measures	Mean	SD	Mean	SD	Mean	SD
CAPS score	23.50	6.03	6.60	5.25	3.05	4.26
GDS score	3.25	3.37	1.85	2.06	2.10	2.02
PTGI total score	66.35	16.17	75.95	8.06	80.65	7.67
WHO-QOL26 Physical QOL score	3.34	0.44	3.21	0.46	3.20	0.46
Psychological score	3.11	0.30	3.46	0.53	3.59	0.41
Social score	3.37	0.36	3.73	0.55	3.75	0.47
Environmental score	2.92	0.48	3.31	0.48	3.36	0.48
Global score	3.19	0.24	3.43	0.30	3.42	0.30
Salivary cortisol level	2.29	2.45	1.53	1.63	1.66	1.62

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

Table 3: Psychological changes of Intervention group (Pre, Post, and FU).

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)=4.65, $p<0.05$]. 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. PTGI-J 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 ($p<0.01$), 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)=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 ($p<0.05$), confirming that this effect was sustained. WHO-QOL26 social QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant [F(2,38)=8.70, $p<0.001$]. 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 ($p<0.01$). WHO-QOL26 environmental QOL scores showed that the main effect of time (pre-intervention, post-intervention, and FU) was significant [F(2,38)=8.27, $p<0.001$]. 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 ($p<0.01$). WHO-QOL26 global 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-J 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[51]. 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.

Previous studies suggest that HT improve QOL [51-53]. In our study, WHO-QOL26 physical QOL score did not have the change by the HT intervention. However, psychological QOL score, social QOL score, environmental QOL score, and global QOL score was significantly improve by HT intervention and these effects was sustained after FU periods. We think that the raising of the plant make challenging in everyday life and communication with the people around one. Additionally, we think the raising of the plant produces different changes life and the synergy that imposed by a plant improved the QOL.

The intervention group showed improved salivary cortisol levels, indicating that HT reduced stress. This finding was similar results to a previous study [20]. Cortisol is popular as indicator of psychological and physiological stress and salivary cortisol levels increase in people with PTSD symptoms. By this result, salivary cortisol levels in intervention group was significantly decreased after HT intervention, and salivary cortisol levels did not change after a follow-up compared to the post-intervention. We think that the reduction of salivary cortisol level reflects that HT improve stress condition because the score of CAPS and GDS that used to measure stress-related psychological changes was improved after HT intervention and these effects is sustained after FU. For all of these reasons, the results of our present study suggest the possibility of HT as an effective intervention against the earthquake-related stress.

The major limitation of this study was the small sample size. In the results of analysis of variance (ANOVA) for sensitivity, the effect size of this study was 0.45 and power was 0.8, and α err prob was 0.05. Therefore, a possible future direction would be to replicate and extend the results of current study with larger sample and a lighter (more casually controlled) trial design.

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.

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Research Article

The Psychological Effect of Horticultural Therapy Intervention on Earthquake-Related Stress in Women of Earthquake-Related Areas

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Abstract

In this study, we provided horticultural therapy as an intervention to 54 adult women with earthquake-related stress from the disastrous Great East Japan Earthquake along the coastline of Miyagi Prefecture. After two months of horticultural intervention, scores on the Clinician-Administered PTSD Scale (CAPS), Positive and Negative Affect Schedule (PANAS), Positive Affect (PA), and the Japanese version of the Posttraumatic Growth Inventory (PTGI-J) improved significantly in the intervention group, and salivary cortisol concentration decreased significantly. Although subsequent retesting after a two-month follow-up period revealed no major changes in CAPS or PANAS-PA scores or salivary cortisol concentration, there was an increase in PTGI-J score. These findings suggest that horticultural therapy has an effect on the symptoms of earthquake-related stress in women, and that this effect may sustain.

INTRODUCTION

The Great East Japan Earthquake on March 11, 2011 was the largest earthquake and tsunami to have occurred in the postwar period. It devastated large swathes of eastern Japan, with particularly severe damage in the prefectures of Iwate, Miyagi, and Fukushima on the Pacific coast. Despite the passage of time, some people are still living with the emotional trauma and stress experienced, when lifelines were disrupted immediately after the earthquake, and the stress caused by directly experiencing or witnessing the devastating structural, human, and other damage that occurred in coastal areas. Previous studies reported about mental health problems of survivors after a disaster such as a temporary increase in cortisol level [1-3]. Horticultural therapy (HT) is an intervention 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 [4]. In Europe, HT was developed as a program for elderly people. HT interventions are led by professionals trained to incorporate the use of plants and horticultural education into rehabilitation therapies. HT typically involves seeding and growing vegetables and flowers, actions that have been observed to improve the participant's mood and attentiveness. In addition, therapy in a group setting improves the participant's communication skills through collaborative horticultural activities. It has been reported that participants begin to identify with plant growth, regain health and motivation, and have a chance to be happy again. Through such experiences and their association with nature, participants are thought to experience improvement [5]. HT in Japan became the focus of attention, when it was implemented as assistance for rehabilitation after the Great Hanshin-Awaji Earthquake; it has mainly been developed for elderly adults and people with disabilities [6].

Previous studies of patients, veterans, and older persons have suggested that HT and exposure to nature can have cognitive [7,8], psychological [9-12], social [13,14], and physical [10,12] benefits. Studies of allotment gardeners have also suggested that HT has a positive effect on physiological factors, such as heart rate and salivary cortisol levels [15]. In this way, most research on the effect of HT has utilized psychological measures and observational data, and the effect of HT on earthquake-related stress and the maintenance of this effect have not been fully investigated. The purpose of this study was to verify the reduction in the symptoms of earthquake-related stress in women who live in disaster areas through HT intervention using psychological measures and salivary cortisol level. Additionally,

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