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Posted Date: 18 January 2024

doi: 10.20944/preprints202401.1410.v1

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Stress Control in Elderly through Healing Garden Activities

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Abstract: This study was conducted on elderly over 65 years of age to verify that healing garden activities control stress in the elderly. The experimental group performed garden activities once a week for 12 weeks, 2 hours each, and the control group continued their daily lives. Each group's cumulative stress at the beginning and end, total power (TP), the standard deviation of the normal-to-normal interval (SDNN), and root mean square differences of successive R-R intervals (RMSSD) were measured using a stress index meter, u-bio MACPA. As a result of the analysis, the experimental group had a statistically significant decrease in cumulative stress compared to the control group, and TP significantly increased compared to the control group. SDNN and RMSSD of the experimental group increased, respectively, and the control group decreased, respectively, but it was not statistically significant. The fact that cumulative stress decreased, and stress evaluation indicators increased shows that daily stress can be controlled through healing garden activities. This confirms that the value of the garden can extend to healing.

Keywords: cultivation management; mental; physical; the significance of the garden; utilization

1. Introduction

With the improvement of living standards and the development of medical technology, the elderly population is rapidly increasing worldwide. In the case of Korea, the transition to an aging society is progressing more rapidly, and the country is expected to become a super-aged society with the population aged 65 and older reaching 24.3% by 2030 [1,2]. The increase in the elderly population and increase in life expectancy may cause various social problems, such as economic poverty, physical aging, and loss of social status. According to data from the National Statistical Office, 48.6% of seniors aged 65 and older responded that they feel stressed in all aspects of their lives [3].

Ulrich defined stress as the process of reacting to events and environmental characteristics that are challenging, burdensome, or threaten happiness [4]. Stress threatens an individual's quality of life and increases the likelihood of physical and mental health problems in the human body [5]. In the short term, it increases heart rate and blood pressure, weakens the immune system, and reduces the body's capabilities [4]. Stress is not limited to a certain period of development, but is experienced throughout one's entire life, and its type and intensity vary depending on the life cycle or individual [6]. In old age, changes such as decline in physical function, economic instability, anxiety about loneliness, and social alienation occur, and inability to adapt to these changes leads to great stress [7]. The many losses that occur due to outside forces act as a stressor in daily life [8]. For the elderly, the stress experienced in daily life has a greater emotional and psychological impact than major life events do [9]. Daily stress destroys the body's homeostasis and has a negative impact on the body's immune response, reducing its ability to cope with disease [10,11]. The elderly experience more stress as they age, but their ability to find effective ways to resolve stress decreases [12]. With research on the occurrence and resolution of stress in the elderly being continuously conducted, the need for various programs on stress management methods are being increasingly emphasized [13].

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For people in modern society living with a lot of stress, gardens are a space of relaxation and recovery. Healing gardens help restore balance to the mind and body through various stimuli, such as the color, scent, sound, and touch of plants [14]. Scent particles from various plants in the garden contact the nasal mucosa and reach the limbic system of the brain via the olfactory nerve, thereby strengthening cerebral mental function, reducing the stress response [15], and improving immune function and leading to changes in response [16]. In addition, a healing garden is a place to recover, maintain, and improve physical and mental health as it encourages physical exercise. It is also a space that can aid in cognitive recovery through gardening, an act of directly experiencing nature [17]. Healing garden activities allow participants to use their muscles when grasping tools (compacting the soil with a shovel or planting plants) and are effective in exercising both small and large muscles (improving the flexibility of the thumb and index finger), and as such [18], leads to improved physical abilities. In addition, healing garden activities are known to be effective in the recovery and maintenance of physical and mental health because one can experience the intellectual effect of acquiring new knowledge and utilizing technology, as well as the social effect of forming social relationships through interaction with others [19].

The purpose of this study is to confirm that gardens can be used as a tool to maintain and improve the physical and emotional health of the elderly in the Super-aged Society. A healing gardening activity program is provided to an elderly population with gradually deteriorating physical abilities and unstable psychological/emotional states, to increase physical activity levels and offer psychological/emotional stability. Through this method, the study aims to confirm that healing gardening programs have a positive impact on the stress of the elderly population.

2. Materials and Methods

2.1. Participants

The subjects of the study were 19 elderly people over 60 years of age with the ability to move and express their opinions freely and who could participate in garden activities during the program. The control group was set as elderly people who did not participate in the program. For this purpose, 19 elderly people who voluntarily expressed their intention to participate were selected among users of the XX Senior Center located in Eunpyeong-gu. Those who participated in the experiment participated for 12 weeks from April 22 to July 1, 2023.

2.2. Experimental Procedures

Looking at previous studies on programs that mediate stress in the elderly, it was common to set the frequency at once a week and the program duration at more than 1 month [20]. In terms of personnel composition, participants with depression or other conditions were often placed into small groups of 5-7 people [13], and general participants were placed into medium-sized groups of 20-25 people [21]. In terms of content, it was effective to repeatedly teach participants skills that could be easily applied to daily life, considering the physical and physiological characteristics of the elderly [20]. Based on previous research, this study created a program with 12 sessions, once a week, to improve the decline of physical function and emotional dissatisfaction, which are causes of stress in the elderly, and to improve exercise muscle function and achieve physical and physiological balance. During this period, the 19 program participants engaged in activities such as planting, cultivating, and managing plants; creating a garden; utilizing harvested produce; meditating and exercising in nature; and taking walks.

Participants' cumulative stress index and heart rate variability (HRV) were measured before participation and at 4, 8, and 12 weeks after participation. Sub-items of HRV include total power (TP), an immunity index, resistance to stress index (SDNN, the standard deviation of the normal-to-normal interval), and state of physiological health (RMSSD, root mean square differences of successive R-R intervals). Participants with low program participation rates were excluded, and 11 people in the experimental group and 11 in the control group were selected for the final analysis (Figure 1).

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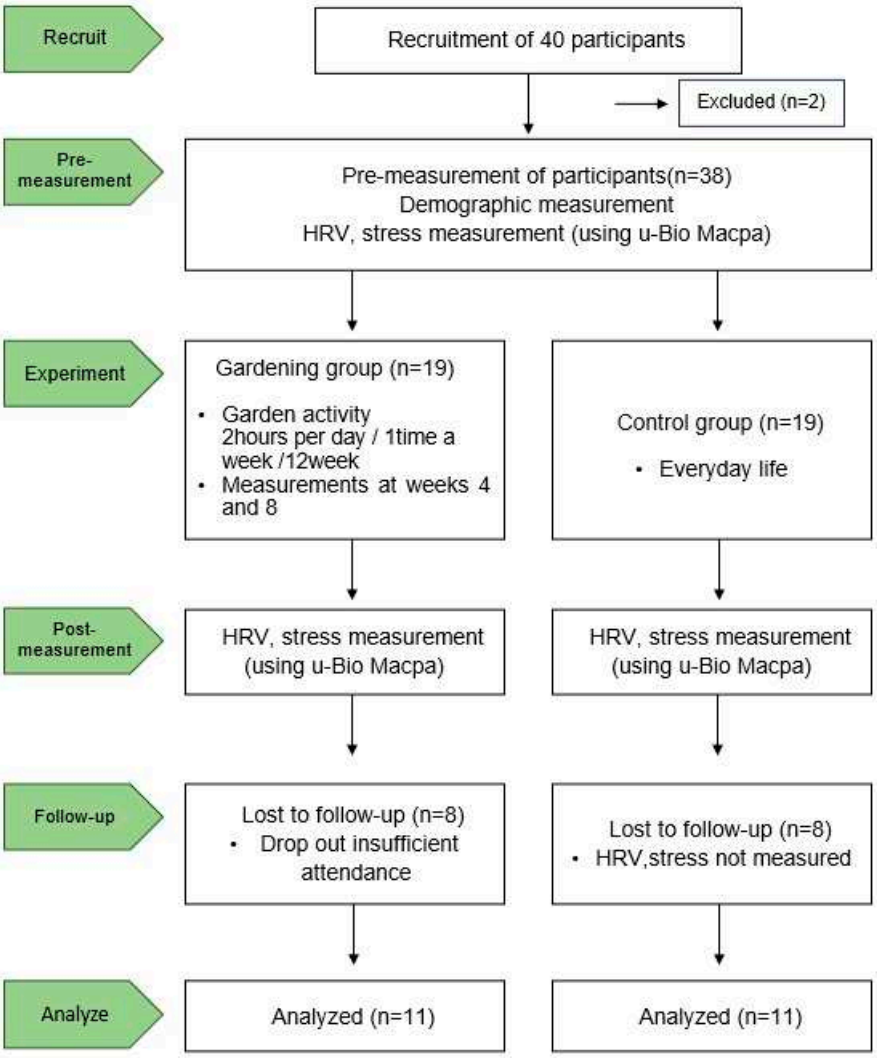

Figure 1. Flow diagram of total experimental procedure.

2.2.1. Healing Garden Activity Program

The healing garden activity program allows people to experience a variety of activities, such as planting, cultivating, and managing plants; creating a garden; utilizing harvested produce; meditating and exercising in nature; and taking walks. Garden creation and planting activities included creating a garden, sowing, planting herbs and edible flowers, setting and planting companion plants, creating a mini garden, and growing vegetable sprouts, as well as regular cultivation and maintenance of the garden, such as watering, thinning, fertilizing, and propagation. A "farm party," which is a community activity centered around the garden, was also held, and included activities such as drinking herbal tea using harvested plants, making pressed flowers, flower arranging, natural dyeing, and making natural object frames (Table 1).

Table 1. Healing garden activity program.

Class	Topic	Garden Activities and Test for Stress
1	We met on the green	Program orientation and pre-test (u-bio) Introductions A tour of the garden
2	A budding seed in my heart	Fertilizing the garden / planting annuals A plant that resembles my heart

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3	Herbs and Flowers	Planting herbs and edible flowers Showing off my pet plants
4	Beautiful, my life	Taking care of the garden and my heart Making a terrarium Week 4 u-bio test
5	A scented day	Walking in the herb garden My favorite scent / making herb soap
6	Forest is my friend	Forest meditation Taking care of the garden
7	Flavor and coolness	Cooking with herbs and edible flowers Sharing food
8	The growing number of green friends	Greenwood cutting Taking care of the garden Week 8 u-bio test
9	I'm a flower	Cutting flowers in the garden Arranging flowers / Showing my flowers
10	The pigments of flowers	Dyeing scarves with natural dyes Talking about my color
11	Mini my garden	Making a Succulent Garden Taking care of the garden
12	A heart-sharing garden	Taking care of the garden Creating a natural object frame Week 12 u-bio test

2.2.2. Measuring Tool

Physiological stress was measured using a u-Bio Macpa (u-Bio Clip v70, BIOSENSE CREATIVE CO., LTD, Korea). u-Bio Macpa is a portable heart rate variability (HRV) testing device that measures the autonomic nervous system via a clip that connects to the participant's fingertip. An LED light coming from the device passes through the blood vessels of the finger, and through signal analysis of the measured pulse wave, the device measures vascular health and the stress index [6]. The stress index is calculated by adding the values of each sub-item (i.e. HRV, LF, HF, autonomic balance, SDNN, and RMSSD) and is expressed numerically from 0 to 100 points. A state of almost no stress is 25 or less, temporary stress is 25 to 35, initial stress is 35 to 45, a state where tolerance to stress begins to weaken is 45 to 60, and chronic stress is above 60. The higher the score, the more stressed the participant. The reference values of TP, SDNN, and RMSSD vary depending on age. For the age range of 50 to 70, the reference values are 6.96 to 8.87 Ln for TP, 20 to 100 for SDNN, and 10 to 60 for RMSSD. Within this range, it has been reported that the higher the number, the healthier [22].

2.3. Statistical Analysis

A non-parametric test was conducted to analyze the effectiveness of this program [6]. Pre- and post-average comparisons within groups for healing garden activities were analyzed using the Wilcoxon signed-rank test, and mean comparisons between experimental and control groups were conducted using the Mann-Whitney U-test. All statistical processing was performed using SPSS version 29.0 (IBM Co., Chicago, USA). All statistical significance levels for the data were set at $P<0.05$.

3. Results

Looking at the general characteristics of the experimental group, there were 3 men (27.3%) and 8 women (72.7%). 10 people (90.9%) were married, and 1 person (9.1%) was single. The age range consisted of 8 people (72.7%) between 60 and 69 years of age, and 3 people (27.3%) between 70 and 79 years of age (Table 2). The control group consisted of 3 men (27.3%) and 8 women (72.7%), 11 of

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whom were married (100%). The age range was 6 people (54.5%) between 60 and 69 years of age, and 5 people (45.5%) between 70 and 79 years of age.

Table 2. Demographic data of groups.

Demographics		Gardening N (%)	Control N (%)
Gender	Male	3(27.3)	3(27.3)
	Female	8(72.7)	8(72.7)
Marital status	Unmarried	1(9.1)	0(0.0)
	Married	10(90.9)	11(100)
Age	60~69	8(72.7)	6(54.5)
	70~79	3(27.3)	5(45.5)
	80~89	0(0.0)	0(0.0)

3.1. Pre- homogeneity Test of Gardening group and Control group

The Mann-Whitney U-test was performed as a preliminary measurement to determine whether the two groups were physiologically homogeneous. As a result, the stress index, TP, SDNN, and RMSSD were all p>0.05, showing no significance between the two groups, confirming that they were homogeneous groups (Table 3).

Table 3. Pre-homogeneity test of gardening group and control group.

Analysis	Gardening	Control	z	p
Stress Level	56.26 ± 10.54 [w]	61.87 ± 10.55	-1.22	0.22 [NS]
TP[z]	7.27 ± 0.74	7.01 ± 0.84	-0.85	0.39 [NS]
SDNN[y]	25.34 ± 10.74	22.22 ±10.06	-0.69	0.49 [NS]
RMSSD[x]	24.36 ± 19.74	17.93 ± 9.93	-1.28	0.20 [NS]

[z]TP: Total power. [y]SDNN: The standard deviation of the normal-to-normal interval. [x]RMSSD: Root mean square differences of successive R-R intervals. [W]Mean ± Standard deviation (N=11). [NS]Non-significant at $p < 0.05$ leveled by Mann-Whitney U-test.

3.2. Changes in stress and TP, SDNN, and RMSSD of the Gardening group

Table 4 shows the degree of change in the experimental group's physical responses as garden activities progressed. Cumulative stress levels steadily increased during the garden activities, but dropped sharply in the 12th week, decreasing by an average of 3.82 from the initial 56.26 to 52.44. Total power (TP) steadily increased from the start of the program, increasing by an average of 0.25. The standard deviation of the normal-to-normal interval (SDNN) decreased at week 4, then began to increase from week 8, and increased sharply at week 12. There was an average increase of 2.78 compared to the baseline. Root means square differences of successful R-R intervals (RMSSD) also showed the same changes as SDNN. It decreased in the 4th week, but increased starting from the 8th week, showing an average increase of 1.34 in the 12th week compared to the baseline. No statistical significance was found for these dependent variables. However, when comparing week 0 and week 12, stress decreased overall and TP, SDNN, and RMSSD values showed an increasing trend.

Table 4. Changes in stress and TP, SDNN, and RMSSD of the gardening group (n=11).

Analysis	Pre (Week 0)	Week 4	Week 8	Post (week 12)	F	p
	M±SD	M±SD	M±SD	M±SD		
Stress Level	56.26±10.54[w]	56.53±13.22	57.21±9.71	52.44±12.84	2.55	0.13 [NS]
TP[z]	7.27±0.74	7.37±0.65	7.30±0.49	7.52±0.57	0.49	0.70 [NS]
SDNN[y]	25.34±10.74	24.17±14.69	24.46±7.17	28.12±11.55	0.93	0.47 [NS]
RMSSD[x]	24.36±19.74	20.46±14.34	23.20±10.54	25.70±15.63	1.09	0.41 [NS]

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[z]TP: Total power. [y]SDNN: The standard deviation of the normal-to-normal interval. [x]RMSSD: Root mean square differences of successive R-R intervals. [w]Mean separation within columns by ANOVA at $p < 0.05$. NS, [*,**]non-significant or significant at $p < 0.05$ or 0.01, respectively.

3.3. Changes After the Program in Gardening group and Control group

Comparing the pre- and post- values between the experimental and control groups, the stress index of the experimental group decreased by approximately 6.8%, while the stress index of the control group increased by approximately 6.5% with an average increase of 3.41, and the difference was statistically significant (Figure 2).

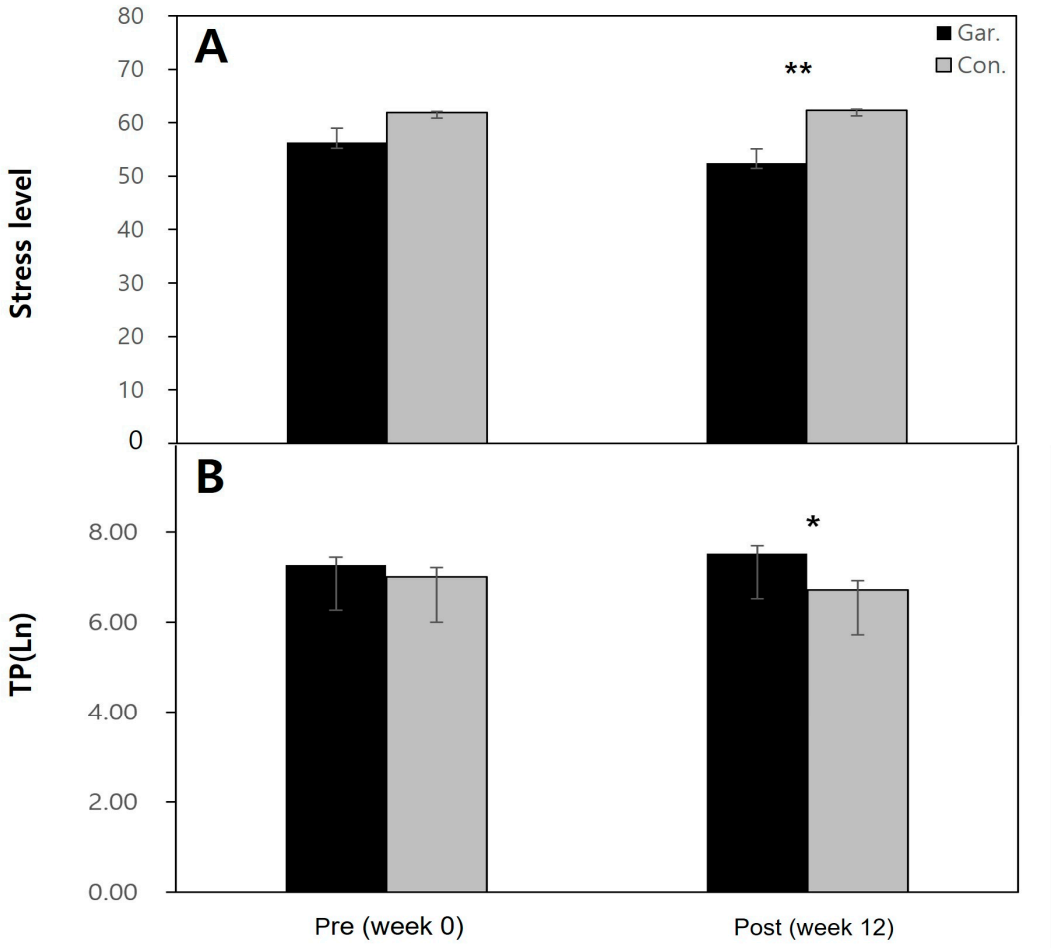

Figure 2. Changes of stress level and TP of gardening participants and the control group after the gardening program: A, After the gardening program, the stress level decreased in gardening participants while it increased in the control group. B, After the gardening program, TP slightly increased in gardening participants, while it decreased in the control group.

The TP level showed an increase of 0.25 Ln in the experimental group, while the control group showed a decrease of 0.27 Ln. The value was statistically significant. For SDNN, the experimental group showed an increase by approximately 2.78, while the control group showed a decrease by 0.19. RMSSD also increased by 1.34 in the experimental group, but as the control group also showed an increase by 1.67, this was not a significant result (Table 5).

Table 5. Changes after the program in the gardening group and the control group.

Analysis	Gardening	Control	z	p
Stress Level	52.44±12.84 [w]	65.28±6.92	-2.66	0.008**
TP[z]	7.52±0.57	6.72±0.66	-2.30	0.022*

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SDNN[y]	28.12±11.54	22.01±8.94	-1.02	0.31[NS]
RMSSD[x]	25.70±15.63	19.60±12.37	-1.28	0.20 [NS]

[z]TP: Total power. [y]SDNN: The standard deviation of the normal-to-normal interval. [x]RMSSD: Root mean square differences of successive R-R intervals. [w]Mean ± standard deviation (N=11). NS, *, **Non-significant or significant at $p < 0.05$ or 0.01 leveled by Mann-Whitney U-test, respectively.

4. Discussion

The purpose of this study is to investigate whether healing garden activities can control stress in elderly people. The results of the study showed that the cumulative stress level of the elderly who participated in the healing garden activities decreased by 6.5% compared to the control group who continued their daily lives. According to previous research on the stress of the elderly, people in modern society experience an aging process accompanied by physical, psychological, and social changes as well as a sense of loss as they become older [23]. As a result, people face various types of stress in their daily lives due to aging of the body and a sense of helplessness in being unable to control their surroundings [5]. Stress is an important factor in determining an elderly individual's satisfaction with life. Increased expectations for satisfaction with life leads to increases in well-being and a decrease in stress [24], and it has been reported that regular physical activities such as daily exercise helps facilitate this process. [25]. In other words, regular physical activity release stress and decreases daily stress levels [23]. Cultivating and garden managing activities, such as watering, sowing, weeding, pruning, and harvesting performed daily in the garden require continuity and regularity in the sense of cyclic seasonal changes and the repeated act of nurturing. In addition, cultivating and garden maintenance are activities that mostly utilize large muscles in outdoor spaces and help increase body movement as well as improve motor function. Although seemingly easy and simple compared to daily exercise, garden activities are easy to start and considered appropriate in increasing the physical activity of the elderly, whose physical health and strength are often weak due to a lack of physical activity.

The effect is also clearly visible in the HRV results of elderly people who participated in healing garden activities. In the case of TP levels, the elderly who participated in the healing garden activities showed an increase of 0.25, but the control group showed a decrease of 0.29, outside the reference range. TP being outside the reference range means that immune function is also outside the normal range. Immune function is connected to the autonomic nervous system and the pituitary-adrenocortical system, which influences the stress response [26]. When stressed, the body's sympathetic nervous system is activated, blood cortisol levels increase, and immune function decreases [27]. These results are consistent with previous research results [28], which showed that the levels of cortisol, a stress hormone, in those who participated in plant cultivation activities were statistically significantly lower than those in the control group. The healing garden activity program was considered to reduce stress and increase immune function in elderly who participated in the program. In contrast, elderly who continued their daily lives had no medium to mediate daily stress, and as a result, stress accumulated and resulted in decreased TP levels, signifying decreased immune function.

SDNN reflects the response of the autonomic nervous system, which is involved in responding quickly and appropriately to changes in both the body and the external environment. The higher the SDNN, the healthier the person [29]. RMSSD is an index of heart rate fluctuations, which reflects the parasympathetic state, and decreases overall in groups with high stress [30]. The SDNN and RMSSD of the elderly who participated in the healing garden activity increased by 2.78 and 1.34, respectively. In the control group, SDNN decreased by 0.19 and RMSSD increased by 1.67. This suggests that healing garden activities, like other stress intervention programs, help maintain a physiologically healthy state by improving the overall activity and control of the autonomic nervous system. Positive changes in participants' HRV levels were considered to have been due to a sense of peace from being close to plants and being provided an opportunity to escape stress, even for a moment [31].

Healing garden activities can also be expected to have a psychological effect on body-oriented programs, such as yoga, dance, and gate ball, which are widely used in elderly stress intervention.

Meditation, walking, and sharing thoughts in the garden are also suitable as emotional coping methods to relieve stress through making small changes in life or exchange of emotions [32]. Activities that use harvests directly from the garden can also help participants gain a sense of accomplishment in the process of creating their own final produces. Garden-centered community activities, such as farm parties, can contribute to alleviating feelings of loneliness and alienation resulting from the collapse of the traditional family system. It also has a positive effect on depression and mental health [33]. The elderly group that engages in green activities for leisure shows lower stress levels compared to other groups that engage in travel, gatherings, and exercise [27]. This shows that healing garden activities control stress more effectively than other stress intervention programs. Anyone can easily participate in healing garden activities without any special skills or knowledge, and there is no spatial restriction. R. Kaplan introduced the concept of "nearby nature" and stated that any type of activity, such as growing indoor plants, looking at trees through a window, tending a garden, or looking at trees or flowers on the street, contributes positively [34]. In other words, simply enjoying the space through the senses could be considered effective in controlling stress.

Although this study confirmed that healing garden activities are effective in controlling stress in the elderly, it is difficult to generalize its effectiveness due to the small sample size. In addition, due to the nature of the garden where the environment changes with the seasons, its effectiveness can only be clearly revealed when conducted as a mid- to long-term program rather than a one-time program.

Currently, healing garden activities targeting the elderly generally focus on special groups such as those with dementia or depression. However, it is necessary to expand the scope of what is considered healing and conduct research on the effectiveness of easily implementable healing gardens as a preventative measure, as well as the subsequent development of such programs. To achieve this, urban gardens should also be considered as a potential space for healing activities found in everyday life.

Author Contributions: Conceptualization, S.-H.K., J.-B.S.; methodology, S.-H.K., J.-B.S.; validation, B.-Y.R.; formal analysis, S.-H.K.; investigation, S.-H.K., J.-B.S.; project administration, J.-B.S.; Supervision, B.-Y.R.; Writing—original draft, S.-H.K.; Writing—review & editing, S.-H.K., J.-B.S.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Sahmyook University in the Korea (SYU2023-02-005-002 and 2023-03-21).

Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

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