The Influence of Urban Gardening Activities on Participants' Perceived Restorativeness, Resilience, Sense of Community and Stress

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Article

The influence of Urban Gardening Activities on participants' Perceived Restorativeness, Resilience, Sense of Community and Stress

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Abstract: This study aimed to investigate the influence of urban garden activities on participants' Perceived restorativeness, resilience, sense of community, and stress reduction. Ninety individuals who agreed to participate to the experiment were divided into experimental and control groups. To collect data 16 sessions of urban garden activities were conducted every two weeks from May to November of 2022. Perceived Restorativeness Scale, Conner-Davidson Resilience Scale, Sense of Community Index, and Brief Encounter Psychosocial Instrument were employed to measure participants' psychological effects. To evaluate physiological effect salivary cortisol tests were performed. The results of the study revealed that urban gardening activities influenced on participants' physiological and psychological reactions in positive ways.

Keywords: urban garden; perceived restorativeness; resillience; sense of community; stress; salivary cortisol

1. Introduction

According to the "2019 Urban Planning Status Statistical Survey," 9 out of 10 Koreans reside in urban areas. The proportion of the urban population increased from 50.1% in 1970 to 81.9% in 1990 and reached 91.8% as of 2019 [1]. Urbanites suffer from various stresses due to environmental stress sources. To combat this problem, various types of gardens are created in cities[2].

According to the enactment of the Garden Act in 2015, the social demand for gardens is expanding nationwide in Korea. Therefore, the act for garden industrialization and establishing a basic plan for fostering and expanding gardens [3]. As interest in nature and well-being culture spreads and nature-friendly leisure activities increase, movements are being made to encourage residents to actively meet citizens' educational needs for plants and gardens. In order to systematically support the gardening activities, the Korea Forest Service established a legal and policy foundation [4].

Urban gardening refers to planting various types of plants in a city or preparing an environment related to them and comprehensively refers to gardens created in the area of a city [5]. Urban gardens can be understood by including examples of urban agriculture, container gardens, community gardens, indoor gardens, guerrilla gardens, and rooftop gardens [6]. The gardens in modern cities are places where 'participation' through 'priming behavior' is emphasized. Its value is highlighted as a 'place of productive function' to grow and eat crops, an 'alternative green' to reduce food mileage, and a 'place to restore community life' [7]. It also emphasizes that urban agriculture or gardens should be approached as a garden culture and public garden in terms of landscaping, focusing on the perspective of a process rather than the result of re-establishing human relations with urban green areas [8].

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Alison et al. [9] explained the importance of urban gardens to maintain and improve urban biodiversity, benefit human health and welfare, and connect people to the natural world. Park and Jeong [10] explain the effect of urban gardens, and citizens close to the gardens contribute to their ability to recover from natural factors such as grass, flowers, plants, and water, which not only contribute to psychological well-being, low stress, and increased exchanges with neighbors. The garden positively affects urban aesthetics and food and desert issues, such as safety, cleanliness, and greening of alleys, and has a significant psychological and social effects. The garden is said to be an efficient means of improving mental and physical health because it is accessible to urban residents and provides as many psychological benefits as forests.

Humans have social relationships from birth and live in the community through participation and cooperation to solve the increasingly complex problems of modern society. Mcmillan and Chavis [11] defined community consciousness as a sense of belonging, feeling the problem of members as an individual or group problem, and a belief that can discuss and satisfy the members' needs together. Among many studies, Kim [12] argued that community garden creation using urban gardens could revitalize local communities. Sim and Zoh [7] also reported that urban gardening is an alternative to daily life, and sustainable urban regeneration suggested physical residential environment and urban regeneration in Seoul.

Most of the daily lives in modern society, people are facing activities that make them feel tired and pressured physically and mentally [13]. Therefore, individuals engage in recovery activities and experiences such as hobbies, leisure, and tourism to alleviate acute load reactions and restore them to their pre-stressed states [14]. In the Attention Restoration Theory (ART) proposed by Kaplan and Kaplan [13], the recovery environment defines an individual's consumed instructional attention as an environment that can be effectively recovered. Research on the recovery environment has been focused on natural and forest environments outside the city. In a study by Shin et al. [15], the natural environment positively affected psychological recovery, and a positive correlation was confirmed between the preference and psychological recovery of the visiting area. However, research on the recovery environment based on gardens in the city is still insufficient.

Resilience is a fundamental coping function that can restore psychology against an individual's adversity [16]. Lazarus and Falkman [17] stated that they feel threatened by psychological well-being when the stimulus they receive for stress is much greater than the level of the personal dimension they can cope with. Several previous studies studied stress and resilience together, Lee et al. [18] suggested that healing agricultural activity positively affect stress relief and resilience in young adults, and Kim [19] reported that leisure satisfaction in urban parks positively affects job stress and resilience of office workers.

Ulrich [20] suggested that simply looking at nature is more effective in promoting stress recovery than looking at architecture without nature. Honeyman [21] argues urban environments with grass and trees significantly recover more than urban scenes without nature. In 2021, the stress recognition rate for adults aged 19 or older in Korea was 28.7%, the depression experience rate was 11.3%, the stress perception rate was 24~30%, and the depression experience rate was 10~13% over the past ten years [22]. It can be seen that stress and depression are continuously occurring in daily life. As one of the solutions to combat to increasing of social diseases, the importance and necessity of healing garden activities and programs with community-based public is increasing. Park et al. [23] emphasize the function and effectiveness of garden healing as a critical strategy for green welfare and healing as public interest and social awareness of garden activities increase.

It is time for garden activities as a nature-friendly intervention therapy to improve people's psychological and emotional quality of life under the urban environment's stress and the positive effects of green care given by plants. As a space for green welfare that relieves stress and enjoys a healthy life, research on the value and meaning of urban gardens is insufficient. Therefore, this study aims to add natural factors such as sunlight, scenery, and sound through garden activities and forest healing treatments such as plant therapy, exercise therapy, diet, and psychotherapy in the garden, as well as the possibility of restoring the community by interacting with each other.

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2. Materials and Methods

2.1. Study site

To collect data, series of experiments (the urban garden activity program) conducted at the Rainbow Light Garden located in Hyangnam-eup, Hwaseong-si, Gyeonggi-do in Korea (Figure 1). The participants of the study consisted of students who enrolling forest gardener classes. The rainbow garden is located between apartments, shopping malls, and new sites in agricultural cities created by developing farmland and hills and is located on a circular concrete floor with a diameter of 80m and an area of 2,355 m². The main tree species are *Vitis coignetiae*, *Lonicera periclymenum*, *Cornus kousa*, *Hydrangea macrophylla*, *Cotinus coggygria*, *Akebia quinate*, *Rosa pendulina*, *Kerria japonica*, *Clematis patens*, and there are box gardens planted with shrubs, vineyards, bulbs and seasonal flowers, and vegetable gardens for donation and sharing to the socially disadvantaged.

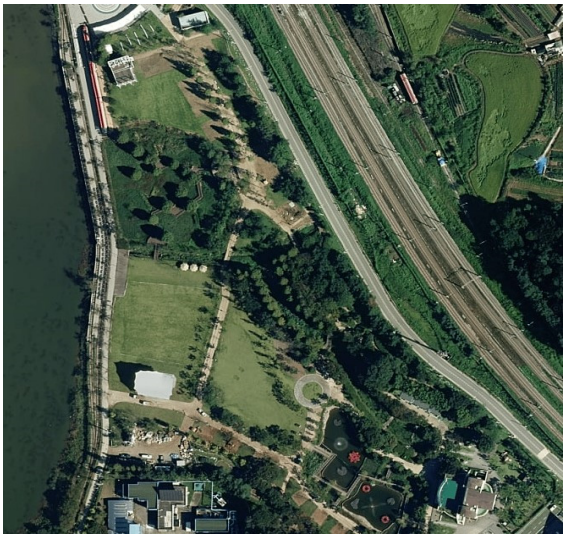

Figure 1. Rainbow Light Garden.

2.2. Participants

The sample size of this study was determined by substituting the effect size, significance probability, and power using the G-Power 3.1.9.7 Program (University of Düsseldorf, Düsseldorf, Germany). The effective size and dropout rate of 20% were referred to Lee [24], a previous study, and the sample size was 78 when the F-test calculated as Effect size 0.23, alpha value 0.05, and 1-β value Cohen's power was 0.95. In this study, the sample size was set to 90 participants in consideration of the dropout rate.

This study investigated the value of the garden as a psychological recovery environment through urban garden activities and divided it into three groups, experimental group 1, experimental group 2, and a control group. The data collection period was from April 1 to April 20, 2022, with garden activity participants at Hwaseong Agricultural Technology Center, Gyeonggi-do. This study was conducted with the deliberation and approval of the Institutional Review Board of Chungbuk National University (IRB Number: CBNU-202203-HRBRHR-0045).

Experimental groups 1 and 2 conducted 16 garden activity programs once every two weeks from May to November 2022. The control group was consisted of 30 participants who did not participate in the garden activity program during the same period to secure the homogeneity of the group. The garden activity program conducted in this study was planned and carried out by two gardeners and researchers with qualifications as landscape technicians. The urban garden activity program was divided into experimental group 1, experimental group 2, and daily life control group.

This study investigated the effect on participants' perceived restorativeness, resilience, sense of community, and stress through the garden activity program 1 (planting, caring for, and managing

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plants), the garden activity program 2 (program 1 + forest healing therapy). The experimental design was carried out using the pretest-posttest control group design method of experimental group 1, experimental group 2, and the control group. Program 1 was conducted for experimental group 1, and the effect was investigated. The treatment effect was evaluated by pre-post-testing with Perceived Restrictiveness Scale, Conner- Davidson Resilience Scale, Sense of Community Index, Brief Encounter Psychosocial Instrument, and saliva cortisol. Table 1 shows a schematic diagram of the research design for program effectiveness verification.

Table 1. Research Design for Program Effectiveness Verification.

Group	Pre-test	Experimental treatment	Post-test
Experimental group 1	○	◇, □	◎
Experimental group 2	○	◇	◎
Control group	○		◎

Note; ○, pre-test; ◇, garden activities program 1; □, garden activities program 2; ◎, post-test.

2.3. Psychological and physiological assessment

This study conducted a self-reported survey on demographic questions, the Perceived Restorativeness Scale (PRS), the Conner-Davidson Resilience Scale (CD-RISC), the Sense of Community Index (SCI), and Brief Encounter Psychosocial Instrument (BEPSI). It measured saliva cortisol, a stress hormone, as a physiological test.

The recovery environment is a Korean version of the Perceived Restorativeness Scale developed by Hartig et al. [25] and adapted by Lee and Hyun [26], which measures how much a specific environment is equipped as a recovery environment depending on the subject. This scale consisted of four sub-factors: rest, fascination, organization, and understanding. With a total of 26 questions, the higher the total score on the Likert 7-point scale, from "not at all (1 point)" to "very much (7 points), the higher the perception of the recovery environment. The reliability of this study was Cronbach's α= 0.94, which is a reasonable level.

The Conner-Davidson Resilience Scale (CD-RISC), developed by Conner and Davidson [27], used CD-RISC translated into Korean to measure subjects' resilience. The resilience scale studied by Ahn [28] for the elderly was used. This measure consists of five sub-factors: inner strength, patience, optimism, a capacity for change, a sense of control over the environment, and spirituality, a belief in spiritual influence. With a total of 25 questions, from "not at all (0 points)" to "almost always (4 points)" on a Likert 4-point scale, the higher the total score, the higher the resilience. The reliability of this study was Cronbach's α = 0.90.

The Sense of Community Index (SCI) developed by McMillan and Chavis [11] measured the subject's sense of community. This scale comprises four sub-factors: satisfaction of needs, member consciousness, mutual influence consciousness, and emotional intimacy. With a total of 12 questions, the higher the total score on the Likert 5-point scale, the higher the sense of community. The reliability of this study was Cronbach's α = 0.75.

Stress measurements were based on the Brief Encounter Psychosocial Instrument (BEPSI) developed by Frank and Zyzanski [29] to evaluate the negative effects on health, and the Korean version of Brief Encounter Psychosocial Instrument (BEPSI) modified by Bae et al. [30] and Yim et al. [31] was used. This scale measures the degree of feeling of the subject with five questions on a Likert 5-point scale; the higher the total score, the higher the stress. The reliability of this study was Cronbach's α = 0.82.

Cortisol measurements were measured twice before and after the study through saliva tests and twice before and after the study, and in the middle of the study. In the middle of the study, two measurements were conducted to reduce the variables of the study and increase reliability. Cortisol varies with a 24-hour cycle, so saliva was collected at the same time between 9:30 a.m. and 12:00 p.m. when the program started and ended. Since saliva cortisol is easily contaminated by food and gum bleeding, food intake and brushing were restricted from an hour before saliva collection to control

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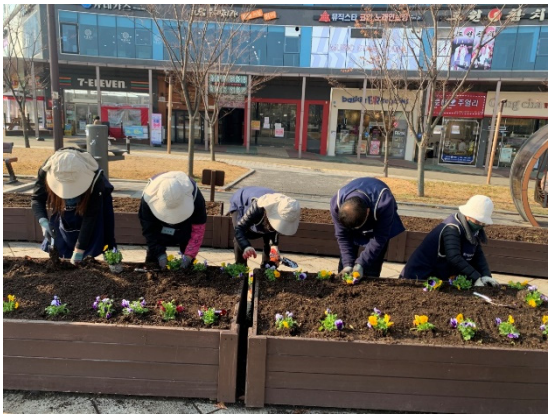
the situation that affects cortisol. For saliva collection, referring to the study of Kim [32], a previous study, a highly accurate and widely used polyester or polypropylene Salivette System was used. About 2 ml of saliva samples were collected by putting an absorption swab under the tongue of the study subject, and the researcher delivered the samples to the research institute in a frozen state. In the laboratory, experts centrifuged the saliva absorbed by the swab of the saliva container. They analyzed it on ELISA Reader (BioTek, VT, USA) devices using Human Cortisol ELISA Kit (DRG, NJ, USA) reagents.

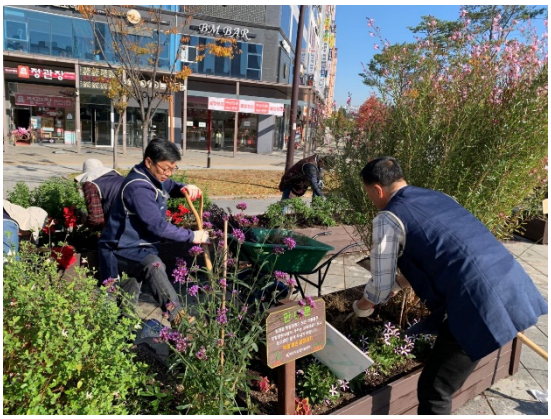
2.4. Program

The urban garden activity program consisted of 16 sessions to increase awareness of the recovery environment, resilience, community consciousness, and reducing stress. The garden activity program was composed of planting plants, trees and shrubs, vineyards, vegetables, fruits, flowers, and bulbous plants directly, managing flowers in various seasons, and inducing interest in the garden. Experimental group 1 conducted a garden activity program I (Figure 2), and experimental group 2 performed a garden activity program Ⅱ (Figure 3) that added five senses stimulation activities such as plant therapy for growing plants, diet for garden products, aerobic exercise and body relaxation, and meditation to help emotional stability. The program was operated by one forest healing instructor, one main instructor qualified as a landscaping engineer and three urban agricultural managers. The specific program schedule is shown in Table 2.

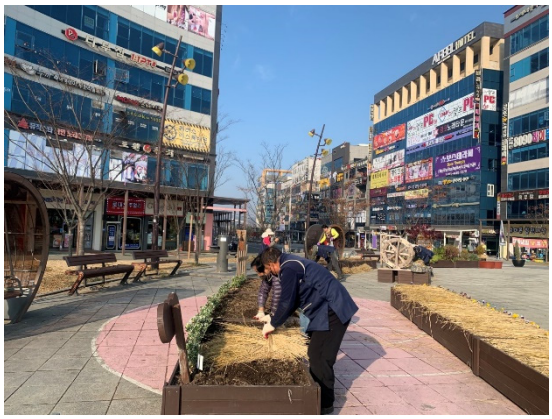


(a) Planting spring flower

(b) Placement and Planting of Trees



(c) Garden care



(d) Garden Plant Overwintering care

Figure 2. Garden activities program I.

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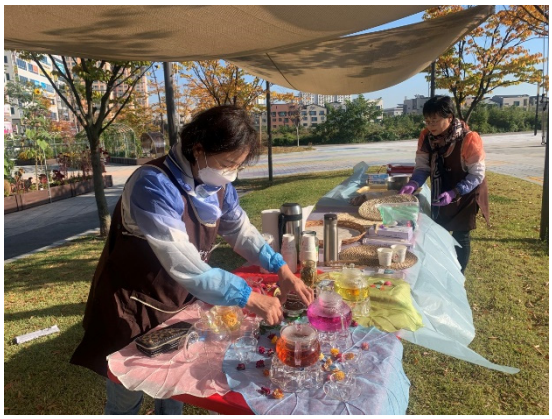
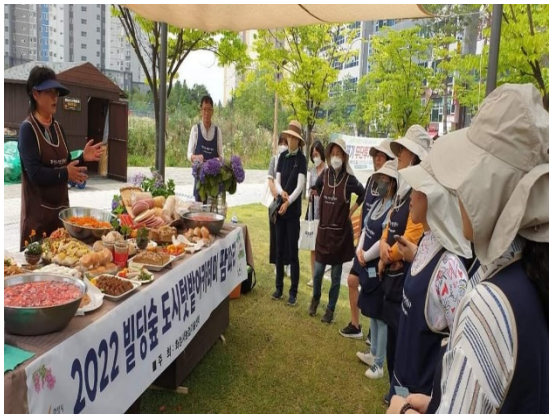
(a) Singing Bowl meditation



(b) Flower tea therapy

(c) Phalaenopsis flower pot making



(d) Healthy Meal Garden Farm Party

Figure 3. Garden activities program II.

Table 2. Urban gardening activities program.

Session	Period	Garden activity program I	Garden activity program Ⅱ
1	May Spring	Orientation Garden design Planting spring flower	Proper walking and Walking meditation
2		Placement and Planting of Trees and Herbal plants	Breathing meditation
3		Vegetable garden planting and management Pest management Garden plant sign drawing	Singing Bowl Meditation
4	June Summer	Panting aquatic plants Planting summer plants	Phalaenopsis flower pot making
5		Propagating with Plant Cuttings	Healthy Meal Garden Farm Party
6	July Summer	Harvesting vegetable garden crops Flower planting and garden management	Crop Sharing and Donation Making Herb Scent Bags
7		Understanding and management of medicinal plants	Making Aroma Oil Fragrance Necklace
8	August Summer	Flower bed creation and herb plant management	Aroma massage
9		Planting and arrangement of autumn herbaceous plants Create a vegetable garden	Object meditation

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10	September Fall	Garden care and sign drawing	Garden Plant Miniature Drawing 1
11		Autumn herbaceous planting, garden management	Garden Plant Miniature Drawing 2
12	October Fall	Autumn herbaceous planting garden management	Flower tea therapy
13		Pruning and tree care	Making natural dyed scarves Using garden plants
14		Autumn bulbous planting	Making rice cakes with local rice
15	November Fall	Garden Plant Overwintering care Crop harvest	Making a mini garden with houseplants, Crop Sharing and Donation
16		Garden Plant Overwintering care Surveys and Cortisol Measurements	farm party

2.5. Data analysis

This study was conducted with experimental and control groups to determine the effect of urban garden activity programs on participants' perception of the recovery environment, resilience, community consciousness, and stress. For data analysis, 90 questionnaires were analyzed using the SPSS 19.0 statistical program. Frequency analysis and multiple response analysis were conducted for the demographic characteristics and the degree of demand for the number of study subjects. Repeated measures analysis of variance (RM ANOVA) was conducted to verify the means difference between the experimental group and the control group's PRS scores, CD-RISC scores, SCI scores, and BEPSI scores before and after the urban garden activity program. For the analysis of the difference in cortisol in the physiological reaction, a corresponding paired t-test and RM ANOVA were used. All statistical tests used a p-value of <0.05 as the significance level.

3. Results

3.1. Demographic Characteristics

In order to find out the general characteristics of the study participants, frequency analysis was conducted by gender, age, educational background, occupation, and average monthly income. The results of the frequency analysis for this are shown in Table 3. Most of the participants were women (75.6%). Forty-three participants were in their 50s (4.8%), 24 participants were in their 60s or older (26.7%), and 12 participants were in their 50s or younger (25.5%). For the education level, 52 participants (57.8%) graduated from university, 29 participants (32.2) graduated from graduate school or higher, and nine participants (10.0%) graduated from high school or lower.

Participants' occupations were housewives (25.6%), students (22.2%), service workers (12.2%), self-employed and CEOs (12.2%), production and technology workers (11.1%), office administrative workers (7.8%), unemployed-others (5.6%), and professional researchers (3.3%). Most of participants' average monthly income were less than 1 million won (KRW) (25.6%) or between 2 million won (KRW) and 3 million won (KRW) (22.2%).

Table 3. General characteristics of participants.

Variable	Category	Frequency	Percent (%)
Gender	Male	22	24.4
	Female	68	75.6
Age	Under 49	12	25.5
	50~59	43	47.8
	Over 60	24	26.7
Education	Less than high school	9	10.0
	Graduate from college	52	57.8

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	More than graduate university	29	32.2
Occupation	Office worker	7	7.8
	Production/technician	10	11.1
	Profession/researcher	3	3.3
	Service job	11	12.2
	Self-employed-CEO	11	12.2
	Student	20	22.2
	Housewife	23	25.6
	Unemployed-Etc	5	5.6
Monthly income(won)	Less than 1 million	23	25.6
	1 million ~ less than 2 million (KRW)	16	17.8
	2 million ~ less than 3 million (KRW)	20	22.2
	3 million ~ less than 4 million (KRW)	13	14.4
	4 million ~ less than 5 million (KRW)	6	6.7
	More than 5 million (KRW)	12	13.3
	Total	90	100.0

3.2. Perceived restorativeness

Table 4 shows the results of repeated measurement variance analysis to verify the difference in PRS pre- and post-score of experimental groups 1 and 2 who participated in the urban garden activity program and the control group. It can be seen that the differences between the four sub-factors of repose, fascination, coherence, and legibility in the recovery environment, the interaction effect between time and group was statistically significant in repose factors ($F = 31.009$, $p < 0.001$). The scores of experimental group 1 and experimental group 2 increase significantly in the posttest than that of the pretest.

In addition, the results of repeated measures ANOVA by the group to find out the change in repose factors for each group showed statistically significant differences in experimental group 1 ($F = 54.497$, $p < 0.001$), experimental group 2 ($F = 21.720$, $p < 0.001$), and control group ($F = 12.231$, $p = 0.002$).

The fascination factor's interaction effect between time and group was statistically significant ($F = 11.760$, $p < 0.001$). Also, it can be seen that the fascination scores of experimental group 1 and experimental group 2 were increased. In addition, the results of repeated measures ANOVA by the group to find out the change in the fascination factor showed a statistically significant difference in experimental group 1 ($F = 47.698$, $p < 0.001$) and experimental group 2 ($F = 22.077$, $p < 0.001$).

The Coherence factor's interaction effect between time and group was not statistically significant ($F = 3.588$, $p = 0.076$). Therefore, looking at the results of repeated measures ANOVA for each group to find out the changes in the Coherence factors for each group, statistically, significant differences were found in experimental group 1 ($F = 26.437$, $p < 0.001$) and experimental group 2 ($F=12.878$, $p = 0.001$).

In addition, the results of repeated measures ANOVA by the group to find out the changes in the legibility factors showed statistically significant differences in experimental group 1 ($F = 49.685$, $p < 0.001$) and experimental group 2 ($F = 16.761$, $p < 0.001$).

Table 4. Change in Perceived Restorativeness scale by variables.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Repose	Experimental group 1	4.80	1.00	5.71	0.78	F=54.497, p<.001	F=31.009, p <.001 η^2_p=.416
	Experimental group 2	5.17	0.91	5.79	0.61	F=21.720, p <.001	
	Control group	5.19	0.76	4.64	0.80	F=12.231, p =.002	

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Fascination	Experimental group 1	4.90	0.98	5.75	0.79	F=47.698, p <.001	F=11.760 p <.001 η^2_p=.213
	Experimental group 2	5.24	0.86	5.85	0.69	F=22.077, p <.001	
	Control group	5.14	0.98	4.91	0.81	F=1.048, p =.314	
Coherence	Experimental group 1	5.50	1.03	6.18	0.62	F=26.437, p <.001	F=3.588 p =.076
	Experimental group 2	5.48	1.06	6.01	0.73	F=12.878, p =.001	
	Control group	5.50	1.27	5.50	0.94	F=1.000, p =1.00	
Legibility	Experimental group 1	5.00	0.91	5.83	0.76	F=49.685, p <.001	F=8.670 p <.001 η^2_p=.166
	Experimental group 2	5.08	1.16	5.66	0.88	F=16.761, p <.001	
	Control group	5.00	1.20	4.83	1.07	F=.467, p =.500	

3.3. Resilienece

Table 5 shows the results of RM ANOVA to verify the difference in CD-RISC pre- and post-score for experimental groups 1 and 2 who participated in the urban garden activity program and the control group. The Hardiness factor's interaction effect between time and group was statistically significant (F = 11.539, p < 0.001). It can be seen that the Hardiness factor scores of experimental group 1 and experimental group 2 were increased. In addition, the results of repeated measures ANOVA by the group to find out the change in the Hardiness factor showed a statistically significant increase in experimental group 1 (F = 51.958, p < 0.001) and experimental group 2 (F = 14.466, p = 0.001).

In the Persistence factor, the interaction effect between time and group was statistically significant (F = 10.706, p < 0.001). It can be seen that the persistence factor of experimental group 1 and experimental group 2 were increased. In addition, the results of RM ANOVA by group to find out the change in the persistence factor increased statistically significantly in experimental group 1 (F = 41.321, p < 0.001) and experimental group 2 (F = 16.080, p < 0.001).

In the optimistic factor, the interaction effect between time and group was statistically significant (F = 7.853, p = 0.001). It can be seen that the optimistic factors of experimental group 1 and experimental group 2 were increased. In addition, the results of RM ANOVA by group to find out the change in the optimistic factor was increased statistically significant in experimental group 1 (F = 15.149, p = 0.001) and experimental group 2 (F = 25.495, p < 0.001).

In the control group, factor's interaction effect between time and group was not statistically significant (F = 2.431, p = 0.094). Therefore, looking at the results of RM ANOVA for each group to find out the change in support factors for each group, experimental group 1 (F = 6.021, p = 0.020) and experimental group 2 (F = 6.167, p = 0.019) were increased statistically significantly.

In the Spirit factor, the interaction effect between time and group was not statistically significant (F = 1.982, p = 0.144). Therefore, the results of RM ANOVA by the group to determine the change in the spirituality factor for each group were significantly increased in Experimental Group 1 (F = 12.941, p = 0.001) and Experimental Group 2 (F = 1.478, p = 0.23).

Table 5. Changes in the Conner-Davidson Resilience Scale by variables.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Hardiness	Experimental group 1	2.62	0.37	3.00	0.43	F=51.958, p<.001	F=11.539 p <.001 η^2_p=.210
	Experimental group 2	2.60	0.55	2.88	0.56	F=14.466, p =.001	
	Control group	2.68	0.42	2.66	0.36	F=.192, p =.664	
Persistence	Experimental group 1	2.84	0.36	3.25	0.41	F=41.321, p <.001	F=10.706 p<.001 η^2_p=.197
	Experimental group 2	2.91	0.55	3.15	0.45	F=16.080, p <.001	
	Control group	3.03	0.51	3.05	0.44	F=.101, p =.753	
Optimism	Experimental group 1	2.93	0.43	3.22	0.51	F=15.149, p =.001	F=7.853 p=.001 η^2_p=.153
	Experimental group 2	2.69	0.56	3.03	0.44	F=25.495, p <.001	
	Control group	2.99	0.54	2.96	0.45	F=.205, p =.654	

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Control	Experimental group 1	2.88	0.45	3.12	0.55	F=6.021, p =.020	F=2.431 p=.094
	Experimental group 2	2.90	0.61	3.08	0.49	F=6.167, p =.019	
	Control group	3.03	0.60	3.00	0.60	F=.108, p =.745	
Spirit	Experimental group 1	2.37	0.78	2.68	0.68	F=49.685, p <.001	F=8.670 p <.001
	Experimental group 2	2.50	0.69	2.63	0.72	F=16.761, p <.001	
	Control group	2.48	0.52	2.55	0.63	F=.467, p =.500	

3.4. Sense of Community

Table 6 shows the results of RM ANOVA to verify the difference in Sense of Community Index (SCI) pre- and post-score of experimental groups 1 and 2 who participated in the urban garden activity program and the control group. The interaction effect between time and group was statistically significant in the Intergration and Fulfillment of needs factor (F = 13.054, p < 0.001). It can be seen that the factors that satisfy the Intergration and Fulfillment of needs of experimental group 1 and experimental group 2 were increased. In addition, the results of RM ANOVA for each group to find out the change in the Integration and Fulfillment of needs were increased significantly in experimental group 1 (F=36.001, P<0.001) and experimental group 2 (F = 26.868, p < 0.001).

The interaction effect between time and group was statistically significant in the factor of membership (F = 11.034, p < 0.001). It can be seen that the scores of the factors of membership in experimental group 1 and experimental group 2 were increased. In addition, the result of RM ANOVA by the group to find out the change in the factors of membership is experimental group 1 (F = 65.384, p < 0.001), Experimental Group 2 (F = 26.025, p < 0.001) showed a statistically significant increase in post-test than pre-test.

The interaction effect between time and group was statistically significant in the factor of influence (F = 3.777, p = 0.027). It also can be seen that the factor of influence between experimental group 1 and experimental group 2 was increased. In addition, the results of RM ANOVA by group to find out the change in the factors of Influence showed that experimental group 1 (F = 8.939, p = 0.006) and experimental group 2 (F = 26.868, p < 0.001) increased statistically significantly in the post-test compared to the pre-test.

In the Shared Emotional Connection factor, the interaction effect between time and group was statistically significant (F = 8.273, p < 0.001). It can be seen that the factor scores of Shared Emotional Connection between experimental group 1 and experimental group 2 were increased. In addition, the results of RM ANOVA by the group to find out the change in the factors of Shared Emotional Connection increased statistically significantly in the post-test compared to the pre-test in experimental group 1 (F = 54.696, p < 0.001) and experimental group 2 (F = 16.650, p < 0.001).

Table 6. Changes in Sense of Community Index scale by variables.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Intergration and Fulfillment of needs	Experimental group 1	3.61	0.55	4.13	0.49	F=36.001, p<.001	F=13.054 p<.001 η^2_p=.231
	Experimental group 2	3.68	0.47	4.09	0.44	F=26.868, p<.001	
	Control group	3.88	0.50	3.79	0.65	F=.750, p=.394	
Membership	Experimental group 1	2.78	0.48	3.90	0.56	F=65.384, p<.001	F=11.034 p<.001 η^2_p=.202
	Experimental group 2	3.22	0.54	3.78	0.60	F=26.025, p<.001	
	Control group	3.26	0.44	3.51	0.59	F=.750, p=.091	
Influence	Experimental group 1	2.78	0.47	3.19	0.55	F=8.939, p=.006	F=3.777 p=.027 η^2_p=.080
	Experimental group 2	2.76	0.62	3.02	0.47	F=26.868, p<.001	
	Control group	2.87	0.46	2.91	0.45	F=.219, p=.643	
Shared Emotional	Experimental group 1	3.82	0.43	4.33	0.38	F=54.696, p<.001	F=8.723 p<.001
	Experimental group 2	3.88	0.60	4.21	0.45	F=16.650, p<.001	

Connection	Control group	3.88	0.63	3.88	0.61	F=1.000, p=.998	η^2_p=.167

3.5. Stress

Table 7 presents results of stress reduction from gardening activities for each group. The interaction effect between time and group was statistically significant (F = 4.600, p = 0.013). It can be seen that there were stress reduction in experimental group 1 and experimental group 2. In addition, the results of RM ANOVA by the group to find out the change in stress were significantly reduced in experimental group 1 (F = 41.043, p < 0.001) and experimental group 2 (F = 13.476, p = 0.001).

Table 7. Changes in the Brief Encounter Psychosocial Instrument by variable.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Stress	Experimental group 1	2.46	0.75	1.89	0.53	F=41.043, p<.001	F=4.600
	Experimental group 2	2.37	0.70	1.87	0.46	F=13.476, p=.001	p=.013
	Control group	2.25	0.72	2.16	0.56	F=.986, p=.520	η^2_p=.096

3.6. Cortisol

3.6.1. Verification of the difference between pre- and post-cortisol in the group (repeated measurement variance analysis)

Considering the circadian rhythm of salivary cortisol, researchers collected a total of four measurements, one measurement in pretest and one measurement in posttest and two-hour intervals in the intermediate session. Repeated measures ANOVA was conducted to verify the difference between cortisol according to experimental group 1 and experimental group 2 participating in urban garden activities and the control group.

In order to reduce the variables of the study and measure the effect more accurately, the pre-second and post-third differences measured at the beginning and end of the mid-session were analyzed once more by dividing the analysis into two sessions. As shown in Table 8, the interaction effect between time and group before and after was not statistically significant (F = 0.342, p = 0.711). Therefore, looking at the results of verifying the difference in cortisol by performing RM ANOVA again to find out the change in cortisol by group, there was a statistically significant difference in experimental group 1 (F = 13.506, p = 0.001). As shown in Table 9, the interaction effects between the group and the time before and after measures in the mid-session were not statistically significant (F = 1.248, p = 0.292). Therefore, the results of verifying the difference in cortisol by performing RM ANOVA again to find out the change in cortisol by group, there was a statistically significant difference in experimental group 1 (F = 5.255, p = 0.030). As a result of the two analyses, there was a statistically significant decrease only in experimental group 1 and a cortisol decrease in both experimental group 2 and the control group, but no significant difference was found.

Table 8. Results of repeated measures ANOVA of the difference between cortisol before and after in the groups.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Cortisol	Experimental group 1	0.170	0.076	0.105	0.055	F=13.506, p=.001	F=.342
	Experimental group 2	0.182	0.187	0.132	0.100	F=1.800, p=.190	p=.711
	Control group	0.147	0.084	0.112	0.069	F=4.166, p=.051	η^2_p=.

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Table 9. Results of repeated measures ANOVA of the difference between mid-session in the groups.

Variables	Group	Pre(score)		Post(score)		Time	Group×Time
		M	SD	M	SD		
Cortisol	Experimental group 1	0.127	0.084	0.084	0.052	F=5.255, p=.030	F=.1.248
	Experimental group 2	0.141	0.089	0.139	0.071	F=0.110, p=.919	p=.292
	Control group	0.166	0.090	0.140	0.088	F=2.027, p=.166	η^2_p=.

3.6.2. Verification of the difference between pre- and post-cortisol in homogeneous groups

As a result of repeated cortisol measurements, the interaction effect between time and group was not statistically significant, so the results of a paired t-test were shown in Table 10 to see if there was a difference in the mean of cortisol. In the experimental group 1, the cortisol concentration decreased statistically significantly posttest than pretest ($t = 4.457$, $p < 0.001$). In the interim measurement of the session, experimental group 1 ($t = 2.651$, $p = 0.013$) showed a significant difference (Table 11). In the two measurements, experimental group 2 and control group showed a decrease in cortisol, but did not show any significant differences.

Table 10. Differences in cortisol before and after urban gardening program.

Variables	Group	Pre		Post		t	p
		M	SD	M	SD		
Cortisol	Experimental group 1	0.180	0.077	0.100	0.054	4.457	.000
	Experimental group 2	0.182	0.186	0.132	0.099	1.342	.190
	Control group	0.146	0.083	0.111	0.068	2.041	.051

Table 11. Differences in cortisol before and after mid-session in urban gardening program.

Variables	Group	Pre		Post		t	p
		M	SD	M	SD		
Cortisol	Experimental group 1	0.131	0.081	0.083	0.051	4.457	.000
	Experimental group 2	0.140	0.089	0.138	0.071	1.342	.190
	Control group	0.165	0.090	0.140	0.088	2.041	.051

4. Discussion

This study aimed to investigate the effect of urban garden activities on participants' psychological and physiological benefits. This study showed that urban garden activities significantly change participants' perceived restorativeness. The perceived restorativeness after participation increased statistically significantly in the urban garden activity participating group compared to before participating in the program. However, there was no significant difference for the control group. These results of this study are consistent with Tyrväinen et al. [33] that short-term visits to urban natural areas have a positive effect on stress relief and recovery environment perception compared to the architectural environment and Kang and Suh [34] that visitors to Suncheon Bay National Garden experience stress relief and recovery naturally through involuntary attention.

This study also showed that urban garden activities significantly change participants' resilience. Participants in urban garden activities significantly increased their resilience, but the control group showed no significant change. These results are consistent with the results of Lee et al. [18] that healing agricultural activities for young adults relieve stress and improve resilience and happiness, and An [28] that physical activities such as outdoor walking for adults have a significant effect on resilience and psychological happiness.

This study showed that urban garden activities significantly change participants' sense of community. Participants in urban garden activities significantly increased sense of community, but the control group showed no significant change. These results are consistent with the results of Park and Lee [35], where participants in the urban garden program show a higher level of sense of community than non-women, and Jeong and Jang [36], who see the urban garden as an important place to develop users' sense of community.

This study showed that urban garden activities significantly change participants' stress reduction. Participants in urban garden activities showed a statistically significant decrease in stress after participation compared to before participation in the program. The control group had a decrease in stress, however, the difference was not statistically significant. These results are consistent with Stigsdotter and Grahn's [37] study investigated that access to gardens has a positive effect on stress, Park et al. [38] that healing programs in gardens affect stress changes in the elderly, and Park et al. [23] that garden activities have helped relieve stress.

This study showed that there was a significant reduction in cortisol level after participants in the urban garden activities in experimental group 1. However, for the control group and experimental group 2 there were no statistically differences in cortisol level. These results are consistent with Jang et al. [39], that stress was relieved, and cortisol levels were lowered in adult gardening plant cultivation activities. Therefore, urban garden activities can contribute to the community's revitalization and have positive effects, such as strengthening participants' attentional resilience, resilience, and stress relief.

As Lee [40] found that cortisol in subjects who shed tears or expressed upset during cortisol measurement increased, the further study is required to verify more specifically. In addition, when measuring cortisol, it is believed that cortisol levels increased while physically struggling as subjects skipped water or meals and moved in fear of cortisol contamination.

This study revealed the effectiveness of the urban garden activity program using gardens for adults. It is meaningful that the garden activity program verified the effectiveness of attention resilience, resilience, increased sense of community, and stress reduction. Therefore, urban garden activities can contribute to community revitalization and positive effects on mental health, such as increased attention resilience, resilience, and stress relief of urban residents.

In this study there were some as follows. In order to generalize the research results, first, it is necessary to secure a sufficient number of research subjects nationwide for garden activities. Second, since there was a difference in the proportion of male and female participants in this study, a study with a similar proportion of subjects should be conducted in subsequent studies. Third, since it has not been verified whether the program's effect persists even after returning to daily life after the program is terminated, a follow-up study is needed to determine the effect after the program is terminated. Fourth, the intensity of physical activities such as plant planting and management in the garden was not adjusted according to the size of the garden. In subsequent studies, physical activity should be controlled in gardens of similar sizes.

5. Conclusions

This study confirmed that urban garden activities have a physiological and psychological effects on the participants. The study participants showed significant positive changes after taking part in the garden activity programs in their perceived restorativeness, resilience, increased sense of community and decreased stress. Therefore, it is believed that urban garden activities will improve social relations with people, relieve stress through mental communication, improve individual quality of life, and realize green welfare to enjoy a healthy life. It is expected to be used as primary data to reveal the effects of gardens using urban garden activity programs.

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