J. People Plants Environ. Vol. 22 No. 3: 255-268, June 2019

ISSN : 2508-7673(Print)
ISSN : 2508-7681(Online)

https://doi.org/10.11628/ksppe.2019.22.3.255

RESEARCH ARTICLE OPEN ACCESS

# Differences in the Effects of a Horticultural Activity Program Depending on the Level of Resilience of College Students

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## ABSTRACT

Horticultural therapy, as a kind of complementary alternative therapies using nature as a medium, is an intervention method that can be applied to various subjects by utilizing horticultural activities that anyone can enjoy as a leisure activity. This research defined the resilience of individuals as a personal characteristic, and examined differences in the intervention effect of horticultural activities depending on the level of resilience. The results obtained in this study can be utilized in planning a horticultural activity program and setting the purpose and goals of horticultural activity programs. The subjects of this study were divided into the high resilience experimental group (Group A), the low resilience experimental Group (Group C), the high resilience control group (Group B), and the low resilience control group (Group D). The experiment was conducted in the campus of G University from September to November 2017, and the experimental group participated in the program once per week, a total of 10 sessions. The Korean version of the Connor-Davidson Resilience Scale, autonomic nervous assessment, and the interpersonal relationship change scale were carried out as pre- and post-assessment. Statistical analysis was performed using a non-parametric test. Group A showed statistically significant positive changes in relaxation of physical tension and stability. In conclusion, those with high resilience showed the higher intervention effects of horticultural activities on physical relaxation and stability than those with low resilience. However, there were some possible limitations in this study. Since the number of subjects was small and subjects were limited to college students, it is impossible to generalize the results of this study. Therefore, it is necessary to conduct follow-up studies to address and overcome these limitations.

**Keywords:** autonomic nervous assessment, green care, horticultural therapy, nature-based therapy, socio-horticulture

## Introduction

Complementary and alternative medicines (CAMs) have long been used in various areas as an adjuvant therapy to manage pain in daily life, and in the United States, CAMs have been developed into a science-based field of medicine as a complementary and alternative medicine center was established (Blake, 2019). In particular, the demand for the deve-

This study was approved by the Institutional Review Board (IRB) of Gyeongsang National University under the title of 'A Comparison Study on the Effects of a Horticultural Activity Program on the Stress Level of College Students from Daily Life and College Life Depending on the Level of Resilience (IRB No. GIRB-A17-Y-0006).'

**Received:** January 31, 2019, **Revised:** March 12, 2019, **Accepted:** April 29, 2019

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lopment and research of complementary and alternative medicine with the concept of green care using nature as a medium has been on the rise to address various personal problems and social problems not only for patients who need therapeutic interventions but also for the general public (de Boer et al., 2017).

Among them, activities using various horticultural materials provide people with opportunities to contact nature and captivating experience through the opportunities (Kaplan, 1973), and they are common leisure activities that every family member can enjoy (Yusuf et al., 1996). These activities provide humans with various effects including improving physical and mental health, and enhancing creativity and intellectual abilities (Infantino, 2004).

In particular, these horticultural activities have been developed by many researchers as a specialized method for mediation based on a systematic and structured theoretical framework (Son et al., 2016). Son et al. (2016) mentioned horticultural activities using living plants, therapy targets and measurable goals as three essential factors of specialized mediation methods.

Resilience is a system or a personal characteristic that protects people from psychological dangers associated with adversity that they experience (Rutter, 1987). In addition, Rutter (1987) described resilience as the capacity to reduce negative effects and chain reactions, to establish and maintain a sense of self-examination and self-esteem and to open opportunities and important turning points through positive attitudes towards life. Resilience is a kind of mental resistance to recover an adaptive state from difficulties (Hong, 2006), and is not a simple characteristic, but a multi-faceted personal characteristic that involves various human natures including control, positiveness and sociality (Shin et al., 2009).

To examine the impact of resilience, as a personal characteristic, on the effects of horticultural activities, this study provided a horticultural activity program (HAP) for college students and measured and analyzed differences in the effects of the HAP by dividing subjects based on the level of resilience by measuring the autonomic nervous system as a physical state and changes in interpersonal relationships as a psychological and emotional state.

## Research Methods

### Subjects and methods

#### Subjects

This study was conducted after acquiring an approval from the Institutional Review Board (IRB) of G university located in Jinju, Gyeongsangnam-do (approval number: GIRB-A17-Y-0006). Subjects were recruited by posting a recruitment notice on bulletin boards in the campus of the university from August 1 to 25, 2017, and they were informed of the purpose of this study and the procedures of the HAP. After they signed a consent form for participation, pre-assessment was conducted. A total of 45 subjects were recruited, and they were randomly divided into a control group (15 subjects) and a treatment group (30 subjects). For the control group, pre- and post-assessment was conducted without providing the HAP for them, and a free gift was provided for them after completing assessment. The treatment group was divided into two sub-groups considering the time they were able to participate in the HAP and the number of participants, and the same HAP was provided for the two sub-groups at a different time on the same day. As a reward for participating in the program, the outcome of the program was provided for subjects. In addition, those who are juniors and seniors in university are known to show a higher stress level (Lee, 2015), and based on the results, juniors and seniors were selected in this study to reduce demographical variables.

#### Process of operating the horticultural activity program (HAP)

The horticultural activity program (HAP) conducted in this study was composed for the purposes of managing and

reducing stress that subjects might experience in the process of studying or finding a job, and improving interpersonal relationships in social life considering the characteristics of subjects who enter the employment market. The HAP was provided once a week for one hour, a total of 10 sessions from September 1, 2017 to November 17, 2017 (Table 1).

Activities were performed in each session in order to achieve detailed goals as follows. In the Session 1, the activity of 'making a name tag with pressed flowers' was designed to ensure subjects explore their strengths and select words with which they can express themselves, and thus to improve their self-expression ability. The activity of 'making and drinking a herbal tea and sowing seeds' in the Session 2 was designed to relieve subjects' mental tension by selecting and mixing herbs of their favorite scent to make a herbal tea. Sowing seeds was a preliminary activity to the activity of 'creating a vegetable garden on the roof' to be performed later. The activity of 'decorating pots and planting herbs' in the Session 3 was designed to build an emotional bond with plants based on the concept of companion plants through the processes of decorating pots in which plants will be planted and moving them to a new space, and thus to improve emotional stability and reduce the level of stress. The activity of 'creating a vegetable garden on the roof' in the Session 4 was intended to create a vegetable garden together with other subjects on the roof of the university, to discuss where they plant plants and to move seedlings to another space with the goal of improving interpersonal relationships. The activity of 'making collages with leaves' in the Session 5 was designed to ensure subjects confront and express stress and talk with others about their stress sources including studying and finding a job while making their own portrait with leaves. The activity of 'making a grass doll' in the Session 6 was intended to share what they want to achieve with others, to imagine their happy future while making a doll and thus to create a successful self-image about studying and finding a job. In the Session 7, the activity of 'strolling around gardens in the campus' was performed considering that the session was conducted in the mid-term exam week with the goal of relieving physical tension and reducing stress from the exam. The activity of 'meditating while moving beans' in the Session 8 was designed to sort out inner problems while moving beans. Subjects were instructed to think of three different types of beans mixed in a bowl as their complex problems inside them (worries about studying and finding a job, personal problems, other worries), and to sort them into types while listening to the sound of nature like meditating in a quiet environment, and looking inside their mind to sort out their inner problems. In the Session 9, subjects participated in the activity of 'harvesting vegetables and cooking.' Vegetables from the garden that was created in the Session 4 and had been maintained since then were harvested. Subjects shared the collected vegetables

**Table 1.** Protocols for horticultural activity program

| Session | Topic | Objective | Date (mm/dd) |
|---|---|---|---|
| 1 | Creating a name tag with pressed flowers | Find one's strengths and improve self-expression | 09/01 |
| 2 | Make and drink herbal tea and sowing vegetables seedlings | Relaxation of mental tension | 09/08 |
| 3 | Decorate a pot and planting herbs | Relieving stress by communicating with plants | 09/15 |
| 4 | Rooftop gardening | Improvement of interpersonal relationship | 09/22 |
| 5 | Collage with leaves | View one's stress and express oneself in fallen leaves | 09/29 |
| 6 | Making a grass doll | Imagine oneself as a joyous figure | 10/13 |
| 7 | Walk in the school garden | Relaxation of physical tension and think about one's stress | 10/20 |
| 8 | Meditation while moving beans | Relaxation of mental tension and classifying stress sources | 11/03 |
| 9 | Harvest and cook | Enhance relationships through harvesting and sharing activities | 11/10 |
| 10 | Reflection the HAP and drink herbal tea | Looking back on one's stress by looking at past activities | 11/17 |

with others and made a sandwich and salad with some of them, talking about previous activities. In the last session, they had conversations with others about previous activities that they had done over the past nine sessions, while having a herbal tea and refreshments. Subjects also talked about how their stress that they had before participating in the program changed over the course of the program and how they felt after the program, looking back on their stress.

**Surveyed items**

The demographical characteristics of subjects including gender, age and grade were surveyed, and the Connor-Davidson Resilience Scale translated into Korean (KCD-RS) was used to assess their resilience. According to Baek (2010) that translated the scale into Korean and tested its reliability and validity, the reliability (Cronbach's α) of the original scale was .89, and that of the Korean version was .93, showing a high reliability. The reliability of this study was .956. Connor and Davidson (2003) developed the original scale and reported that the average score of general people was 80.4, and that the higher the score, the higher their resilience.

Subjects' physical and physiological conditions were measured to assess their physical stress in the autonomic nervous system using uBioMacpa (uBioClip v70, BioSence Creative co., Ltd, Seoul, Korea) in a non-invasive manner, including the stress index, pulse variability, sympathetic activation (Low frequency, LF), parasympathetic activation (High frequency, HF), autonomic balance (LF/HF), mean BPM, standard deviation of normal to normal R-R intervals (SDNN) and heart stability (the root mean square differences of successive R-R (heartbeat) intervals, RMSSD). They were measured with a detector on their fingers in a seated position for 2 minutes 30 seconds after getting enough rest in a comfortable position for over 5 minutes.

In terms of the stress index, the score of less than 25 means 'almost no stress,' and the score between 25 and 34 means 'under stress temporarily.' The score between 35 and 44 means 'in an early stressed state,' and the score between 45 and 59 means 'in a state of weak tolerance due to repetitive stressful events.' The score of 60 or more means 'in a chronically stressed state.' Pulse variability shows periodic changes in the heart rate over time. Healthy adults show high and complex pulse variability, and those with diseases or under stress show lower pulse variability. The average pulse variability of adults is between 30 and 40, and the score of 20 or lower means a chronically stressed state. Low frequency (LF) is an index of sympathetic activation, and is associated with mental stress. The score increases in a tense or excited state, and the normal LF range of those in the 20s is between 6.24 and 8.3. High frequency (HF) is an index of parasympathetic activation. The score increases in a fully-relaxed state, and the normal HF range of those in the 20s is 4.56-7.79. Autonomic balance (LF/HF) shows a balance between sympathetic and parasympathetic activation. The average range of those in the 20s is between 0.2 and 1.99 (1.0-1.2 in the daytime, 0.9-1.1 in the nighttime). Mean BPM is an average heart rate, and the average range of those in the 20s is between 62.52 and 98.5. Standard deviation of normal to normal R-R intervals (SDNN) is an index of the body's adaptability to external environments, and shows the body's resistance against stress. The average range of those in the 20s is between 44.36 and 124.84, and the lower the score, the lower the resistance of the body. The root mean square differences of successive R-R (heartbeat) intervals (RMSSD) is an index of heart stability, and the higher the score, the better the heart stability. The average range of those in the 20s is between 2.93 and 4.44. These scores were suggested based on the guidelines on the assessment and interpretation of the autonomic nervous system that were developed by the Heartmath Institute based on the guidelines on the analysis methods of pulse variability issued by the North American Society of Pacing and Electro-physiology and the European Society of Cardiology in 1996 (Vanderlei et al., 2009). Based on the scores, the autonomic nervous system is interpreted and assessed, and the level of stress is diagnosed and assessed (Lee et al., 2010).

To assess the psychological and emotional state of subjects, changes in the interpersonal relationships of subjects were

measured using the relationship change scale (RCS) developed by Schlein & Guerney and translated into Korean by Moon (1980). The scale is composed of a total of 25 questions, including four questions about satisfaction, four questions about communication, three questions about confidence, three questions about affection, two questions about sensitiveness, five questions about openness and four questions about understanding (Moon, 1980). The reliability (Cronbach's α) of the original scale was .860, and that in an earlier study similar to this study (Jo, 2013) was .845. The reliability of the scale used in this study was .904.

## Analysis methods

Data on the control group and the treatment group were collected, and based on the results of Connor and Davidson (2003) that the average resilience score of ordinary people was 80.4, subjects were divided into two groups: those who showed a high resilience score, and those who showed a low resilience score.

Out of 30 subjects in the group treated with the HAP, two subjects who did not participate in post-assessment and nine subjects who did not participate in any activity or did not answer any question during the questionnaire survey were excluded. A total of 19 subjects in the treatment group were divided into the high resilience group (nine subjects) and the low resilience group (10 subjects). Out of 15 subjects in the control group, two subjects who did participate in pre-assessment, but not in post-assessment were excluded. A total of 13 subjects in the control group were divided into the high resilience group (seven subjects) and the low resilience group (six subjects) (Figure 1).

Statistical analysis and graph analysis were performed using a statistical analysis program (IBM SPSS 25). The homogeneity of the surveyed groups was analyzed using the Kruskal-Wallis test and the Mann-Whitney U test, and the significance level was $p < .05$. To examine the effects of the HAP treatment, the Wilcoxon signed rank test was conducted, and the significance level was $p < .05$.

In order to test differences between the groups and to analyze the size of the groups as a post-hoc test, the Mann-Whithey U test was conducted based on Bonferronis's Method, and the significance level was .0083.

In addition, correlation analysis was conducted to identify the correlation between resilience and the score of interpersonal relationships.

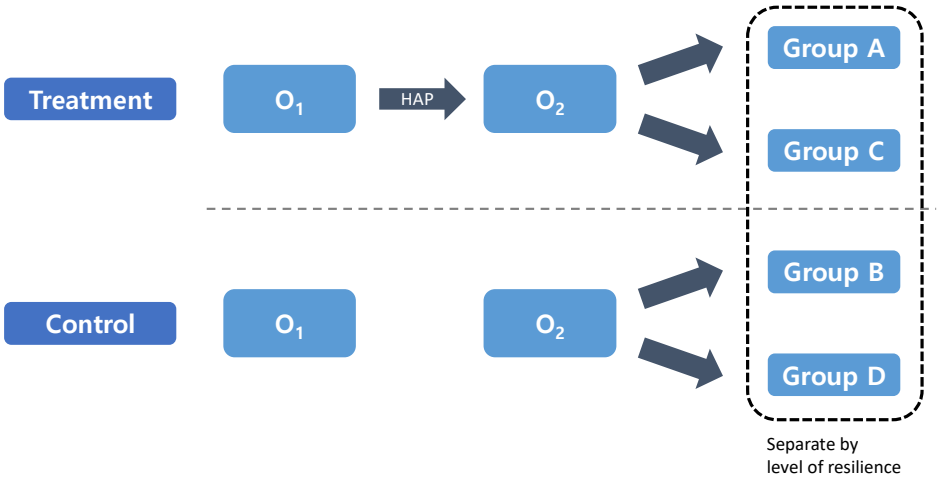


**Figure 1.** Classification of the study participants. $O_1$ = pre-test; $O_2$ = post-test; HAP = horticultural activity program; Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.

## Results and Discussion

### Demographic characteristics and pre-homogeneity test

#### Classification of groups depending on the level of resilience and homogeneity test

The average resilience score of ordinary people reported by Connor and Davidson (2003) was 80.4, and based on the score, subjects were divided into those who showed a high resilience score, and those who showed a low resilience score (Table 2). The number of those who showed a high resilience score and those who showed a low resilience score was 16 respectively, and specifically, the number of those who showed a high resilience score in the treatment group (Group A) and a high resilience score in the control group (Group B) was 9 and 7 respectively. The number of those who showed a low resilience score in the treatment group (Group C) and a low resilience score in the control group (Group D) was 10 and 6 respectively. The homogeneity between the groups was tested using the Kruskal-Wallis test, and there were statistically significant differences between the four groups. The homogeneity between the treatment and control groups by the level of resilience was tested using the Mann-Whitney U test, and there was no statistically significant difference within the same group that was divided depending on the level of resilience, both within the high resilience group and the low resilience group, showing that they were homogeneous.

#### Demographic characteristics

The demographic characteristics of the four groups were as shown in Table 3. The average age of the entire subjects was 23.4, and the number of male and female students was 10 (30.3%) and 22 (66.7%) respectively. The number of juniors and seniors was 17 (51.5%) and 15 (45.5%) respectively. The average age of Group A was 22.4, and the number of juniors and seniors in Group A was eight and one respectively. All of them were female. The average age of Group B was 23.9. and the number of juniors and seniors in Group B was one and six respectively. The number of female and male students in Group B was two and five respectively. The average age of Group C was 23.6, and the number of juniors and seniors in Group C was eight and two respectively. The number of male and female students in Group C was four and six respectively. The average age of Group D was 23.83, and all of them were seniors. The number of male and female students in Group D was four and two respectively. Except the number of juniors and seniors, there was no significant difference in average age and gender between the groups divided depending on the level of resilience ($p < .05$).

#### Homogeneity test on surveyed items

The homogeneity test was conduced on the measured data on the autonomic nervous system and changes in inter-

**Table 2.** Comparison of resilience characteristics between groups before the horticultural activity program (HAP)

| Variable | High level of resilience (n = 16) | | Low level of resilience (n = 16) | | Test[z] (*p*-value) |
|---|---|---|---|---|---|
| | Group A (n = 9) | Group B (n = 7) | Group C (n = 10) | Group D (n = 6) | |
| Resilience | 90.67 (10.50) | 93.71 (13.09) | 69.70 (6.46) | 72.83 (4.71) | H = 23.75 (.000[***]) |
| Test (*p*-value)[y] | Z = –0.32 (.758) | | Z = –1.26 (.220) | | |

*Note*. Values are mean (standard deviation). Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.

[z]Verification of homogeneity among all groups by Kruskal-Wallis test.

[y]Verification of homogeneity between each level of resilience by Mann-Whitney U test.

[***]$p < .001$ by Kruskal-Wallis test.

personal relationships, and the results were as shown in Table 4. The results of the homogeneity test between the groups with high and low resilience showed no statistically significant difference in all the sub-items of the autonomic nervous system and changes in interpersonal relationships.

**Table 3.** Comparison of demographic characteristics of participants between groups

| Variable | High level of resilience (n = 16) | | | | | Low level of resilience (n = 16) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Group A (n = 9) | | Group B (n = 7) | | Test ($p$-value) | Group C (n = 10) | | Group D (n = 6) | | Test ($p$-value) |
| | M (SD) | n (%) | M (SD) | n (%) | | M (SD) | n (%) | M (SD) | n (%) | |
| Age | 22.44 (0.88) | | 23.86 (1.57) | | Z = –1.94 (.071) | 23.60 (1.58) | | 23.83 (1.32) | | Z = –0.56 (.635) |
| Gender | | | | | | | | | | |
| Male | | - | | 2( 29) | $\chi^2$ = 2.94 (.086) | | 4( 40) | | 4( 67) | $\chi^2$ = 1.07 (.302) |
| Female | | 9(100) | | 5( 71) | | | 6( 60) | | 2( 33) | |
| College year | | | | | | | | | | |
| Junior | | 8( 89) | | 1( 14) | $\chi^2$ = 8.91 (.003) | | 8( 80) | | - | $\chi^2$ = 9.60 (.002) |
| Senior | | 1( 11) | | 6( 86) | | | 2( 20) | | 6(100) | |

*Note*. Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.

**Table 4.** Comparison of baseline characteristics of participants between groups

| Variable | High level of resilience (n = 16) | | | Low level of resilience (n = 16) | | |
|---|---|---|---|---|---|---|
| | Group A (n = 9) | Group B (n = 7) | Test ($p$-value) | Group C (n = 10) | Group D (n = 6) | Test ($p$-value) |
| Autonomic nervous assessment | | | | | | |
| Stress index | 36.11( 7.17) | 36.57( 7.48) | Z = –0.32( .758) | 37.60( 3.78) | 38.33( 7.45) | Z = –0.98( .368) |
| Pulse variability | 45.59(10.43) | 40.29(15.60) | Z = –1.11( .299) | 37.23( 8.14) | 37.32(17.90) | Z = –0.87( .428) |
| LF | 7.66( 0.87) | 7.56( 0.52) | Z = –0.27( .837) | 8.01( 0.76) | 8.03( 0.96) | Z = –0.50( .635) |
| HF | 6.83( 0.45) | 6.60( 0.61) | Z = –0.65( .562) | 6.80( 0.74) | 6.68( 1.06) | Z = –0.65( .562) |
| LF/HF | 1.12( 0.10) | 1.13( 0.08) | Z = –0.74( .492) | 1.18( 0.06) | 1.22( 0.15) | Z = –0.28( .778) |
| Mean BPM | 80.63(12.98) | 81.87(11.09) | Z = –0.80( .470) | 84.96(17.55) | 92.35( 15.26) | Z = –0.74( .492) |
| SDNN | 47.40(16.03) | 44.81(10.39) | Z = –0.37( .313) | 44.86(18.45) | 40.65( 12.84) | Z = –1.09( .313) |
| RMSSD | 37.70(13.16) | 34.81(18.74) | Z = –0.58( .606) | 28.68(10.59) | 25.60( 16.32) | Z = –0.76( .492) |
| Relationship Change Scale (RCS) | | | | | | |
| Satisfaction | 14.78( 1.39) | 14.86( 2.91) | Z = –0.38( .758) | 12.70( 1.49) | 12.17( 1.47) | Z = –0.22( .875) |
| Communication | 15.33( 2.60) | 15.29( 2.50) | Z = –0.11( .918) | 13.00( 2.21) | 12.33( 1.51) | Z = –0.40( .713) |
| Trust | 10.33( 1.80) | 11.57( 2.15) | Z = –1.19( .252) | 9.40( 1.26) | 8.33( 1.03) | Z = –1.71( .118) |
| Intimacy | 10.56( 2.01) | 11.43( 2.23) | Z = –0.92( .408) | 10.20( 1.55) | 9.00( 0.63) | Z = –1.47( .181) |
| Sensitivity | 7.78( 1.20) | 7.57( 1.51) | Z = –0.06(1.000) | 6.00( 1.49) | 7.50( 1.76) | Z = –1.59( .147) |
| Openness | 16.44( 3.57) | 18.29( 3.35) | Z = –1.17( .252) | 14.50( 2.37) | 15.00( 0.89) | Z = –1.10( .313) |
| Understanding | 15.89( 2.32) | 15.29( 1.60) | Z = –0.43( .681) | 13.10( 2.28) | 14.17( 1.94) | Z = –0.78( .492) |
| Total | 105.67(25.60) | 94.29(13.61) | Z = –0.48( .681) | 78.90( 8.90) | 78.50( 2.43) | Z = –0.22( .875) |

*Note*. Values are mean (standard deviation). Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group; LF = low frequency; HF = high frequency; BPM = beats per minute; SDNN = standard deviation of normal to normal R-R intervals; RMSSD = the root mean square differences of successive R-R (heartbeat) intervals.

## Effects of the horticultural activity program (HAP) on changes in the autonomic nervous system depending on the level of resilience

To examine the effects of the horticultural activity program (HAP) on physiological responses, the activity of the autonomic nervous system was measured and the results are as shown in Table 5. Group A showed statistically significant differences in several items between pre- and post-assessment.

**Table 5.** Comparison of variances on autonomic nervous assessment between groups before and after horticultural activity program (HAP)

| Variable | Group A | Group B | Group C | Group D | *p*-value |
|---|---|---|---|---|---|
| Stress index | | | | | |
| Pre | 36.11( 7.17) | 36.57( 7.48) | 37.67( 3.78) | 38.33( 7.45) | .533 |
| Post | 28.33( 5.39) | 39.71(10.44) | 34.90( 6.33) | 39.00( 3.69) | .013 |
| *p*-value | .021 | .310 | .137 | .715 | - |
| Pulse variability | | | | | |
| Pre | 46.59(10.43) | 40.29(15.60) | 37.23( 8.14) | 37.32(17.90) | .168 |
| Post | 61.50(14.95) | 38.58(19.95) | 44.28(14.71) | 34.27( 4.19) | .018 |
| *p*-value | .086 | .612 | .203 | .753 | - |
| Low frequency (LF) | | | | | |
| Pre | 7.66( 0.87) | 7.56( 0.52) | 8.01( 0.76) | 8.03(0.96) | .641 |
| Post | 8.02( 0.50) | 7.39( 0.74) | 8.24( 0.56) | 7.55(0.49) | .038 |
| *p*-value | .120 | .596 | .312 | .465 | - |
| High frequency (HF) | | | | | |
| Pre | 6.83(0.45) | 6.60( 0.61) | 6.80( 0.74) | 6.68( 1.06) | .769 |
| Post | 6.94(0.52) | 6.21( 1.13) | 6.90( 0.66) | 6.68( 0.43) | .432 |
| *p*-value | .953 | .443 | .440 | .917 | - |
| LF/HF | | | | | |
| Pre | 1.12( 0.10) | 1.13( 0.08) | 1.18( 0.06) | 1.22( 0.15) | .254 |
| Post | 1.17( 0.10) | 1.20( 0.17) | 1.19( 0.12) | 1.15( 0.14) | .954 |
| *p*-value | .194 | .301 | .792 | .336 | - |
| Mean BPM | | | | | |
| Pre | 80.63(12.98) | 81.87(11.09) | 84.96(17.55) | 92.35(15.26) | .370 |
| Post | 71.91( 5.21) | 83.56( 9.77) | 79.74(11.06) | 86.37( 6.22) | .017 |
| *p*-value | .021 | .735 | .241 | .173 | - |
| SDNN | | | | | |
| Pre | 47.40(16.03) | 44.81(10.39) | 44.86(18.45) | 40.65(12.83) | .710 |
| Post | 69.10(20.56) | 39.73(12.92) | 59.99(13.76) | 46.23( 9.99) | .005 |
| *p*-value | .028 | .398 | .017 | .249 | - |
| RMSSD | | | | | |
| Pre | 37.70(13.16) | 34.81(18.74) | 28.68(10.59) | 25.60(16.32) | .286 |
| Post | 56.56(18.09) | 30.09(15.66) | 38.86(16.36) | 24.05( 5.52) | .005 |
| *p*-value | .028 | .176 | .093 | .753 | - |

*Note*. Values are mean (standard deviation). Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group; LF = low frequency; HF = high frequency; BPM = beats per minute; SDNN = standard deviation of normal to normal R-R intervals; RMSSD = the root mean square differences of successive R-R (heartbeat) intervals.

Specifically, the stress index of the groups treated with the HAP significantly decreased, and Group A with a high resilience level showed a statistically significant decrease from 36.11 in pre-assessment to 28.33 in post-assessment. On the other hand, the stress of index of the two control groups increased although the increase was not statistically significant. These results were similar to the results of Kang and Back (2017) that the stress index of elderly people obtained by measuring pulse waves decreased after participating in an urban agricultural experience program. In addition, another study that analyzed the level of cortisol, a stress hormone, in the body to examine changes in physiological stress after performing a horticultural therapy program (Han et al., 2018) also reported a decrease in the physiological stress after treatment, which was similar to the results of this study.

The mean BPM and RMSSD in Group A showed statistically significant changes compared to other groups. The mean BPM decreased from 80.63 in pre-assessment to 71.91 in post-assessment ($p$ = .21), and the RMSSD increased from 37.71 in pre-assessment to 56.56 in post-assessment ($p$ = .28).

The SDNN in the groups treated with the HAP showed a statistically significant increase compared to the control groups. The SDNN shows the adaptability of the body to external environments, and the treatment of the HAP seems to contribute to improvements in the adaptability of the body against external environments regardless of the resilience of subjects.

Decreases in the BPM and increases in the RMSSD and SDNN mean improvements in the autonomic nervous system and relaxation of physiological responses (Kim, 2016). For example, studies on the effects of exercises that relax the body by relaxing breathing such as Pilates, Qi-gong and yoga reported that physical changes caused by these exercises such as decreases in the mean BPM and increases in the RMSSD and SDNN are effective in achieving physiological stability both in the body and mind and activate the autonomic nervous system (Kim, 2015, 2016). The results of these studies indicate that horticultural activities used in this study without placing any burden on the body are effective in relaxing the body and mind of subjects.

There was no statistically significant difference in pulse variability, LF, HF and LF/HF within each group between pre- and post-assessment. However, pulse variability and LF showed a statistically significant difference between groups, and the items were compared between groups (Table 6).

After testing differences between groups, the size between groups was tested using the Mann-Whitney U test based on Bonferroni's method (significance level = .0083), and there were statistically significant differences in pulse variability between Group A and Group D.

These results indicate that the horticultural activity program (HAP) had a positive impact on the autonomic nervous system. In addition, in terms of resilience, a personal characteristic, the impact of the HAP treatment on the autonomic nervous system of those who showed high resilience was higher than those who showed low resilience.

**Table 6.** Paired test results on pulse variability and low frequency (LF) between each group

| Variable | Group setting | | | | | |
|---|---|---|---|---|---|---|
| | A × B | A × C | A × D | B × C | B × D | C × D |
| Pulse variability | .028 | .031 | .005* | .669 | .181 | .731 |
| LF | .400 | .091 | .066 | .033 | .031 | .731 |

*Note*. Values are $p$-value. Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.
*$p$ < .008 by Mann-Whitney U test based on Bonferroni's method.

## Effects of the horticultural activity program (HAP) on interpersonal relationships depending on the level of resilience

The effects of horticultural activities on changes in the interpersonal relationships of subjects were examined as shown in Table 7. In terms of changes in interpersonal relationships, subjects were divided into those who showed high resilience in the treatment and control groups and those who showed low resilience in the treatment and control groups respectively, and changes between pre- and post-assessment within each group were tested. Except Group A that showed an increase from 91.11 to 98.89 ($p$ = .44), there was no statistically significant difference.

**Table 7.** Comparison of variances on subcategories of interpersonal relationship between groups before and after horticultural activity program (HAP)

| Variable | Group A | Group B | Group C | Group D | $p$-value |
|---|---|---|---|---|---|
| Satisfaction | | | | | |
| Pre | 14.78( 1.39) | 14.86( 2.91) | 12.70( 1.49) | 12.17( 1.47) | .026 |
| Post | 15.44( 1.81) | 15.29( 2.56) | 13.60( 2.07) | 13.33( 1.63) | .082 |
| $p$-value | .290 | .450 | .281 | .339 | - |
| Communication | | | | | |
| Pre | 15.33( 2.60) | 15.29( 2.50) | 13.00( 2.21) | 12.33( 1.51) | .032 |
| Post | 15.78( 1.79) | 15.57( 2.23) | 13.00( 2.45) | 12.00( 1.10) | .003 |
| $p$-value | .339 | .581 | 1.000 | .655 | - |
| Trust | | | | | |
| Pre | 10.33( 1.80) | 11.57( 2.15) | 9.40( 1.26) | 8.33( 1.03) | .017 |
| Post | 10.56( 0.88) | 11.00( 1.91) | 10.10( 1.20) | 8.67( 2.07) | .101 |
| $p$-value | .565 | .480 | .168 | .577 | - |
| Intimacy | | | | | |
| Pre | 10.56( 2.01) | 11.43( 2.23) | 10.20( 1.55) | 9.00( 0.63) | .097 |
| Post | 10.89( 2.20) | 11.29( 2.14) | 10.00( 1.56) | 9.33( 1.86) | .261 |
| $p$-value | .453 | .854 | .952 | .458 | - |
| Sensitivity | | | | | |
| Pre | 7.78( 1.20) | 7.57( 1.51) | 6.00( 1.49) | 7.50( 1.76) | .072 |
| Post | 7.78( 0.83) | 7.86( 1.21) | 6.10( 1.29) | 6.50( 1.38) | .014 |
| $p$-value | .705 | .480 | .803 | .063 | - |
| Openness | | | | | |
| Pre | 16.44( 3.57) | 18.29( 3.35) | 14.50( 2.37) | 15.00( 0.89) | .066 |
| Post | 17.11( 1.83) | 17.71( 4.46) | 15.10( 1.52) | 13.83( 1.60) | .029 |
| $p$-value | .527 | .336 | .233 | .157 | - |
| Understanding | | | | | |
| Pre | 15.89( 2.32) | 15.29( 1.60) | 13.10( 2.28) | 14.17( 1.94) | .087 |
| Post | 15.22( 2.22) | 15.86( 2.27) | 12.90( 1.85) | 13.00( 2.53) | .028 |
| $p$-value | .526 | .480 | .887 | .102 | - |
| Total | | | | | |
| Pre | 91.11(10.99) | 94.29(13.61) | 78.90( 8.90) | 78.50( 2.43) | .006 |
| Post | 98.89( 6.88) | 94.57(15.94) | 80.80( 8.27) | 76.67( 4.55) | .000 |
| $p$-value | .044 | .916 | .313 | .528 | - |

*Note*. Values are mean (standard deviation). Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.

In addition, the score of the entire subjects was compared without dividing them depending on their resilience level. Unlike the results of the autonomic nervous system, there were several items that showed statistically significant differences in the four groups in pre-assessment. The average score of some items in the groups that showed high resilience in pre-assessment was higher than the groups that showed low resilience. Given this, the results above can be attributed to differences in the level of resilience that reflected subjective personal characteristics.

Items that showed statistically significant differences between groups in post-assessment were further analyzed to identify differences by pairing groups using the Mann-Whitney test. After that, the results were tested based on Bonferroni's method (significance level = .0125) (Table 8). There was no statistically significant difference between the two experiment groups (A × C), between the high resilience control group and the low resilience treatment group (B × C), and between the low resilience treatment and control groups (B × D).

However, there was a statistically significant difference between the high resilience treatment and control groups (A × B) in sensitivity ($p$ = .008) and the total score of changes in interpersonal relationships ($p$ < .001). These results can be attributed to the effects of the HAP on the high resilience treatment group improved the total score of interpersonal relationships and sensitivity.

In addition, the results of communication showed that the difference between the high resilience treatment and control groups (A × B) was close to the breakpoint of statistical significance ($p$ < .0125), and that there was a statistically significant difference (.001) between the high resilience treatment group and the low resilience control group (A × D). There was a statistically significant difference (.002) between the low resilience treatment and control groups (C × D), which indicates that the HAP brought about significant changes in the communication skills of subjects. However, there was no statistically significant difference between the high resilience control group and the low resilience treatment group (B × C), showing no significant effect of the HAP treatment ($p$ = .055). As such, when the level of resilience was the same, the effect of the HAP treatment was significant. However, when the level of resilience in the control group was high, but that in the treatment group was low, the level of resilience seems to affect the results of the effects of the HAP treatment as an intrinsic variable.

There were statistically significant differences between the high resilience treatment group and the low resilience control group (A × D) in communication ($p$ = .001), openness ($p$ = .005), and the total score of changes in interpersonal relationships ($p$ < .001), which can be attributed to the interaction between the treatment and the level of resilience.

The overall results above showed that the total score of changes in interpersonal relationships that was subjectively measured by subjects showed a significant increase after providing the HAP only in the high resilience treatment group,

**Table 8.** Paired test results on subcategories of interpersonal relationship between each group

| Variable | Group setting | | | | | |
|---|---|---|---|---|---|---|
| | A × B | A × C | A × D | B × C | B × D | C × D |
| Communication | .013 | .681 | .001* | .055 | .220 | .002* |
| Sensitivity | .008* | 1.000 | .088 | .019 | .635 | .138 |
| Openness | .035 | .681 | .005* | .193 | .181 | .101 |
| Understanding | .028 | .837 | .113 | .014 | .875 | .073 |
| Total | .000* | .351 | .000* | .019 | .313 | .014 |

*Note*. Values are $p$-value. Group A = high-resilience experimental group; Group B = high-resilience control group; Group C = low-resilience experimental group; Group D = low-resilience control group.
*$p$ < .008 by Mann-Whitney U test based on Bonferroni's method.

which seems to indicate that the level of resilience affects the total score of interpersonal relationships through horticultural activities. Earlier studies on resilience and interpersonal relationships reported that the two variables are closely related to each other, having a positive correlation (Son and Moon, 2011; Woo et al., 2012; Choi, 2016). The results of this study also seem to indicate that the treatment of horticultural activities resulted in a significant increase in the total score of interpersonal relationships in the high resilience treatment group. However, in other sub-items under interpersonal relationships, the level of resilience as a personal characteristic, regardless of whether the treatment was provided or not, seems to affect the results. The results are similar to those of Son and Moon (2011) that social relationships were closely related to resilience as a socio-environmental factor that directly affects resilience, and those of Woo et al. (2012) that resilience and interpersonal relationships had a significant correlation.

Other studies on resilience and interpersonal relationships reported that changes in socio-environmental factors such as interpersonal relationships directly affected the resilience of individuals (Son and Moon, 2011; Woo et al., 2012; Choi, 2016). It was also reported that improvements in resilience improved self-esteem and positiveness in a positive direction (Choi, 2016), reduced anxiety, depression and obsessive-compulsive symptoms and brought about positive changes to mental wellbeing (Hjemdal et al., 2011; Souri and Hasanirad, 2011). In line with that, it will be necessary to additionally identify the effects of horticultural activity programs not only on changes in interpersonal relationships, but also on changes in resilience, and to analyze and verify their correlation and effects.

## Conclusion

Many horticultural activity programs (HAP) using plants as a medium have been developed as a complementary and alternative therapy not only for patients who need professional treatment, but also for other purposes such as addressing a variety of psychological and mental problems that occur in daily life from the perspective of social welfare and promoting communication within a community. In particular, as the demand for eco-friendly programs has recently increased in society, many studies have been conducted. In the process of conducting these studies, personal characteristics of subjects often act as a variable that significantly affects research results depending on the application of treatment.

This study focused on individuals' resilience level, and set it as one personal characteristic to examine differences in the effects of a HAP depending on the level of resilience.

This study measured changes in the autonomic nervous system that are expressed as a physiological response after providing the HAP, and the high resilience groups depending on the level of resilience showed more improvements in the relaxation of the body and adaptability than the low resilience groups. The results seemed to indicate that the high resilience groups showed better physical effects during horticultural activities due to their personal characteristics such as activeness, social response to others and positive attitudes. In terms of changes in interpersonal relationships subjectively measured by subjects, the total score of the high resilience treatment group showed a positive increase, but there was no significant effect of horticultural activities observed in overall items, but changes were observed only in some sub-items of changes in interpersonal relationships including sensitivity and communication over time depending on the level of resilience. Considering the results of earlier studies, these results can be attributed to the high correlation between interpersonal relationships and resilience, and the correlation seemed to have a positive impact on the high resilience treatment group.

The overall results of this study indicate that the level of resilience as a personal characteristic acted as one factor that affects the effects of horticultural activities. If the level of resilience is studied as one of the basic survey items, it is expected to contribute to verifying the effects of horticultural activity programs and reaching conclusions. In addition, in

follow-up studies on the period of time required to achieve the effects of horticultural therapies depending on the level of resilience, the results of this study can be utilized in determining the number of session suitable for individual subjects in the intial planning stage. In particular, these results can be utilized in planning programs for individual subjects who show low resilience to maximize the effects of horticultural therapy interventions.

There are some limitations in this study. Since the subjects surveyed in this study were limited to a small number of college students, it is difficult to generalize the results of this study. Therefore, it will be necessary to verify the effects of horticultural activity programs considering the level of resilience as a personal characteristic targeting various groups of subjects in order to address the limitations.

## References

Baek, H.S. 2010. Reliability and validity of the Korean version of the Connor-Davidson resilience Scale (K-CD-RISC). Master's thesis, Eulji University, Daejeon, Korea.

Blake, H.M. 2019. Botanical treatments in cancer pain management. In: A. Gulati, V. Puttanniah, B.M. Bruel, W.S. Rosenberg, an J.C. Hung (Eds.), Essentials of interventional cancer pain management (pp. 503-506). Cham, Switzerland: Springer.

Choi, M.J. 2016. A study on recovery resilience, depressions, and self-esteem in university students. Korean Acad. Pract. Hum. Welf. 17:233-250.

Connor, K.M. and J.R.T. Davidson. 2003. Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC). Depress. Anxiety 18(2):76-82. https://doi.org/10.1002/da.10113

de Boer, B., J.P. Hamers, S.M. Zwakhalen, F.E. Tan, H.C. Beerens, and H. Verbeek. 2017. Green care farms as innovative nursing homes, promoting activities and social interaction for people with dementia. J. Am. Med. Dir. Assoc. 18(1): 40-46. https://doi.org/10.1016/j.jamda.2016.10.013

Han, A.R., S.A. Park, and B.E. Ahn. 2018. Reduced stress and improved physical functional ability in elderly with mental health problems following a horticultural therapy program. Complement. Ther. Med. 38:19-23. https://doi.org/10.1016/j.ctim.2018.03.011

Hjemdal, O., P.A. Vogel, S. Solem, K. Hagen, and T.C. Stiles. 2011. The relationship between resilience and levels of anxiety, depression, and obsessive-compulsive symptoms in adolescents. Clin. Psychol. Psychother. 18(4):314-321. https://doi.org/10.1002/cpp.719

Hong, E.S. 2006. Conceptual understanding of resilience and instructional suggestion. Korean J. Spec. Educ. 41(2):45-67.

Infantino, M. 2004. Gardening: A strategy for health promotion in older women. J. N. Y. State Nurses Assoc. 35(2):10-17.

Jo, H.J. 2013. Effect of horticultural therapy program using the floral design on the ego-identity, personal relations, and stress of the university students. Master's thesis, Korea University, Seoul, Korea.

Kang, H.K. and S.J. Back. 2017. Effect of urban agriculture experience program on the mental health of the elderly. J. People Plants Environ. 20(1):1-6. https://doi.org/10.11628/ksppe.2017.20.1.001

Kaplan S. 1973. Cognitive maps, human needs and the designed environment. In: W.F.E. Preiser (Ed.), Environmental design research (pp. 275-283). Stroudsburg, PA: Dowden, Hutchinson and Ross.

Kim, J.S. 2015. The effect of the exercise performance of yoga and pilates on the autonomic nervous system. J. Korea Acad. Ind. Coop. Soc. 16(7):4450-4458. https://doi.org/10.5762/KAIS.2015.16.7.4450

Kim, J.S. 2016. The effects of breathing exercises on the change of autonomic nervous system activity in female adults. J. Korean Phys. Educ. Assoc. Women 30(2):295-309. https://doi.org/10.16915/jkapesgw.2016.06.30.2.295

Lee, J.H., J.Y. Kim, S.J. Kim, J.H. Seo, and W.Y. Sung. 2010. Effects of acupuncture at GV 20(Baihui) evaluated by the second derivative of photoplethysmogram waveform under stress. J. Orient. Neuropsychiatry 21(3):19-27.

Lee, M.R. 2015. Relationship of career-related stress, commitment to a career choice and career decision self-efficacy of college students. J. Korea Acad. Ind. Coop. Soc. 16(12):8767-8775. https://doi.org/10.5762/KAIS.2015.16.12.8767

Moon, S.M. 1980. A study on the effect of human relations training of university students. J. Gyeongsang Natl. Univ. 19(2): 195-203.

Rutter, M. 1987. Psychosocial resilience and protective mechanisms. Am. J. Orthopsychiatry 57(3):316-331. https://doi.org/10.1111/j.1939-0025.1987.tb03541.x

Shin, W.Y., M.G. Kim, and J.H. Kim. 2009. Developing measures of resilience for Korean adolescents and testing cross, convergent, and discriminant validity. Stud. Korean Youth 20(4):105-131.

Son, D.S. and Y.H. Moon. 2011. A study on the influence factors the resilience of social welfare majors in college. Korean J. Soc. Welf. Educ. 16:48-69.

Son, K.C., S.J. Jung, A.Y. Lee, and S.A. Park. 2016. The theoretical model and universal definition of horticultural therapy. Acta Hortic. 1121:79-88. https://doi.org/10.17660/ActaHortic.2016.1121.12

Souri, H. and T. Hasanirad. 2011. Relationship between resilience, optimism and psychological well-being in students of medicine. Procedia Soc. Behav. Sci. 30:1541-1544. https://doi.org/10.1016/j.sbspro.2011.10.299

Vanderlei, L.C.M., C.M. Pastre, R.A. Hoshi, T.D. Carvalho, and M.F.D. Godoy. 2009. Basic notions of heart rate variability and its clinical applicability. Rev. Bras. Cir. Cardiovasc. 24(2):205-217. https://doi.org/10.1590/S0102-76382009000200018

Woo, S.H., G.H. Song, and G.P. Cho. 2012. The effects of university students' self-differentiation on ego-resiliency and interpersonal relations. Korea Educ. Inquiry [Chung-Ang University] 30(4):59-80.

Yusuf, H.R., J.B. Croft, W.H. Giles, R.F. Anda, M.L. Casper, C.J. Caspersen, and D.A. Jones. 1996. Leisure-time physical activity among older adults. United States, 1990. Arch. Intern. Med. 156(12):1321-1326. https://doi.org/10.1001/archinte.1996.00440110093012