Effects of an Agro-healing Program on Promoting Mental Health of the Middle-aged

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ABSTRACT

Background and objective: This study was conducted with 10 men and women in their 50s–60s to investigate the effect of agro-healing activities on the improvement of mental health.

Methods: The experimental group participated in total 8 sessions of agro-healing activities, once a week for 2 hours each, at a care farm in Wanju-gun. Physiological measurements were taken with an electroencephalogram (EEG), Salivettes samples, and blood pressure before and after the activities.

Results: As a result of analyzing the changes in brainwaves of the experimental group before and after agro-healing activities, relative slow alpha (RSA), relative fast alpha (RFA), and ratio of alpha to high beta (RAHB), the indices of stability and relaxation, increased after the program with statistical significance. Also, the ratio of SMR to theta (RST) of the attention index increased on the right frontal lobes, temporal lobes, and left occipital lobes, and relative low beta (RLB) increased on the frontal lobes, temporal lobes, and occipital lobes after the program with statistical significance. The sympathetic nervous system activity, which is a stress index, decreased after the program, whereas the parasympathetic nervous system activity, which is a relaxation index, increased, showing statistical significance ($p < .05$). As a result of analyzing the changes in blood pressure after the program, systolic blood pressure and diastolic blood pressure decreased from prehypertension to normal blood pressure, showing statistical significance. These results indicate that participating in agro-healing activities at a care farm for the 50–60s helps reduce stress and improve stability and relaxation as well as attention.

Conclusion: Thus, developing and applying customized agro-healing programs for participants will have a positive effect on brain activity and psychophysiological improvement by relieving tension and stress. However, there are limitations in generalizing the results of this study since most of agro-healing farms have low accessibility that leads to a low level of participants.

Keywords: agro-healing activity, blood pressure, electroencephalogram (EEG)

Introduction

It is difficult to accurately distinguish the stages of human development, especially adulthood, but typically adulthood is classified into three stages of young adulthood (ages 20–40), middle adulthood (ages 40–64), and late

adulthood (age 65 and above) (Chung, 2008). Those in middle adulthood have lived their lives for family in younger years but cannot expect their children to take care of them in later years, and they are the first generation to strongly perceive that they must lead an independent life to prepare for old age (Jang, 2001). They also face the

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typical stress of the ‘sandwich generation’ (Chung, 2008). Middle age is the stage in which physiological functions are deteriorated by aging and economic/social activities are declining on the surface, and the interest and need for health are different from other ages. Stress in the middle age involves physical symptoms such as women’s menopause and men’s andropause, and they even mentally face a mid-life crisis (Haber, 2006; Chung, 2008). In particular, hormonal changes and aging of middle-aged women deteriorate the functions of all body organs (Kim et al., 2019) as well as cognitive functions like memory or concentration (Kim et al., 2000), and may even lead to emotional symptoms like depression, sense of failure, and loneliness (Lee and Chang, 1992). Therefore, to increase women’s satisfaction with the quality of their lives after middle age, there must be an intervention to overcome the health crisis that may appear in the middle age. There is an increasing interest in health during this stage to live a healthier and more fulfilling life (Kim et al., 2005), especially in complementary and alternative medicine (Park et al., 2005). Alternative therapies to promote psychological and physical health include agro-healing (or care farming), horticultural therapy, forest therapy, and kinesitherapy, which are carried out and studied in various ways (Ulrich, 1984; Kaplan, 2001; Shin et al., 2007; Jeong et al., 2010; Kim, 2011; Lee et al., 2013; Jang et al., 2018).

The World Health Organization (WHO) defines health as a dynamic state of complete physical, mental, spiritual and social well being and not merely the absence of disease or infirmity (The WHOQOL group, 1998). Recently in Korea, there has been an increasing need to handle health and disease prevention issues at the national level and the importance of healthcare policies focused on prevention, and thus the Act on Research, Development and Promotion of Healing Agriculture has taken effect since March 25, 2021. The purpose of this Act is to contribute to the promotion of people’s health, the improvement of the quality of life, and sustainable growth of agriculture and agricultural communities by providing for matters concerning the research, development, and promotion of healing agriculture and by boosting healing agriculture with resources of agriculture and agricultural communities (Korean Law Information Center, May 25, 2021).

With the enforcement of this Act, there has been a growing interest in healing agriculture or agro-healing, which is one field of alternative therapy. Agro-healing includes inclusive experiences that are expected to have pure therapy or therapeutic value using agricultural environments such as farming, plants, landscape, culture, and animals for the general public or socially disadvantaged (Braastad and Hauge, 2007). All agricultural and rural elements such as agricultural activities, natural environment, and emotional or cultural exchange with people can be the resources of agro-healing. Care farms (or agro-healing farms) where these resources can be used provide services offered by mental health specialists and various agro-healing programs including meaningful physical activities for participants to overcome their difficulties (Loue, 2016). In other words, agro-healing programs are comprised of activities using crops or vegetables in addition to physical movements, designed to reduce anger, depression, and fatigue while increasing self-efficacy and self-esteem (Park and Kang, 2017). Thus, there is growing importance and interest in care farms where these activities can take place.

However, there is insufficient research on customized agro-healing programs for the middle-aged or their physiological effects. Lee et al. (2011) studied the relationship among middle-aged women’s fatigue, stress resistance, and emotions and clinically measured fatigue, stability, and stress for scientific research. As a result of conducting a statistical analysis on brain quotients (tension degree, anti-stress quotient, and emotional quotient), they discovered that there was a close relationship among middle-aged women’s fatigue, stress resistance, and emotions. Therefore, this study measured and analyzed physiological changes of the middle-aged before and after all sessions of an agro-healing program at a care farm, such as pretest and posttest brainwaves, saliva cortisol that is a stress hormone, and blood pressure. The goal was to scientifically study positive and useful methods of agro-healing programs such as relieving stress of participants and increasing the declined concentration caused by decreased brain activity of the middle-aged.

Research Methods

Selection of participants

To determine the physiological changes brought by agro-healing programs in care farms to the mental health of the middle-aged, this study carried out agro-healing activities at a care farm located in Wanju-gun from May 9 to July 4, 2020 with 10 men and women with the mean age of 60.7 ± 7.34 years. Then we measured and analyzed brainwaves (EEG: electroencephalogram), electrocardiogram (ECG), blood pressure, and saliva cortisol (saliva collection system). Participants were recruited from online and offline bulletin boards of the care farm and selected among those who meet the selection criteria of general brain studies (Son et al., 1998, 1999; Lee et al., 2009; Jang et al., 2017; Jang et al., 2019a). Based on those criteria (Lee et al., 2009; Son et al., 1998, 1999), right-handed people who agreed to participate in the study were selected. They were to have no mental or physical disorders, visual disturbance, brain diseases, and heart problems, and take no medication. We fully explained the purpose of this study, contents of the agro-healing program, measurement items, and methods to the selected participants and measured only those who voluntarily agreed to participate and signed the consent. They were to stop drinking for 2 days before participation and were not allowed to consume coffee, black tea, green tea, or other food that may stimulate the brains, ECG, saliva, and blood pressure for 2 hours before measurement.

Lab settings and conditions

Physiological measurements such as brainwaves, ECG,

and blood pressure were performed in an indoor space of the care farm. The space was 5.0 m long, 4.0 m wide, and 2.6 m high with the mean illuminance of 700 ± 10 lux (UT383 Mini Light Meters, Japan), humidity 70 ± 10 % (TR-72Ui, T&D CORP., Japan), and temperature 25 ± 0.5 °C. Lights or noises from the outside were blocked considering the impact they may have on psychological conditions of the participants, and the fluorescent light on the ceiling was turned on instead.

Materials and methods

Agro-healing programs are comprised of activities using crops or vegetables in addition to physical movements, designed to reduce anger, depression, and fatigue while increasing self-efficacy and self-esteem (Park and Kang, 2017). Thus, the program in this study was designed considering the care farm environment and age of the participants, and agro-healing activities were carried out total 8 times, once a week for 2 hours each, at a care farm located in Wanju-gun. Physiological measurements of brainwaves, ECG, blood pressure, and pulse rates as well as saliva collection were conducted before and after the activities (Fig. 1). The group of middle-aged subjects could participate in this program at the care farm located in Wanju-gun, Jeonbuk because they had the time and money to participate. However, there is insufficient participation of the middle-aged who might have more severe stress with financial difficulties or lack of measures for their later years. Therefore, samples lack representativeness of the middle-aged in Korea as well as review from multiple perspectives, and thus there are limitations in generalizing the results of this study.

Fig. 1. Activity experiment used electroencephalography device: (A) Yoga, (B) Gardening activities (C) Walking and meditation; positions of 7 electrodes on the top view of the scalp (D) used for measurement of electroencephalography.

Table 1. Plant cultivating activities applied to the objects

Session	Title	Plant cultivating activities program
1	Orientation / Me in nature	Knowing the characteristics of plants; Make a garden using a farmer culture technique; Eneagram personality type test
2	Garden where fruits come out	Planting in a box garden; Planting plants in a pot; Drawing a life curve graph
3	The sound of nature	Making musical instruments with natural objects; Finding meaningful people in my life; Give a flower basket to you're most thankful person
4	My pillar	Cut off sprouts and build a pillar; Thinking about what to cut off and build a pillar in my life; Make food for animals and feed them
5	The fragrant herbs inside me	Harvest herbs; Making herbal tea; Making a succulent terrarium
6	Balance of my life	Growing a garden; Listening to music; Thinking about the meaning of death
7	Garden of my life	Growing a garden; Designing my life and making a dish-garden; Imagine myself in the future
8	Party with your family	Harvest plants and make foods for the party; Making bamboo water guns and playing games with family

Sessions 1–8 of the agro-healing program

The program focused on agro-healing activities was carried out in 8 sessions, one every week, with 1 care farm owner, who is an expert of agro-healing programs and is well aware of the care farm's environment and resources, as well as 3 assistant instructors (Table 1 and Fig. 1). The care farm program and services are designed by identifying the problems and needs based on the farm and participant characteristics to provide healing and improve cognitive and physical functions, based on which suitable activities were developed so that the participants can experience them by communicating with one another (RDA, 2017, 2019). The agro-healing program was designed to be suitable for the participants' characteristics by consulting with the farm owner who is the main host of the program as well as an expert of horticultural therapy, assistant instructors who majored in horticulture, and clinical measurements specialists. In Session 1 titled "Me in nature", the participants greeted one another and could feel the power of healing in nature by opening up. The farm owner provided information such as the farm's characteristics, the direction of the program, and materials used. After that, the participants learned the theories about the characteristics of crops and planted seedlings of *Solanum lycopersicum*, *Solanum melongena*, *Capsicum annuum*, and *Cucumis sativus* in the common garden. In Session 2, gardens were made in pairs to plant seedlings of *Lactuca sativa*, *Cichorium intybus*, *Apium graveolens*, and herbs in a box

garden, after which they created mini-herb pots of their own at home and drew positive and negative fruits to think about the fruits produced in their lives, thinking about how to turn their negative fruits into positive ones. In Session 3, the participants removed weeds in the garden and discovered various natural objects that make sounds around the farm. They made one-and-only musical instruments and played them together. They also made flower baskets to give to someone they want to thank the most. In Session 4, they trimmed and propped up *Solanum lycopersicum*, and *Solanum melongena*, through which they thought about what to cut off or prop up in life. In Session 5, they harvested flowers and herbs in the garden and the forest to make floral and herbal tea. They also made a succulent terrarium to remember the difficult times in life and change their perspective about pain. In Session 6, the participants walked around the forest trail around the farm and meditated. They also collected various materials from the forest and made a natural mobile using those objects. In Session 7, they tended their garden, made a dish garden with air purifying plants, and designed their life, through which they imagined their lives after 1 year and 5 years and expressed them in a letter and pictures. They talked about how they expressed their future lives. Finally, in Session 8, they harvested the agricultural products they had grown in the garden, wrapped them up, and shared their thoughts and experiences of this program. They also had a farm party with their families at the farm and encouraged one another.

Fig. 2. The sequential steps in saliva samples using salivette system.

Physiological assessment tool for participants

Brainwave and ECG measurement

Brainwave and ECG measurement was conducted using a wireless portable brainwave measurement device that is convenient to install (BIOS-SW8, BioBrain Inc., Daejeon, Korea). We gave a general description of the experiment to the participants before measurement and obtained their consent. While attaching the device, we helped them get familiar with the measurement environment. The brainwave measurement spots are based on the authorized international 10–20 electrode system (Berger, 1929), and we designated 7 channels for electrode attachment such as frontal lobes (F3, F4), temporal lobes (T3, T4), central zone (Cz), and occipital lobes (O1, O2) and put on a dry cap. The reference electrodes were attached behind ears, and ECG measurement was done by attaching 1 disposable electrode on both wrists, thereby attaching total 10 electrodes (Fig. 1). Disposable earplugs were used to keep the participants from being exposed to external noises, and we allowed them to take a break for 2 minutes in a relaxed state before the measurement.

Saliva collection and analysis using the Salivettes system

Saliva was collected in each session before and after the activities. Since cortisol levels of adults vary depending on time (Posener et al., 2000), saliva was collected at the same time (Choi et al., 2014).

Good quality saliva was collected using cotton based Salivette, which minimizes contamination by hand or air and thus can accurately measure saliva cortisol. Saliva cortisol was analyzed using ER HS SALIVARY CORTISOL

kit (Salimetrics Inc., USA) and VERSA Max Microplate Reader (Molecular device, USA) in the unit of $\mu\text{g/dL}$. The increase of saliva cortisol levels (stress hormone) refers to increased stress response, and the decrease refers to decreased stress response (Fig. 2).

Blood pressure measurement

Prior to measurement of brainwaves and ECG, blood pressure and pulse rates were measured using a portable digital blood pressure gauge (HEM-1000, OMRON, Japan) in an oscilloscope method.

Statistical analysis

Statistical analysis was conducted using IBM SPSS ver. 25.0, and Wilcoxon paired signed ranks test was conducted to analyze brainwaves, ECG, blood pressure, and saliva. To analyze physiological signals, we obtained the power spectrum of each frequency band using the fast Fourier transform (FFT) algorithm with brainwave data. The electrode amount of each was standardized in means, based on which the mean of each electrode was obtained and a brain map was developed. The brain map marks the band with low potential as in and the band with high potential in red depending on the regions of cerebral cortex to show the fluctuations of electric energy (Fig. 3).

Results and Discussion

Changes in brainwaves after participating in the agro-healing program

As a result of analyzing the changes in brainwaves of

Table 1. Differences of brain wave changes before/after agro-healing activity

EEGz	F3y	F4	T3	T4	Cz	O1	O2
RSA	3.411**	1.535	2.209	2.332*	1.934	1.941	2.854*
RFA	3.153*	1.641	1.902	2.168	2.851*	1.312	2.307*
RAHB	3.138*	1.044	1.264	1.664	1.006	1.792	1.219
RST	1.467	2.389*	2.693*	3.691**	4.056**	2.497*	1.256
RT	0.249	-0.251	-0.539	-0.634	-1.697	-0.694	0.770
RLB	3.389**	2.046	2.532*	2.722*	3.651**	2.259	4.612**
RMB	1.613	1.598	0.797	1.853	3.670**	1.496	-0.698
SEF95	-2.220	-1.459	-1.465	-1.633	-1.415	-1.145	-2.166

^zElectroencephalographic (EEG); Before: Value before agro-healing activity; After: Value after agro-healing activity; RSA = Relative slow alpha power spectrum, RFA = Relative fast alpha power spectrum, RAHB = Ratio of alpha to high beta, RST = Ratio of SMR to theta, RT = Relative theta power spectrum, RLB = Relative low-beta power spectrum, RMB = Relative mid-beta power spectrum, SEF95 = Spectral edge frequency 95%.

^yF = frontal lobes, T = temporal lobe, C = central zone, O = occipital lobes, odd and even numbers indicate left and right hemispheres, respectively. Mean $\pm$ standard error.

* $p < .05$, ** $p < .01$, by wilcoxon paired singed-rank test (N = 10).

Fig. 3. The brain map for change of brain wave of total participant before / after agro-healing activity. Electroencephalographic (EEG) mapping; blue and red indicate low and high electrical potential, respectively. Before: Value before agro-healing activity; After: Value after agro-healing activity; RSA = Relative slow alpha power spectrum, RFA = Relative fast alpha power spectrum, RAHB = Ratio of alpha to high beta, RST = Ratio of SMR to theta, RT = Relative theta power spectrum, RLB = Relative low-beta power spectrum, RMB = Relative mid-beta power spectrum, SEF 95 = Spectral edge frequency 95%; F = frontal lobes, T = temporal lobe, C = central zone, O = occipital lobes, odd and even numbers indicate left and right hemispheres, respectively.

the experimental group before and after agro-healing activities, the stability and relaxation indices RSA (relative slow

alpha power spectrum) increased on the left frontal lobes (F3), right temporal lobes (T4), and right occipital lobes

Table 2. Brain wave of participants before/after agro-healing activity

EEG ^z	T ^y	F3	F4	T3	T4	Cz	O1	O2
RSA	Before	0.087 ± 0.006 ^y	0.095 ± 0.009	0.119 ± 0.012	0.104 ± 0.013	0.103 ± 0.009	0.142 ± 0.014	0.134 ± 0.013
	After	0.115 ± 0.008	0.111 ± 0.008	0.140 ± 0.008	0.136 ± 0.011	0.123 ± 0.007	0.173 ± 0.011	0.171 ± 0.012
RFA	Before	0.048 ± 0.004	0.051 ± 0.004	0.053 ± 0.003	0.049 ± 0.005	0.049 ± 0.004	0.061 ± 0.005	0.058 ± 0.005
	After	0.060 ± 0.003	0.060 ± 0.003	0.061 ± 0.002	0.062 ± 0.003	0.063 ± 0.002	0.069 ± 0.003	0.069 ± 0.004
RAHB	Before	0.671 ± 0.055	0.734 ± 0.070	0.981 ± 0.104	0.822 ± 0.100	0.809 ± 0.080	1.250 ± 0.137	1.198 ± 0.155
	After	0.863 ± 0.065	0.826 ± 0.063	1.108 ± 0.048	1.014 ± 0.081	0.911 ± 0.054	1.436 ± 0.106	1.654 ± 0.181
RST	Before	0.435 ± 0.032	0.435 ± 0.023	0.351 ± 0.021	0.410 ± 0.035	0.361 ± 0.035	0.353 ± 0.030	0.349 ± 0.031
	After	0.509 ± 0.031	0.538 ± 0.029	0.463 ± 0.048	0.543 ± 0.024	0.535 ± 0.043	0.448 ± 0.036	0.416 ± 0.062
RT	Before	0.166 ± 0.016	0.166 ± 0.012	0.209 ± 0.014	0.174 ± 0.014	0.197 ± 0.015	0.221 ± 0.015	0.221 ± 0.018
	After	0.171 ± 0.013	0.161 ± 0.013	0.197 ± 0.022	0.162 ± 0.009	0.169 ± 0.013	0.205 ± 0.015	0.254 ± 0.039
RLB	Before	0.069 ± 0.004	0.072 ± 0.005	0.072 ± 0.004	0.068 ± 0.005	0.068 ± 0.004	0.075 ± 0.004	0.073 ± 0.003
	After	0.084 ± 0.004	0.084 ± 0.003	0.082 ± 0.003	0.087 ± 0.004	0.086 ± 0.003	0.088 ± 0.003	0.087 ± 0.003
RMB	Before	0.119 ± 0.004	0.119 ± 0.004	0.116 ± 0.004	0.123 ± 0.004	0.120 ± 0.005	0.116 ± 0.003	0.117 ± 0.004
	After	0.129 ± 0.006	0.129 ± 0.005	0.122 ± 0.005	0.134 ± 0.006	0.134 ± 0.008	0.123 ± 0.004	0.112 ± 0.005
SEF95	Before	46.163 ± 0.257	45.900 ± 0.280	45.335 ± 0.364	45.775 ± 0.302	45.425 ± 0.288	44.463 ± 0.323	44.650 ± 0.317
	After	44.650 ± 0.698	45.000 ± 0.584	44.688 ± 0.415	44.513 ± 0.677	44.563 ± 0.557	43.400 ± 0.564	42.250 ± 1.056

^zElectroencephalographic (EEG); Before: Value before agro-healing activity; After: Value after agro-healing activity; RSA = Relative slow alpha power spectrum, RFA = Relative fast alpha power spectrum, RAHB = Ratio of alpha to high beta, RST = Ratio of SMR to theta, RT = Relative theta power spectrum, RLB = Relative low-beta power spectrum, RMB = Relative mid- beta power spectrum, SEF 95= Spectral edge frequency 95%.

^yTreatment; F = frontal lobes, T = temporal lobe, C = central zone, O = occipital lobes, odd and even numbers indicate left and right hemispheres, respectively (N = 10). Mean ± standard error.

(O2); RFA (relative fast alpha power spectrum) increased on the left frontal lobes (F3) and right occipital lobes (O2); and RAHB (ratio of alpha to high beta) increased on the left frontal lobes after the program with statistical significance. The attention indices RST (ratio of SMR to theta) increased on the right frontal lobes (F4), temporal lobes (T3, T4), and left occipital lobes (O1); and RLB (relative low beta power spectrum) increased on the left frontal lobes, temporal lobes, central zona, and right occipital lobes (O2) after the program with statistical significance, showing that participating in an agro-healing program in the middle age (50-60s) when brain activity is deteriorated helps improve stability and relaxation as well as attention (Tables 1 and 2, Figs. 1 and 3). These results are supported by Jang et al. (2019a) and Kim et al. (2002), who claimed that physical and visual environmental factors around the care farm for patients of chronic metabolic diseases and participating in the agro-healing program increased alpha waves, thereby positively affecting brain activity as well as stability and

relaxation. Their studies support the high levels of RSA, RFA, and RAHB in this study, which are stability and relaxation indices. In addition, Lee (2016) stated that taking walks had a positive effect on psychological and physiological changes such as reducing decline of physiological functions, increasing immunity and physical strength, and reducing cortisol that is a stress hormone, which support the results of this study showing positive effects of yoga or walks near the care farm.

Changes in the autonomic nervous system after participating in the agro-healing program

As a result of analyzing the changes in the autonomic nervous system of the experimental group before and after agro-healing activities, LF (low frequency) / LF + HF decreased due to the activation of the sympathetic nervous system that is a stress index of the autonomic nervous system activities, and HF (high frequency) / (LF + HF) increased due to the activation of the parasympathetic nervous system

Table 3. Sympathetic nerve and parasympathetic nerve change of participants between the before and after of agro-healing activity

Autonomic nervous system	N	Before	After	z-value	p-value
		Mean	Mean		
Sympathetic nerve					
Total	10	0.518 ± 0.062 ^z	0.430 ± 0.075	-1.172	.241 ^{NS}
Parasympathetic nerve					
Total	10	0.482 ± 0.062	0.570 ± 0.075	-1.172	.241 ^{NS}

^zValues are mean ± standard error.^{NS}Nonsignificant, by wilcoxon paired singed-ranks test (N = 10).**Table 4.** Blood pressure change of participants between the before and after of agro-healing activity

Blood pressure	N	Before	After	z-value	p-value
		Mean	Mean		
Systolic blood pressure					
Total	10	130.70 ± 4.41 ^z	117.90 ± 4.64	-2.091	.037*
Diastolic blood pressure					
Total	10	77.30 ± 3.40	84.90 ± 3.18	-2.606	.009**

^zValues are mean ± standard error.^{*}*p* < .05, ^{**}*p* < .01, by Wilcoxon paired singed-ranks test (N = 10).

that is the stability index, but there was no statistical significance (Table 3). This showed that participating in the agro-healing program such as plant activities, yoga, and gentle strolls tends to relax tension. According to Kim et al. (2012) who studied the effect of horticultural activities on stress relief of urban climacteric housewives, LF of the sympathetic nervous system decreased in the autonomic nervous system analysis while HF increased due to activation of the parasympathetic nervous system, indicating that horticultural activities were effective in increasing relaxation and stress resistance. In addition, Park (2010) reported in a study taking an experimental approach to forest therapy through forest recreation activities that looking at the scenery of a natural forest inhibited the sympathetic nervous system activity of the human body more than the urban environment. This supports the results of this study that the surrounding environment of the care farm such as the natural forest decreased the sympathetic nervous system activity.

Changes in blood pressure and pulse rates after participating in the agro-healing program

As a result of analyzing the changes in blood pressure

and pulse rates of the middle-aged before and after agro-healing activities, systolic blood pressure decreased after the program by 12.8 mmHg from 130.70 mmHg to 117.90 mmHg, and diastolic blood pressure increased by 7.60 mmHg from 77.30 mmHg to 84.90 mmHg but was still within normal range and showed statistical significance. Therefore, considering that systolic blood pressure decreased from prehypertension to normal blood pressure after participating in the agro-healing program such as gardening, making things with natural objects, meditating, or taking walks, agro-healing activities seem to be having a positive effect on blood pressure (Table 4). In addition, pulse rates seemed to increase after participating in the program, but they were still within the average pulse rates per minute (Table 5). Previous studies proved that the middle-aged and the elderly taking walks in the forest had a positive effect on the autonomic nervous system activity. Taking walks in a natural environment had physiological and psychological relaxation effects on middle-aged hypertension patients more than taking walks in the city (Song et al., 2015). A study comparing blood pressure of patients with chronic metabolic diseases before and after agro-healing activities showed that systolic blood pressure decreased

Table 5. Difference of pulse rate between the before and after of agro-healing activity

Pulse rate	N	Before-pulse	After-pulse	<i>z-value</i>	<i>p-value</i>
		Mean	Mean		
Total	10	68.45 ± 3.17 ^z	68.34 ± 2.69	-0.051	.959 ^{NS}

^zValues are mean ± standard error.^{NS}Nonsignificant, by Wilcoxon paired signed-ranks test (N = 10).**Table 6.** Cortisol value change of participants between the before and after of agro-healing activity

Cortisol (µg/dL)	Before	After	<i>z-value</i>	<i>p-value</i>
Total	0.106 ± 0.018 ^z	0.091 ± 0.023	-1.120	.263 ^{NS}

^zValues are mean ± standard error.^{NS}Nonsignificant, by Wilcoxon paired signed-ranks test (N = 10).

with statistical significance after the activities (Jang et al., 2019b). The results of this study that systolic blood pressure decreased after participating in the agro-healing program are supported by KSH (2013) stating that exercising like yoga or a walk benefits hypertension patients by reducing blood pressure and stress and by Ochiai et al. (2015) claiming that middle-aged men with high blood pressure could lower their blood pressure to the normal range after participating in a forest therapy program.

Changes in saliva cortisol (stress hormone) after participating in the agro-healing program

As a result of examining the changes in cortisol levels before and after agro-healing activities, saliva cortisol (stress hormone) decreased by 0.015 µg/dL from 0.106 µg/dL to 0.091 µg/dL without statistically significant difference, but still showed a decrease after participating in the program (Table 6). Therefore, participating in an agro-healing program at a care farm lowers stress. This result is supported by Ulrich (1984) and Kaplan (2001) who claim that horticultural activities or natural landscapes not only reduce stress and maintain calmness of participants but also are effective in promoting psychological healing or recovery.

Conclusion

To determine the effects of an agro-healing activities program at a care farm on the promotion of mental health,

this study measured brainwaves (EEG: Electroencephalogram) and blood pressure and collected saliva from 10 middle-aged men and women aged 60.7 ± 7.34 before and after the program. The experimental group participated in total 8 sessions of agro-healing activities, once a week and 2 hours each, at a care farm located in Wanju-gun. The activities were comprised of growing plants in an open space of the care farm with a view, making crafts using plant materials, introducing their creations, doing yoga, and taking walks around. As a result of analyzing the changes in brainwaves of the experimental group before and after agro-healing activities, the stability and relaxation indices RSA increased on the left frontal lobes (F3), right temporal lobes (T4), and right occipital lobes (O2); RFA increased on the left frontal lobes (F3) and right occipital lobes (O2); and RAHB increased on the left frontal lobes after the program with statistical significance. The attention indices RST increased on the right frontal lobes (F4), temporal lobes (T3, T4), and left occipital lobes (O1); and RLB increased on the left frontal lobes, temporal lobes, and occipital lobes after the program with statistical significance ($p < .05$). The sympathetic nervous system activity, which is a stress index, decreased after the program, whereas the parasympathetic nervous system activity, which is a relaxation index, increased, showing statistical significance ($p < .05$). As a result of analyzing the changes in blood pressure after the program, systolic blood pressure and diastolic blood pressure decreased from prehypertension to normal blood pressure, showing statistical significance. These results indicate that participating in agro-healing activities at a care farm for the 50-60s helps reduce stress and im-

prove stability and relaxation as well as attention. Thus, developing and applying customized agro-healing programs for participants will have a positive effect on brain activity and psychophysiological improvement by relieving tension and stress.

Therefore, in this COVID-19 pandemic, it is more urgent than ever to develop a customized model of agro-healing programs for the 50-60s facing a mid-life crisis. Agro-healing activities at care farms for the middle-aged will improve mental health by reducing stress and depression of the middle-aged that are the 'sandwich generation' today, while also increasing their life satisfaction and relieving stress. Based on the results of this study, natural environments can be applied to agro-healing activities for the middle-aged, such as yoga or walks around the farm, enjoying the scenery, and gardening activities, which will increase positive effects.

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