

# The Effect of a Forest Healing Program on Cognitive Function, Depression, Anxiety, and Cortisol Levels in Elderly People

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## Abstract

Increasing life expectancy leads to a rise in the prevalence of aging-related mental diseases and a concomitant increase in the financial and societal pressures related to their prevention and management. This issue is attracting increasing attention from researchers. Therefore, this study aimed to determine whether a healing program in a forest environment is effective for improving cognitive function, depression, anxiety, and stress in elderly people. A nonequivalent control group pretest-posttest design was used. The experimental group consisted of 18 males and females aged 60 to 80 years who participated in a forest healing program for seven days, while the comparison group comprised 10 people with similar demographics. For the process of data analysis, this study performed a cross-analysis to determine the homogeneity of the data and carried out the Wilcoxon signed-rank test, a nonparametric statistical test, to verify the significance of each group. Participation in the forest healing program led to a significant improvement in cognitive function ( $p=0.030$ ). The levels of depression decreased, but this result was not statistically significant. The levels of anxiety decreased significantly ( $p=0.004$ ). The mean cortisol score, a measurement of stress, decreased, but it was not statistically significant. These findings confirmed the effectiveness of this program for improving certain mental conditions of elderly people, and affirmed that the use of long-term forest healing programs can be expected to alleviate national pressures created by aging societies.

**Key Words:** depression, stress, anxiety, cognitive function, forest healing program

## Introduction

Societal costs are rising in South Korea as the average life expectancy increases and the population ages due to advances made in medicine. It is projected that the country will become a super aged society by 2025. Moreover, as the average life expectancy of elderly people increases, the proportion of the population aged 65 and older was expected to increase to 15.7% in 2020, and is expected to increase by

20.3% in 2025, and 43.9% in 2060 (SKA 2020). Aging leads to an increase in senile diseases. the prevalence of cognitive disorders such as dementia and Alzheimer's disease, which are the most chronic degenerative diseases of elderly people, will also increase (Naylor et al. 2012; ADI 2015). Specifically, dementia is a mental disorder that begins as an age-related disease characterized by cognitive impairment as well as behavioral and psychological symptoms. As the disease progresses, patients gradually lose their ability to

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carry on with their everyday and professional lives to the point where it is difficult for them to perform the basic activities of daily living on their own (Steinberg et al. 2008; Borsje 2015; Winblad et al. 2016). In addition, patients with dementia are unable to recall new information and may experience depression and a loss of self-esteem, which decrease the quality of life and can lead to psychological symptoms such as depression, delusions, anxiety, and changes in cognitive function (NHISA 2015; Cha 2016; CKRCDCG 2020). Of these symptoms, depression is the most common and occurs in approximately 40-50% of patients with dementia, which is approximately three times higher than the prevalence of depression in the general elderly population aged 65 and older (Kwon 1997; NHISA 2015; CKRCDCG 2020). Depression in elderly people with dementia is accompanied by various emotional symptoms, and worsening cognitive function is associated with higher levels of depression (Barca et al. 2008). Thus, dementia is recognized as one of the most concerning diseases due to the aging population, and the increase in the dementia population is causing great suffering in the families of people with this disease. In most cases, dementia is a chronic, progressive disease that requires continuous treatment and care above all else, which is a reason for dementia's economic burden on society. Therefore, to reduce the incidence of dementia, the cognitive decline of elderly people with mild cognitive impairment (MCI) must first be slowed down and preventive care must begin before people reach 65 years of age (Kim and Kim 2019). MCI is the stage between normal aging and the onset of dementia, in which there is an objective decline in cognitive function, but the ability to perform activities of daily living means that it does not constitute dementia (Petersen 2004). Approximately a quarter of the elderly population has MCI, and as research has shown that early prevention may delay the onset of MCI by up to five years, prevention strategies play an important role with regards to this condition (Kim and Koo 2019). In recent years, there has been a greater number of patients in their 50s or younger who are being treated for MCI than those being treated for dementia (NHISA 2015). Thus, there is a need for studies that take an academic approach to the early management of MCI that begins in younger age groups (Kim and Kim 2019). Treatment of dementia is largely divided into drug and non-drug treatments. While drug treat-

ments may help to delay the onset of symptoms and help patients to function normally (Chang et al. 2015), side effects and complications may increase the risk of death or cerebrovascular disease (Ueda et al. 2013). To observe the effect of a non-pharmaceutical integrated intervention program, studies have been conducted on normal elderly people (Lee and Park 2007; Han et al. 2010; Kim et al. 2010; Park et al. 2013). The results of the study show that the non-pharmaceutical integrated intervention program for elderly people increased physical activity and social contact and improved the level of cognitive activity of the subjects, thereby decreasing depression and improving quality of life (SMDCA 2015). In another study, music therapy was used to improve the function and movements of patients with dementia, and it was shown to reduce neurobehavioral symptoms in addition to decreasing levels of anxiety and depression (Meyer and O'Keefe 2020). Yun and Kim (2009) study emphasized that non-drug treatments are effective for elderly people with dementia by using horticultural therapy, a form of therapy that utilizes plants. Owing to the rising interest in forests with regard to the use of alternative and preventive medicine, there has been an expansion of forest healing activities for the prevention of diseases in elderly people as well as the promotion of their health (Lee et al. 2016). In the Forest Cultural Recreation Act, revised in March 2010, forest healing was defined as a natural remedy that enhances the human body's immunity and promotes health by utilizing various physical and environmental factors of forests (KFS 2022).

This study was an attempt to verify the physiological and psychological effects of enhancing health function and disease healing based on forest resources on the human body scientifically and medically. In addition, based on the results, it was an attempt to utilize the forest for mental and physical healing, and it can be said to be a concept that is one step further than forest bathing. Forest bathing is a natural healing method that involves inhaling the phytoncides, which are antimicrobial allelochemical volatile organic compounds released by the plants, by walking through a dense forest. It combines exposure to natural scenery with mental and physical training and stability. As social interest in the prevention of dementia has risen due to the recent aging trend, we are interested in the development of research on various dementia prevention programs targeting healthy

people. Lim et al. (2014) found that forest healing programs were more effective than indoor programs in increasing self-esteem and reducing depression in elderly people residing in nursing homes, while Kim and Koo (2019) demonstrated the effectiveness of forest healing to improve the mental state, depression, and quality of life in elderly people who live alone. Kim et al. (2012) proposed the importance of urban forests and the importance of encouraging elderly people aged 65 and older to utilize the positive functions of urban forests. In recent years, forest healing has been shown to have a positive effect on mental and psychological stability; in particular, it has been shown to be effective in relieving stress (Shin 2007; Yeoun 2007; Park et al. 2014; Kim and Choi 2018; Seo et al. 2020). Moreover, non-drug treatments that utilize forests can be used to treat mental and physical diseases related to stress (Woo et al. 2012). The use of forests continues to increase because of its safety and lack of side effects (Ueda et al. 2013; Blackburn and Bradshaw 2014; Chang et al. 2015). Among forest healing studies so far, cognitive function, depression, and quality of life were significantly improved through a forest healing program targeting the elderly in Korea (Kim and Koo 2019; Lee et al. 2020). As such, forests are being positively highlighted as places of healing. However, there is insufficient research on the use of forest healing programs for elderly people with MCI when compared to other fields of study. Thus, the study suggested a forest healing program with continuous activity to improve cognitive function (Hong 2013).

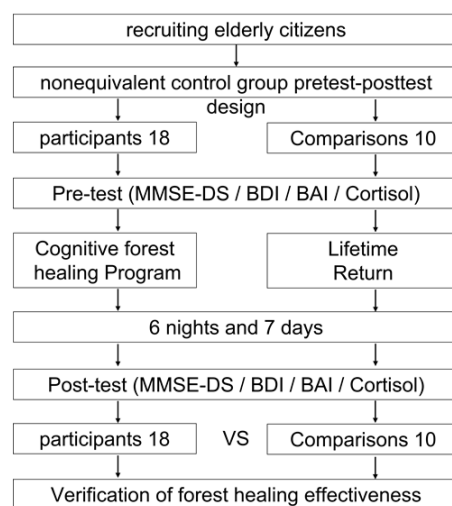
The purpose of this study was to determine how a six night and seven day forest healing program for elderly people affects cognitive, psychological, and physiological functions. Moreover, the results of pre- and post-study examinations were used to analyze and determine the effectiveness of the forest treatment.

## Materials and Methods

### Participants and setting

Participants were selected from those who wished and agreed to participate in a forest healing program and we visited the local senior center and senior welfare center to recruit. A total of 28 people who wished to participate were selected, with 18 people in the experimental group and 10

in the comparison group. The participant group took part in the forest healing program for seven days. The repetitive cognitive function brought about by this activity is the basis for improving cognitive function in forest healing programs. Therefore, this study planned a long-term forest healing program for six nights and seven days, and investigated the effect of this intensive program. When determining the sample size, this study had to take the participants' older age range into consideration. If the sample size was too small, this would reduce the reliability of the results. However, as elderly participants require more attention, having too many participants in the study may have made it difficult to provide them with opportunities related to the program and also may have made it more difficult to ensure their safety. Thus, this study was based on the sample size of previous studies (Lee et al. 2005; Kim and Kim 2019). In addition, the following criteria were used to select participants: male and female adults aged 60 to 80 years who were able to communicate, ingest food orally, participate in physical activities and walk without assistance, fill out questionnaires and take part in additional tests, actively participate in the program, and who are not taking medication for mental health purposes, such as for dementia and depression. Research is conducted by Kangwon National University It was approved after deliberation by the Ethics Review Committee (KWNUIRB 2019-10-006-005). The research



**Fig. 1.** Experimental design flow chart. MMSE-DS, mini mental status examination for dementia screening; BDI, beck depression inventory; BAI: beck anxiety inventory.

took place at the National Center for Forest Healing, which is located in Yeongju, Gyeongsangbukdo.

### *Experimental design*

This experimental study used a nonequivalent control group pretest-posttest design to determine whether the participation of elderly people in a forest healing program had an impact on their cognitive function, depression, anxiety, and cortisol levels. Furthermore, a test of homogeneity was used to form two groups of participants who shared the most similar conditions. The experiment group underwent a forest healing program for six nights and seven days. The comparison group was pre-tested and the members continued to live in the city (Fig. 1).

### *Program*

The forest healing program used in this study was developed by the Yeongju National Center for Forest Healing to suit the natural environment of Yeongju. The program consists of various activities such as going on walks and doing exercises in the forest, performing hydrotherapy, spending time in a hammock, and using objects found in nature to perform reminiscence therapy. Relaxation Meditation is a program that helps the mind and body to relax at the end of the day. Forest Walking is a program to prevent dementia by activating brain function through walking on forest trails and doing gymnastics. Hydrotherapy is a program that improves cognitive function by increasing blood circulation in the brain through water exercise. Hammock Meditation is a program that activates brain function through a hammock experience and body scan meditation. Tea Therapy is a program that wakes up the balance between the body and mind by walking with natural resilience while drinking seasonal tea. Singing Bowl Therapy is a program that helps to relax the mind and body. The special vibrations produced by Singing Bowls are known to bring out natural healing forces that reset our bodies. Finding Forest Health is a human friendly program that relieves muscle fatigue. Brain Health Treatment is a program for brain health that involves using props. The overall program, which is shown in Table 1, aims to improve cognitive function and increase blood flow in the brain and also includes the "Healing Program in the Forest for Age 100," a program accredited by the Korea Forest Service's Forest Training Institute. The

participant and comparison groups were both given pre- and post-tests at the Yeongju National Center for Forest Healing.

### *Measurements*

Measurement instruments were used to investigate the cognitive, mental, and physiological functions of participants in the experimental and comparison groups for comparing the pre- and post-test results of participating in the forest healing program.

#### **Mini mental status examination for dementia screening**

The Korean version of the Mini Mental Status Examination for Dementia Screening (MMSE-DS) was used to assess the participants' cognitive function. The instrument consists of 19 items that assess the following functions: orientation to time (5 points), orientation to place (5 points), attention (5 points), memory registration (3 points), delayed recall (3 points), naming (2 points), repetition (1 point), following commands (3 points), constructional ability (1 point), and judgment (2 points). The instrument, with a score ranging from 0 to 30 points, was developed as a national dementia screening tool and has been used since 2011 (BSNUH 2009). To determine whether the results of the MMSE-DS test are normal or indicative of cognitive decline, the results must be compared with the MMSE-DS test according to the three criteria of sex, age, and education level, as well as the test's manual to standardize and analyze the scores. Higher scores are indicative of a cognitive function that is closer to normal and one participant is between mild cognitive impairment and normal range. Furthermore, the reliability of the instrument items was found to be satisfactory at 0.689.

#### **Beck depression inventory**

The Beck Depression Inventory (BDI), which was created by Aaron T. Beck in 1961 and revised in 1978, is a self-report assessment that consists of 21 items. The degree to which a respondent experiences depressive symptoms is rated using a 4 point scale (Beck et al. 1961). The subscale classifies depressive symptoms into emotional, cognitive, motivational, and physiological symptoms, which include sadness, pessimism, dissatisfaction, sense of failure, self-loathing, self-accusation, suicidal ideation, irritability, fa-

**Table 1.** Forest healing program

Day	Time	Program	Definition
Monday	10:00-15:00	Pre-test	MMSE-DS/BDI/BAI/Cortisol
	16:00-17:00	Orientation	Providing living guidance and safety education suitable for long-term characteristics
Tuesday	17:00-18:00	Relaxation meditation	Meditation to stabilize the mind and body
	09:00-10:00	Mind and body relaxation gymnastics	Mental and physical exercises consisting of breathing, healing stretching, and bowel movements
	10:00-12:00	Forest walking	Forest trail walking and gymnastics to activate overall brain function, including the cerebellum
	14:00-16:00	Hydrotherapy	Improves cognitive function and increases brain blood circulation through water exercise
Wednesday	17:00-18:00	Relaxation meditation	Meditation to stabilize the mind and body
	09:00-10:00	Mind and body relaxation gymnastics	Mental and physical exercises consisting of breathing, healing stretching, and bowel movements
	10:00-12:00	Hammock meditation	Improving cognitive memory through art activities using natural objects, hammock experiences, and body scan meditation
	14:00-15:00	Tea therapy	Natural resilience and balance of mind and body
Thursday	15:00-16:00	Singing bowl therapy	Self-concentration and body and mind stability
	17:00-18:00	Relaxation meditation	Meditation to stabilize the mind and body
	09:00-10:00	Mind and body relaxation gymnastics	Mental and physical exercises consisting of breathing, healing stretching, and bowel movements
	10:00-12:00	Foot reflexology	Barefoot walking, valley foot bathing, sunbathing to utilize the five senses of the whole body
	14:00-16:00	Hydrotherapy	Improves cognitive function and increases brain blood circulation through water exercise
Friday	17:00-18:00	Relaxation meditation	Meditation to stabilize the mind and body
	09:00-10:00	Mind and body relaxation gymnastics	Mental and physical exercises consisting of breathing, healing stretching, and bowel movements
	10:00-12:00	Forest walking	Forest trail walking and gymnastics to activate overall brain function, including the cerebellum
	14:00-16:00	Finding forest health	Using state-of-the-art hydraulic massage instruments and relieving muscle fatigue
Saturday	17:00-18:00	Relaxation meditation	Meditation to stabilize the mind and body
	09:00-10:00	Mind and body relaxation gymnastics	Mental and physical exercises consisting of breathing, healing stretching, and bowel movements
	10:00-12:00	Forest walking	Forest trail walking and gymnastics to activate overall brain function, including the cerebellum
Sunday	14:00-16:00	Brain health treatment	Exercise and brain health promotion activities using small tools
	17:00-18:00	Relaxation Meditation	Meditation to stabilize the mind and body
	10:00-15:00	Post-test	MMSE-DS/BDI/BAI/Cortisol

tigue, and loss of appetite. The scale's score ranges from 0 to 63 points, with higher scores indicating an increasing severity of depression. Moreover, ranges of scores are used to indicate different levels of severity: 0-13 points (minimal depression), 14-19 points (mild depression), 20-28 points

(moderate depression), and 29-63 points (severe depression). The reliability of this instrument's items was found to be satisfactory at 0.827. The items used in this instrument were adapted by Lee and Song (1991), and the cut off point for group selection was 16 points.

### Beck anxiety inventory

The Beck Anxiety Inventory (BAI) is a self-report assessment that consists of 21 items to measure the severity of anxiety symptoms (Beck et al. 1988). The BAI scale used in South Korea is the Korean version translated by Kwon (1997). A 4 point Likert scale is used to measure the severity of anxiety symptoms that were experienced during the past week (0=not at all, 1=mildly, 2=moderately, and 3=severely), and the items cover the cognitive, emotional, and physical aspects of anxiety. The scale's total score ranges from 0 to 63 points, and a score of 26 points or above signifies a state of severe anxiety. The ranges of scores indicate the following: 0-7 points (normal levels), 8-15 points (mild anxiety), 16-25 points (moderate anxiety), and 26-63 points (severe anxiety). The reliability of this instrument's items was found to be satisfactory at 0.928.

### Cortisol

Secretions of the stress hormone cortisol follow a daily cycle, with levels increasing early in the morning and dropping in the evening. Higher concentrations of cortisol signify higher levels of the stress hormone, with average levels ranging from 6.70 to 22.60  $\mu\text{g/dL}$  in the morning and falling below 10.00  $\mu\text{g/dL}$  in the afternoon. In Yeo (2011) study, the average cortisol concentration was 15.68  $\mu\text{g/dL}$ , which was higher than the cortisol concentration in this

study. However, since there is a difference in measurement time, cross sectional comparison may be difficult, so further research is needed to confirm this. To determine the Cortisol concentration, 5 mL of the vein is collected using a single use syringe in a steady state, and the blood is immediately placed in an SST (Serum Separation Tube) containing a coagulant agent, centrifugation at 3,000 rpm for 5 minutes after 30 minutes at room temperature, and the blood is separated into serum and cell layers, and then the upper layer is transferred to the Tube. The sample (blood) to be delivered to the requesting institution is stored using a vacuum serum tube (SST), and the sample is stored in a dry ice sealed box. ECLIA (Electrochemiluminescence immunoassay) was requested and tested. For this study, blood samples were collected from the experimental and comparison groups twice at the same time of day, once before the healing program and once after, at 10:00 in the morning.

### Data analysis

This study used the statistical analysis program SPSS Statistics Version 23.0 to analyze the data and performed a frequency analysis, descriptive statistical analysis, and cross analysis of the participants' general characteristics, while the Wilcoxon signed-rank test, a nonparametric statistical test, was used to determine the pre- and post-test effects of the forest healing program intervention. Wilcoxon sign-

**Table 2.** General characteristics (n=28)

Characteristic	Category	Experiment (n=18)	Comparison (n=10)	$\chi^2$ (p)
Age	60s	6 (33.3)	2 (20)	0.560 (0.669)
	70s	12 (66.7)	8 (80)	
Sex	Male	9 (50)	1 (10)	4.480 (0.034)
	Female	9 (50)	9 (90)	
Education	Elementary school	5 (27.8)	4 (40)	2.285 (0.515)
	Middle school	2 (11.1)	0 (0)	
	High school	8 (44.4)	3 (30)	
	University	3 (16.7)	3 (30)	
High blood pressure	Yes	9 (50)	5 (50)	-
	No	9 (50)	5 (50)	
Diabetes	Yes	4 (22.2)	2 (20)	0.019 (0.891)
	No	14 (77.8)	8 (80)	
Hyperlipidemia	Yes	4 (22.2)	5 (50)	2.274 (0.132)
	No	14 (77.8)	5 (50)	

Values are presented as number (%).

ed-rank test analysis is a useful statistical analysis when the sample size in two corresponding groups is different or when the sample is smaller than 30 (Choi 2013). In addition, the significance level was set at 0.05 for all tests. This is a statistical analysis method used for a small number of samples. It is used when the sample is not normally distributed, that is, when the number of samples is less than 30. In particular, in the medical field, when using experimental data, data are analyzed with 10-15 people.

## Results

### *Participant General Characteristics and Homogeneity Test*

The experimental and comparison groups, with 18 and 10 participants, respectively, were asked to complete the questionnaires. But two questionnaires from the participant group were excluded because the items of the pre- and post-test measurement instruments had not been fully completed. The remaining 28 valid questionnaires were used in the analysis.

To investigate the participants' demographic characteristics and to compare the two groups, a cross analysis that included age, sex, and education level, as well as their diagnosis of high blood pressure, diabetes, and hyperlipidemia, was performed using an independent t-test. The results of the analysis are presented in Table 2. With the exception of the participants' sex, there was homogeneity between the groups.

### *Changes before and after forest healing*

#### **Change in cognitive function**

The pre- and post-test changes in cognitive function with regards to the forest healing program are as follows (Table 3). For the experimental group, the analysis results

revealed that 17 participants were within the normal range of cognitive function and one participant is between mild cognitive impairment and normal range. In the comparison group, nine participants were within the normal range and function and one participant is between mild cognitive impairment and normal range. Thus, it was determined that most of the participants had normal cognitive function, and the individual comparison scores, which took the participants' sex, age, and education level into account, were then determined and analyzed. Out of a total of 30 points, the experimental group reported a mean pre-test score of 26.22 points and a mean post-test score of 27.56, thus demonstrating a 1.36 point increase, which was found to be statistically significant ( $z=-2.551$ ,  $p=0.030$ ). In the experimental group, 9 subjects increased from 1 point to 7 points as a result of the pre-test and post-test of MMSE-DS, confirming the effect of forest healing. On the other hand, the comparison group's mean pre-test score was 26.1, and the mean post-test score was 27.2 points, thereby showing a 1.1 point increase, but this difference was found to be not statistically significant. This can be known from the post mortem SD values. The experimental group SD is 2.10, and the smaller the SD value, the less difference in the mean values, and it is considered that the experimental group showed a significant result. Also, considering that the MMSE-DS results were all normal elderly, there was no significant difference between the pre-test and the post-test. Therefore, it can be explained that the dementia prevention forest healing program for 7 days and 6 nights helped improve the cognitive function of the elderly.

#### **Changes in depression**

Lower scores indicate lower levels of depression. The results are as follows (Table 4). The experimental group's mean pre-test score was 8.72 points, and the mean post-test

**Table 3.** Changes in cognitive function

Dependent variable	Group	Pre		Post		z	p
		Mean	SD	Mean	SD		
MMSE-DS	Experiment	26.22	2.86	27.56	1.82	-2.551	0.030*
	Comparison	26.10	2.70	27.20	2.10		

\*Indicates significance at 5% level.

**Table 4.** Changes in depression

Dependent variable	Group	Pre		Post		z	p
		Mean	SD	Mean	SD		
BDI	Experiment	8.72	7.36	6.67	7.08	-1.859	0.063
	Comparison	9.00	7.54	8.90	6.17	-1.362	0.173

**Table 5.** Changes in anxiety

Dependent variable	Group	Pre		Post		z	p
		Mean	SD	Mean	SD		
BAI	Experiment	4.67	6.07	2.56	3.73	-2.847	0.004*
	Comparison	9.00	7.54	8.90	6.173	-0.105	0.916

\*Indicates significance at 5% level.

**Table 6.** Changes in cortisol

Dependent variable	Group	Pre		Post		Z	p
		Mean	SD	Mean	SD		
Cortisol	Experiment	7.15	2.56	7.87	2.55	-0.762	0.446
	Comparison	5.36	2.03	6.7	2.85	-1.478	0.139

score was 6.67 points, thus showing a 2.05 point decrease, but the difference was determined not to be statistically significant. For the experimental group, the results of the pre and post-test measurements revealed that 15 of them were within the range of minimal depression, thus demonstrating that most of the participants in this group were within the normal range. Moreover, two participants reported an alleviation of their depressive symptoms one participant's score decreased from the range of mild depression to minimal depression, while another participant's score decreased from the range of moderate depression to mild depression. The comparison group's mean pre-test score was 9.00 points, which decreased to a mean post-test score of 8.90 points. The 0.1 point decrease was found not to be statistically significant, and the pre-test and post-test measurements revealed that seven of the participants were within the normal range of minimal depression.

#### Changes in anxiety

Lower scores indicate signify lower levels of anxiety. The results are as follows (Table 5). The experimental group's mean pre-test score was 4.67 points, which decreased by 2.1

points to a mean post-test score of 2.56 points, and this difference was found to be statistically significant. Moreover, 12 of the 18 participants reported a decrease in their anxiety score, which indicates a lessening of anxiety symptoms. The results showed that three participants reported a marked decrease in their anxiety score after participating in the forest healing program, with one participant's score decreasing from the range of severe anxiety to mild anxiety, and the scores of two participants decreased from the range of mild anxiety to a range that indicates normal levels of anxiety. On the other hand, the comparison group's mean pre-test score of 9.00 points decreased by 0.1 points to a mean post-test score of 8.90 points, and the difference was found not to be statistically significant. Thus, the above results demonstrate that the seven day forest healing program improved the psychological state of elderly people with regard to feelings of anxiety.

#### Changes in cortisol

Lower cortisol level scores indicate lower levels of stress. The results are as follows (Table 6). The experimental group's mean pre-test score was 7.15 points, which in-



creased by 0.72 points to a mean post-test score of 7.87 points; the difference was determined not to be statistically significant. The comparison group's mean pre-test score was 5.36, and this score increased by 1.34 points to a mean post-test score of 6.7 points; the difference was also found not to be statistically significant. A cortisol score of less than 1.0 point generally indicates a low level of stress, while a range of 1.0 to 3.0 points indicates a normal level, and a score greater than 3.0 points indicates a high level of stress. According to the mean cortisol scores of the experimental and comparison groups, both groups had high levels of stress, and the experimental group's mean pre-test score in particular was 1.79 points higher than that of the comparison group.

## Discussion

This study was conducted to determine the effects of forest healing programs on cognitive function, depression, anxiety, and cortisol levels in elderly people. The forest healing program was found to improve the cognitive function of elderly people. Kim and Koo (2019) research found that the use of a forest healing program can significantly improve the cognitive function of elderly people who live alone. With this finding, it can be inferred that the elements of the intervention program that perform various manipulations in the forest and complete the results contributed to the improvement of cognitive function. On the other hand, in Jun et al. (2019) study, the forest healing program did not improve the cognitive function of the elderly. The reason for the difference in the research findings may be that each study used different criteria to select its participants. For example, this study was designed for the prevention of dementia in the elderly without cognitive impairment, but Jun et al. The study in focused on the elderly with MCI. This may explain the difference between the results of the two studies (Jun et al. 2019) Depression in the experimental group to which the forest healing program was applied decreased compared to the comparison p, but it was not statistically significant. Depression is a mood swing, and emotions don't come back quickly over a few days. At least two weeks of emotional change and recovery is required (Beck et al. 1961). This study was conducted for 7 days and 6 nights, because the forest healing program did not suffi-

ciently change emotions during that period. However, 12 of the 18 participants in the experimental group reported a lower post-test depression score, thereby demonstrating a positive result. Therefore, in order to verify whether the forest treatment program is effective in reducing depression in the elderly, it is necessary to increase the number of experiences of the forest treatment program. According to the results of previous studies, it was found that the depression level of the elderly decreased when the forest healing program was executed more than 8 times (Chai 2008). It was determined that the levels of anxiety in elderly people decreased after their participation in the forest healing program, thereby demonstrating the program's effect on anxiety. Kwon (2007) and Lim (2014) found that feelings of anxiety have a great impact on elderly people. In recent years, there have been ongoing studies on the use of forest healing programs for elderly people, but there has been insufficient research on elderly people of different age groups. Accordingly, there is a need for research on the development of programs that are effective in reducing feelings of anxiety in elderly people. Furthermore, social support as well as government support in the form of policies are necessary to solve problems that are related to the mental health of elderly people. Measurements of the stress hormone cortisol revealed that cortisol levels decreased in 10 of the 18 participants in the experimental group, but the difference was not statistically significant. This finding was consistent with that of Kim et al. (2018) and Suh (2021) studies, which utilized a two day forest healing program. It is known that an increase in cortisol is also associated with physical weakness or depression and stressful environments (Hoands et al. 2012; Ancelin et al. 2017). The above results may occur with programs that provide accommodations for its participants, as those in the participant group may experience stress as they adjust to the new environment. Participants generally feel a sense of psychological stability as they move away from their daily lives in the city. However, as elderly people may be lacking in energy and be under both physical and mental stress, it may be advisable to design one day programs or short, continuous programs for elderly participants rather than using long-term programs. Moreover, the duration of programs should be changed according to the age groups of the participants.

Overall, this study confirmed that forest healing pro-

grams are effective in improving the cognitive, mental, and physiological functions of elderly people. These findings could be used to develop dementia prevention policies on a national scale for both middle aged and elderly people. The findings of this study also suggest that forest healing programs have a positive psychological impact on elderly people because they help improve their cognitive function. In addition, the significance of this study lies in the fact that a forest healing program was used to provide the participant group with the opportunity to become more positive and psychologically stable during the seven days of the program. However, research on whether the 7 day forest healing program has a long-term effect on cognitive function and anxiety needs to be continued. This is why the scientific basis is still lacking.

This study makes the following suggestions based on the above findings.

First, as there were 18 participants in the experimental group and 10 participants in the comparison group, the research findings may not be generalizable to the entire elderly population. Therefore, when designing the next study, it is necessary to make the sample size of the experimental group and the comparison group the same and increase the number of sample groups to reach statistical significance. In addition, when designing future studies, efforts should be made to secure the best validity by minimizing the possibility of bias and errors by focusing on the RCT study and more meaningful results can be expected if we design a randomized controlled clinical study for a large number of people to review the effects of forest healing in the medium to long term.

Second, as this study was conducted with elderly participants in good health to determine the effectiveness of a program, it did not distinguish between the types of dementia or the stages of symptoms. Cognitive and depressive symptoms differ and progress differently according to the type of dementia. Therefore, if future studies were to distinguish between the types of dementia in their research, they may yield various results according to each type of dementia.

Third, depending on the research purpose, the forest healing program should be structured in a variety of ways and designed to derive the necessary effectiveness from the results. In particular, since the elderly have a higher risk of

accidents than other age groups, it is desirable to operate the program with a limited number of people according to the natural environment, age, and disease.

## Conclusions

In this study, the effects of participation in forest healing programs using forest resources on cognitive function, depression, anxiety, and cortisol levels of the elderly were investigated. As a result, the forest healing program was effective in improving cognitive function and reducing anxiety in the elderly. In the meantime, the program was limited to an indoor environment because the physical abilities of the elderly were limited. However, programming in an outdoor environment is required to improve cognitive function. Therefore, it is necessary to introduce a forest healing program that utilizes the forest environment. This study was attempted to prove the effectiveness of a forest healing program for middle aged and elderly people, and aims to promote public health, disease prevention, and forest use for the public good.

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## References

- Alzheimer's Disease International. 2015. The World Alzheimer Report 2015: The Global Impact of Dementia: An Analysis of Prevalence, Incidence, Cost and Trends. Alzheimer's Disease International, London.
- Ancelin ML, Scali J, Norton J, Ritchie K, Dupuy AM, Chaudieu I, Ryan J. 2017. The effect of an adverse psychological environment on salivary cortisol levels in the elderly differs by *5-HTTLPR* genotype. *Neurobiol Stress* 7: 38-46.
- Barca ML, Selbaek G, Laks J, Engedal K. 2008. The pattern of depressive symptoms and factor analysis of the Cornell Scale among patients in Norwegian nursing homes. *Int J Geriatr Psychiatry* 23: 1058-1065.
- Beck AT, Epstein N, Brown G, Steer RA. 1988. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol* 56: 893-897.
- Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. 1961. An inventory for measuring depression. *Arch Gen Psychiatry* 4:

- 561-571.
- Blackburn R, Bradshaw T. 2014. Music therapy for service users with dementia: a critical review of the literature. *J Psychiatr Ment Health Nurs* 21: 879-888.
- Borsje P, Wetzels RB, Lucassen PL, Pot AM, Koopmans RT. 2015. The course of neuropsychiatric symptoms in community-dwelling patients with dementia: a systematic review. *Int Psychogeriatr* 27: 385-405.
- Bundang Seoul National University Hospital. 2009. Standardization of Dementia Diagnostic Tools (11-1351000-000589-01). Ministry of Health and Welfare, Seoul.
- Central Dementia Research Center. 2020. Dementia Guidebook 'That Gives Me Strength'. Ministry of Health and Welfare, Seoul.
- Cha YJ. 2016. A study on occupational reminiscence therapy (ORT) program for the elderly with mild cognitive impairment (MCI) in local community. *J Korea Acad-Ind Cooper Soc* 17: 605-614.
- Chai RH. 2008. The effects of the bibliotherapy on the cognitive ability, depression and social relationship among Korean older adults. MS thesis. Hoseo University, Asan, Korea. (in Korean)
- Chang YC, Yao G, Hu SC, Wang JD. 2015. Depression affects the scores of all facets of the WHOQOL-BREF and may mediate the effects of physical disability among community-dwelling older adults. *PLoS One* 10: e0128356.
- Choi HC. 2013. Statistical Analysis in Social Sciences: SPSS PC+(20.0). Nanam, Paju.
- Han YR, Song MS, Lim JY. 2010. The effects of a cognitive enhancement group training program for community-dwelling elders]. *J Korean Acad Nurs* 40: 724-735.
- Holanda CM, Guerra RO, Nóbrega PV, Costa HF, Piuvezam MR, Maciel AC. 2012. Salivary cortisol and frailty syndrome in elderly residents of long-stay institutions: a cross-sectional study. *Arch Gerontol Geriatr* 54: e146-e151.
- Hong SS, Kim HC, Cho SH. 2013. The effects of forests healing for cognitive function. *J Orient Neuropsychiatry* 24: 63-74.
- Jun AY, Lee KS, Lee SM. 2019. Effects of the forest experience intervention program on depression, cognitive function, and quality of life in the elderly people with mild cognitive impairment. *Korean J Health Educ Promot* 36: 73-82.
- Kim BR, Kim KS. 2019. The effects of the tangram on the improvement of cognitive function in the elderly with mild cognitive impairment: focusing on neuropsychological assessment (CERAD-K). *J Hum Ecol* 29: 45-65.
- Kim HK, Son SJ, Hur YB, Choi HC. 2018. Effects of stress hormone (cortisol) from the healthy forest experience program in Deogyusan National Park. *J Environ Health Sci* 44: 502-513.
- Kim ID, Koo CD. 2019. A study of walking, viewing and fragrance-based forest therapy programs effect on living alone adults' dementia prevention. *Korean J Environ Ecol* 33: 107-115.
- Kim SY, Choi JK. 2018. Effects of Forest Experience Activity on the Attitude toward Forest and Personality of Primary School Students. *J For Environ Sci* 34: 490-496.
- Kim WT, Kim EJ, Yong MH, Oh HW. 2010. Systematic review of interventions for domestic elderly cognitive health management: proposal for forms of occupational therapy services. *J Korean Aging Health Friendly Policy Assoc* 2: 31-40.
- Kim YL, Yeon PS, Shin WS. 2012. The relationship between urban forest use and senior citizen's social bonding, QOL. *J Agric Sci Chungbuk Natl Univ* 28: 152-157.
- Korea Forest Service. 2022. Recreation Welfare. [https://www.forest.go.kr/kfswweb/kfi/kfs/cms/cmsView.do?mn=NKFS\\_03\\_06\\_01\\_01&cmsId=FC\\_001569](https://www.forest.go.kr/kfswweb/kfi/kfs/cms/cmsView.do?mn=NKFS_03_06_01_01&cmsId=FC_001569). Accessed 22 Jul 2019.
- Kwon HK. 2007. The influence on depression and thought of suicide of the old for the experience of abuse. MS thesis. Kyunghee University, Seoul, Korea. (in Korean)
- Kwon SM. 1997. Assessment of psychopathology in anxiety disorder. *Korean J Psychopathol* 6: 37-51.
- Lee EJ, Park BJ, Wang GO, Lee HH. 2020. The Effects of Forest Healing Program on Depression and Subjective Memory Complaints of the Older Old in an Urban Park -A Case Study of Gonjam Ceramics Park. *J Hum Soc Sci* 11: 1089-1101.
- Lee IS, Bang KS, Kim SJ, Song MK, Kgan KI. 2016. Status of health promotion programs utilizing forest - based on the 2015-2016 regional healthcare plans in Korea. *J Korean Inst For Recreat* 20: 39-52.
- Lee JH, Jeong NW, Jo SH. 2005. Fundamentals of Counseling Psychology. Hakjisa, Seoul.
- Lee YH, Song JY. 1991. A study of the reliability and the validity of the BDI, SDS, and MMPI-D scales. *Korean J Clin Psychol* 10: 98-113.
- Lee YM, Park NH. 2007. The effects of dementia prevention program on cognition, depression, self-esteem and quality of life in the elderly with mild cognitive disorder. *Korean J Adult Nurs* 19: 104-114.
- Lim KW. 2014. A study on the effects of the abuse experience on suicidal ideation in aged women - centering on Daejeon Metropolitan City. *Commun Dev Rev* 39: 31-38.
- Lim YS, Kim DJ, Yeoun PS. 2014. Changes in depression degree and self-esteem of senior citizens in a nursing home according to forest therapy program. *J Korean Inst For Recreat* 18: 1-11.
- Meyer C, O'Keefe F. 2020. Non-pharmacological interventions for people with dementia: a review of reviews. *Dementia (London)* 19: 1927-1954.
- National Health Insurance Service. 2015. Mild Cognitive Impairment before Dementia Increased 4.3 Times in the Last 5 years. [http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR\\_MENU\\_ID=04&MENU\\_ID=0403&page=1&CONT\\_SEQ=325691](http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=325691). Accessed 14 Sep 2015.
- Naylor MD, Karlawish JH, Arnold SE, Khachaturian AS, Khachaturian ZS, Lee VM, Baumgart M, Banerjee S, Beck C, Blennow K, Brookmeyer R, Brunden KR, Buckwalter KC, Comer M, Covinsky K, Feinberg LF, Frisoni G, Green C,

- Guimaraes RM, Gwyther LP, Hefi FF, Hutton M, Kawas C, Kent DM, Kuller L, Langa KM, Mahley RW, Maslow K, Masters CL, Meier DE, Neumann PJ, Paul SM, Petersen RC, Sager MA, Sano M, Schenk D, Soares H, Sperling RA, Stahl SM, van Deerlin V, Stern Y, Weir D, Wolk DA, Trojanowski JQ. 2012. Advancing Alzheimer's disease diagnosis, treatment, and care: recommendations from the Ware Invitational Summit. *Alzheimers Dement* 8: 445-452.
- Park HS, Shin CS, Yeoun PS, Kim JY. 2014. A comparative study on the stress recovery effect of forest therapy. *J Korean Inst For Recreat* 18: 13-24.
- Park KS, Jeong HY, So SY, Park YH, Yang HJ, Jung KR, Moon SJ, Kim HK, Cho JH, Yang KH. 2013. The effects of the activity program for preventing dementia against depression, cognitive function, and quality of life for the elderly. *J Orient Neuropsychiatry* 24: 353-362.
- Petersen RC. 2004. Mild cognitive impairment as a diagnostic entity. *J Intern Med* 256: 183-194.
- Seo Y, Kim S, Jeong S, Lee D, Choi J. 2020. Effect of Aroma Therapy on the Stress Alleviation and Job Satisfaction of Taxi Drivers. *J For Environ Sci* 36: 318-325.
- Seoul Metropolitan Center for Dementia. 2015. 2014 Dementia Management Project in Seoul business Report. [http://www.seouldementia.or.kr/common/e-book\\_2013/dementia\\_data/data1.pdf](http://www.seouldementia.or.kr/common/e-book_2013/dementia_data/data1.pdf). Accessed 21 May 2015.
- Shin WS. 2007. The influence of forest view through a window on job satisfaction and job stress. *Scand J For Res* 22: 248-253.
- Statistics Korea. 2020. 2020 Statistics on the Elderly. [https://kostat.go.kr/portal/korea/kor\\_nw/1/1/index.board?bmode=read&aSeq=385322](https://kostat.go.kr/portal/korea/kor_nw/1/1/index.board?bmode=read&aSeq=385322). Accessed 28 Sep 2020.
- Steinberg M, Shao H, Zandi P, Lyketsos CG, Welsh-Bohmer KA, Norton MC, Breitner JC, Steffens DC, Tschanz JT. 2008. Point and 5-year period prevalence of neuropsychiatric symptoms in dementia: the Cache County Study. *Int J Geriatr Psychiatry* 23: 170-177.
- Suh MH. 2021. Influences of Autonomic Function, Salivary Cortisol and Physical Activity on Cognitive Functions in Institutionalized Older Adults with Mild Cognitive Impairment: Based on Neurovisceral Integration Model. *J Korean Acad Nurs* 51: 294-304.
- Ueda T, Suzukamo Y, Sato M, Izumi S. 2013. Effects of music therapy on behavioral and psychological symptoms of dementia: a systematic review and meta-analysis. *Ageing Res Rev* 12: 628-641.
- Winblad B, Amouyel P, Andrieu S, Ballard C, Brayne C, Brodaty H, Cedazo-Minguez A, Dubois B, Edvardsson D, Feldman H, Fratiglioni L, Frisoni GB, Gauthier S, Georges J, Graff C, Iqbal K, Jessen F, Johansson G, Jönsson L, Kivipelto M, Knapp M, Mangialasche F, Melis R, Nordberg A, Rikkert MO, Qiu C, Sakmar TP, Scheltens P, Schneider LS, Sperling R, Tjernberg LO, Waldemar G, Wimo A, Zetterberg H. 2016. Defeating Alzheimer's disease and other dementias: a priority for European science and society. *Lancet Neurol* 15: 455-532.
- Woo JM, Park SM, Lim SK, Kim W. 2012. Synergistic effect of forest environment and therapeutic program for the treatment of depression. *J Korean For Soc* 101: 677-685.
- Yeo HB, Kim L, Ham BJ, Shim SH, Kwon YJ, Jung HY, Hahn SW, Jung HY, Lee MS, Lee HY. 2011. Association between Somatic Component of the Hamilton Depression Rating Scale and the Plasma ACTH & Serum Cortisol Level in Korean Patients with Major Depressive Disorder. *J Korean Soc Biol Ther Psychiatry* 17: 205-210.
- Yeoun PS. 2007. The relationships among forest experience, anxiety and self-respect. *J Korean Inst For Recreat* 11: 31-36.
- Yun SY, Kim HY. 2009. Effect of the horticultural therapy on activities of daily living and cognitive function of demented old adults. *J Agric Life Sci* 43: 27-32.