Dement Neurocogn Disord. 2024 Jan;23(1):44-53
https://doi.org/10.12779/dnd.2024.23.1.44
pISSN 1738-1495·eISSN 2384-0757

DND Dementia and Neurocognitive Disorder

Original Article

Check for updates

Effect of Anti-Aging Standard Forest Healing Program With Multiple Visits to a Forest Facility on Cognition in Older Age Patients

Jinseok Park [1,2] **Sheng-Min Wang** [2,3] **Dong Woo Kang** [2,4] **Beom Lee** [5] **Hojin Choi** [2,6]

[1]Department of Neurology, Hanyang University Hospital, Seoul, Korea
[2]Society for Cognitive Intervention, Seoul, Korea
[3]Department of Psychiatry, Yeouido St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea
[4]Department of Psychiatry, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea
[5]Forest Welfare Research Center, Korea Forest Welfare Institute, Yeongju, Korea
[6]Department of Neurology, Hanyang University Guri Hospital, Hanyang University College of Medicine, Guri, Korea

OPEN ACCESS

Received: Jan 2, 2024
Revised: Jan 22, 2024
Accepted: Jan 22, 2024
Published online: Feb 6, 2024

Correspondence to
Hojin Choi
Department of Neurology, Hanyang University Guri Hospital, Hanyang University College of Medicine, 222 Wangsimni-ro, Seongdong-gu, Seoul 04763, Korea.
Email: chj@hanyang.ac.kr

ORCID iDs
Jinseok Park
https://orcid.org/0000-0001-6581-5831
Sheng-Min Wang
https://orcid.org/0000-0003-2521-1413
Dong Woo Kang
https://orcid.org/0000-0003-3289-075X
Beom Lee
https://orcid.org/0009-0008-5065-1692
Hojin Choi
https://orcid.org/0000-0002-9637-4423

ABSTRACT

Background and purpose: The anti-aging standard forest healing program (ASFHP), which uses forest therapy, was reported to be effective in improving psychological, physical, and cognitive functions. However, there are several challenges to directly visiting the forest. This study aimed to investigate the impact of multi-session ASFHP with forest visit on the mental and physical health of the older people with visits to forest facilities and compared them with those of the same program conducted indoors.
Methods: Individuals aged over 70 years with concerns about cognitive decline were recruited at dementia relief centers and divided into control and experimental groups. A total of 33 people were administered ASFHP under the supervision of a forest therapy instructor. The control group stayed indoors, while the experimental group visited a forest healing center and repeated the program 20 weeks.
Results: The multiple-session ASFHP positively affected cognitive impairment screening test (CIST) total scores (p=0.002), memory (p=0.014), Korean version of the Repeatable Battery for the Assessment of Neuropsychological Status total scores (p<0.001), immediate recall (p=0.001), visuospatial/construction (p<0.001), language (p<0.001), forest healing standard questionnaire total scores (p=0.002), and cognitive function (p=0.019), regardless of location. The forest visits during the ASFHP showed positive effects on orientation (p=0.035), delayed recall (p=0.042), emotional stability (p=0.032), physical activity (p=0.005), and health (p=0.022). The CIST scores of the memory domain were the strongest indicator of the multiple-session ASFHP effects.
Conclusions: The 20-week multi-session ASFHP with forest visit showed effects on cognitive improvement and physical and emotional stability compared to indoor education.

Keywords: Anti-Aging Standard Forest Healing Program; Forest Therapy; Non-Pharmacological Treatment; Cognitive Decline; Forests

Funding

This work was supported by the Korea Forest Welfare Institute (FOWI).

Conflict of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Park J, Wang SM, Kang DW, Choi H; Data curation: Park J, Lee B; Formal analysis: Park J; Funding acquisition: Park J, Choi H; Investigation: Wang SM, Kang DW, Lee B; Methodology: Park J, Lee B; Project administration: Park J, Lee B, Choi H; Resources: Lee B; Supervision: Wang SM, Kang DW, Choi H; Validation: Park J, Choi H; Writing - original draft: Park J; Writing - review & editing: Park J.

INTRODUCTION

The elderly population, aged 65 and older, was anticipated to account for 18.4% of the total population in 2023 due to advancements in medical technology and declining birth rates. The aging index (the number of older adults, aged 65 or older, per 100 individuals younger than 14 years old) was anticipated to be 167.1, indicating a transition from an aged society to a super-aged society.[1,2] In a super-aged society, there is an increased incidence of mild cognitive impairment (MCI) or dementia, which is associated with major social and economic burdens. Treatment for dementia or MCI, which has been a single target treatment, has several limitations. Therefore, multi-target management including nonpharmacological treatments for cognitive decline has recently been suggested. Among them, the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER), the first large randomized controlled trial, emphasized multidomain intervention, including dietary control, supervised physical exercise, cognitive training, and the management of cardiovascular risk factors.[3,4] The positive results of the FINGER study increased the interest in various nonpharmacological treatments. In addition, psychological distress or depressed mood was reported to increase the risk of cognitive decline, and in such cases, nonpharmacological treatments, such as digital therapy or forest therapy, are effective.[5-7]

Forest therapy is a potential alternative nonpharmacological treatment for cognitive decline as it allows for physical and psychological interventions. The Korea Forest Welfare Institute (FOWI) in a Forestry Culture and Recreation Act article defines forest therapy as “immune-strengthening and health-promoting activities, which utilize a variety of elements in the forest".[8] The FOWI provides customized forest welfare services, according to one’s life stage, through 15 forest welfare facilities around the country.[9] The FOWI provides forest therapy through a forest healing program and has continuously tried to prove the program’s effectiveness in the management of cognitive and psychological disorders.[10,11]

In Korea, forest resources are very abundant with approximately 65% of the country covered with forest. However, in a previous study, while 82% of the subjects had experiences in forest and welfare activities, only 69% of the subjects were aware of the forest healing program, suggesting that the actual use rate is only 1.7%.[12] This could be attributed to the fact that a large percentage of the Korean population lives in urban areas. In addition, outdoor activities decreased during the coronavirus disease 2019 pandemic era. Therefore, digital therapeutics could be a viable alternative for forest healing programs that are implemented by physical forest visits.

However, it is not clear if the program conducted indoors and physical environments offer similar benefits, and research is needed to compare the effectiveness of a supervised forest healing program conducted by physically visiting the forest with the same program conducted indoors.

METHODS

Participants

This study included individuals with cognitive decline in old age from separate community dementia relief centers in Gwangju metropolitan city. The study was conducted from May 2023 to October 2023. A total of 44 individuals aged over 70 years without dementia were enrolled. We excluded individuals who dropped out (n=7), had insufficient data (n=2), and

https://doi.org/10.12779/dnd.2024.23.1.44

had comorbid conditions that could affect cognition, such as stroke, severe depression, illiteracy, and physical inactivity (n=2). We designated the community dementia relief centers as either a control group (indoor education, IE) or an experimental group (visit forest, VF). and analyzed 14 participants in the IE group and 19 participants in the VF group.

The study analysis was approved by the Institutional Review Board of Hanyang University Hospital (HYUH 2023-11-007).

One-day anti-aging standard forest healing program (ASFHP)

The ASFHP consisted of three stages, as shown in **Table 1**, and was conducted under the supervision of a qualified forest therapy instructor. The program was repeated 20 times a week for both the IE group (local dementia relief center in Gwangju city) and the VF group (National Center for Forest Education, Jangseong) and was conducted indoors in case of rain. One-day ASFHP consists of five sessions including introduction (one session), development (three sessions), and finish (one session). The introduction session (warm-up of the brain and body) is a preparatory step for the ASFHP, consisting of light warm-up exercise and movement memorization. The development session consists of cognitive function, physical activity, and emotional stability, and three programs are selected and performed on the same day. The finish session is a summary of the one-day ASFHP and is a process in which participants meditate and share their thoughts about the activities (**Supplementary Table 1**).

Neuropsychological assessment and measurement

Cognitive function and emotional state were examined using the tests below.

The cognitive impairment screening test (CIST) is a dementia screening tool developed by the Korean Ministry of Health and Welfare and has been used in dementia relief centers since January 2021.[13] The CIST evaluates orientation, memory, attention, visuospatial function, language, and executive function (a total score of 30). The results are determined as normal if they are above the cutoff considering age and education level and as cognitive decline if they are below the cutoff. We performed the CIST at baseline and at a 20-week follow-up.

The Korean version of the Repeatable Battery for the Assessment of Neuropsychological Status (K-RBANS). The K-RBANS consists of four identical degrees of difficulty tests and 12 subsets. The K-RBANS evaluates five domains (attention, language, visuospatial/ construction, immediate recall, and delayed recall).[14,15] Higher scores on both the CIS and K-RBANS indicate better cognitive function. In this study, K-RBANS was assessed at baseline, 12 weeks, and 20 weeks.

Table 1. Composition of a one-day anti-aging standard forest healing program

Composition	Benefit	Program
Introduction	Activating body and brain before activity	Warm-up for the brain and body
Development	Improving cognitive function	Memorization training
		Calculating training
		Association training
		Retrieval training
	Improving physical ability and sensory stimulation	Recreational exercise
	Emotional stability and physical nutrition	Eating meditation
		Tea meditation
		Walking meditation
		Raining meditation*
Finish	Clean your body and mind after activity	Sharing thoughts

*In case of rain.

https://doi.org/10.12779/dnd.2024.23.1.44

The geriatric depression scale, short form (sGDS), which is a tool used to assess the degree of depression in older adults, was also used to evaluate the participants. It consists of 15 questions with "yes" or "no" responses.[16] A total score greater than 8 suggests depression.[17]

The forest healing standard questionnaire (FHSQ) is a standard survey form for forest healing programs or forest therapy. It is used to evaluate the effectiveness of a standard forest healing program in patients with cognitive decline. It was jointly developed by the FOWI and researchers at Korea University Anam Hospital. It consists of four domains: cognitive function, emotional state, physical activity, and physical health.[18] Lower scores on both the sGDS and FHSQ indicate better functional status.

Statistical analysis

Continuous variables are presented as the mean±standard deviation or standard error and frequency (%). Statistical analyses were performed with SPSS 27.0 (IBM Corp., Armonk, NY, USA). Comparative analysis between the two groups was performed using the t-test, Mann-Whitney test, or χ^2 test. Two-way repeated measures analysis of variance or the generalized estimating equation (GEE) was used to analyze the differences between the two groups according to ASFHP repetition. The level of significance was set at $p<0.05$.

RESULTS

Baseline demographics of the participants

This study was conducted from May 2023 to October 2023 in separate locations, with a dementia relief center as the control group and a forest healing center as the test group. Forty-four participants were enrolled in an ASFHP. Seven individuals dropped out, two were excluded due to severe depression, and two were excluded due to insufficient test data. Finally, a total of 33 subjects were included in the analysis, with 14 in the control group and 19 in the experimental group. **Table 2** shows the baseline demographics of the participants enrolled in this study. At baseline, there were no significant differences between the two groups in age (78.1±4.4 vs. 76.0±4.2 years), education (6.3±3.5 vs. 6.8±3.6 years), female gender proportion (78.6% vs. 73.7%), CIST scores (22.4±3.0 vs. 20.6±4.9), K-RBANS scores (70.3±15.0 vs. 64.0±15.9), standard questionnaire scores (13.6±12.1 vs. 9.1±6.4), or GDS-15 scores (3.2±4.1 vs. 2.6±2.3).

Table 2. Demographic characteristics of the participants and baseline cognitive function

Variables	Indoor education group (n=14)	Visit forest group (n=19)	*p*-value
Demographics			
Age (yr)	78.1±4.4	76.0±4.2	0.171
Education (yr)	6.3±3.5	6.8±3.6	0.661
Female*	11 (78.6)	14 (73.7)	0.746
CIST	22.4±3.0	20.6±4.9	0.222
K-RBANS	70.3±15.0	64.0±15.9	0.259
FHSQ	13.6±12.1	9.1±6.4	0.168
sGDS	3.2±4.1	2.6±2.3	0.957

Variables are presented as the means ± standard deviation or number (%).
CIST: cognitive impairment screening test, K-RBANS: the Korean version of the Repeatable Battery for the Assessment of Neuropsychological Status, FHSQ: forest healing standard questionnaire, sGDS: geriatric depression scale, short form.
*χ^2 tests were performed.

https://doi.org/10.12779/dnd.2024.23.1.44

Table 3. Effect of a multiple-visit anti-aging standard forest healing program on CIST scores

CIST	Group	Scores at baseline	Scores at 20-week	Effects of visit (V)	Effects of group (G)	G×V
Total score	IE	22.43±0.77	23.36±0.81	9.708*±0.002	1.106±0.293	1.568±0.211
	VF	20.58±1.10	22.63±1.01			
Orientation	IE	4.64±0.16	4.64±0.13	1.130±0.288	4.443**±0.035	1.130±0.288
	VF	4.05±0.19	4.37±0.23			
Attention	IE	1.93±0.21	2.14±0.17	0.778±0.378	0.854±0.355	1.930±0.165
	VF	2.26±0.15	2.21±0.12			
Visuospatial	IE	2.00±0.00	2.00±0.00	1.033±0.309	1.033±0.309	1.033±0.309
	VF	1.94±0.06	2.00±0.00			
Executive†	IE	2.64±0.30	3.00±0.32	0.448±0.508	0.971±0.332	0.448±0.508
	VF	3.39±0.30	3.21±0.32			
Memory	IE	7.93±0.38	8.07±0.46	6.037**±0.014	2.611±0.106	4.318**±0.038
	VF	6.33±0.58	7.84±0.41			
Language	IE	3.43±0.13	3.50±0.13	0.067±0.796	0.334±0.563	1.588±0.208
	VF	3.42±0.11	3.32±0.13			

Variables are presented as the means ± standard error.
CIST: cognitive impairment screening test, IE: indoor education, VF: visit forest.
*p<0.05, **p<0.01; †Two-way Repeated Measures ANOVA were performed.

Effects of a multiple-visit ASFHP

After completing the 20-week ASFHP, the differences between the two groups were analyzed.

CIST

The effects of the multiple-visit ASFHP on CIST in the two groups are shown in **Table 3** and **Supplementary Fig. 1**. There were significant differences in the multiple-visit effect on the total CIST scores (Wald's χ^2: 9.708, p=0.002) and memory (Wald's χ^2: 6.037, p=0.014) between the IE and VF groups. Both parameters improved with the multiple-VF healing program regardless of the location. In both groups, there were significant interactions between multiple visits and the memory domain (Wald's χ^2: 4.318, p=0.038). In the orientation domain, the VF group showed increased scores at 20 weeks compared to the IE group. The GEE showed the effect of the multiple-VF healing program on the groups (Wald's χ^2: 4.443, p=0.035).

K-RBANS

The effects of the multiple-visit ASFHP on K-BRANS in the two groups are shown in **Table 4** and **Supplementary Fig. 2**. There were significant effects on K-RBANS total scores (F: 27.698, p£¼0.001), immediate recall (F: 7.451, p=0.001), visuospatial/construction (F: 14.013, p<0.001£©, and the language domain (F: 20.680, p<0.001). The results indicate that those cognitive domains showed improvements in the multiple-visit ASFHP group, regardless of the location. In the delayed recall domain, the VF group (70.4±13.6 to 74.1±15.4) showed significant improvement compared to the IE group (79.4±12.4 to 81.2±14.0) (F: 4.489, p=0.042). There were no significant interactions between multiple visits and groups in any domains.

FHSQ

The effects of the multiple-visit ASFHP on FHSQ in the two groups are shown in **Table 5** and **Supplementary Fig. 3**. Multiple visits showed significant effects on FHSQ total scores (Wald's χ^2: 12.770, p=0.002) and cognitive function (Wald's χ^2: 7.911, p=0.019). Repeated ASFHP showed positive effects on the two parameters regardless of the location. Emotional state (Wald's χ^2: 4.616, p=0.032), physical activity (Wald's χ^2: 7.952, p=0.005), and physical health (Wald's χ^2: 5.220, p=0.022) scores in the VF group were significantly lower than in the IE group. Thus, positive effects on emotional stability, physical activity, and health were seen in the VF group. There were no significant interactions between multiple visits and groups in any domains.

https://doi.org/10.12779/dnd.2024.23.1.44

Table 4. Effect of the multiple-visit anti-aging standard forest healing program on K-RBANS

K-RBANS	Group	Scores at baseline	Scores at 12-week	Scores at 20-week	Effects of multiple visits (V)	Effects of group (G)	G×V
Total scores	IE	70.3±15.0	75.9±11.4	83.6±12.4	27.698*±0.000	1.867±0.182	0.058±0.944
	VF	64.0±15.9	68.6±17.7	76.3±17.8			
Attention	IE	88.1±13.0	90.1±11.1	92.0±12.8	2.748±0.072	0.271±0.606	0.092±0.913
	VF	85.2±11.1	88.2±13.8	90.8±14.8			
Immediate recall	IE	80.2±14.4	82.5±10.7	89.4±15.6	7.451**±0.001	1.204±0.281	0.043±0.958
	VF	75.7±13.9	78.5±15.7	84.0±13.8			
Delayed recall	IE	79.4±12.4	83.0±16.4	81.2±14.0	0.742±0.480	4.489***±0.042	0.690±0.505
	VF	70.4±13.6	70.5±16.4	74.1±15.4			
Visuospatial/ construction	IE	73.6±12.2	74.7±12.8	88.2±9.4	14.013*±0.000	1.629±0.211	0.518±0.599
	VF	69.4±15.5	71.4±15.0	80.0±18.1			
Language	IE	78.4±16.1	87.1±10.3	91.3±13.2	20.680*±0.000	0.057±0.813	0.093±0.911
	VF	78.1±14.4	85.5±11.9	90.0±14.5			

Variables are presented as the means ± standard error.
K-RBANS: the Korean version of the Repeatable Battery for the Assessment of Neuropsychological Status, IE: indoor education, VF: visit forest.
*p<0.05, **p<0.01, and ***p<0.001.

Table 5. Effect of the multiple-visit anti-aging standard forest healing program on FHSQ scores

FHSQ	Group	Scores at baseline	Scores at 12-week	Scores at 20-week	Effect of multiple visits (V)	Effect of group (G)	G×V
Total score	IE	13.64±3.12	20.36±3.36	20.21±3.72	12.770*±0.002	3.810±0.051	0.158±0.924
	VF	9.05±1.43	13.11±2.17	12.50±2.05			
Cognitive function	IE	9.07±1.69	12.07±2.07	11.64±2.05	7.911**±0.019	2.315±0.128	0.129±0.937
	VF	6.63±1.05	8.74±1.46	8.06±1.43			
Emotional state	IE	3.56±1.03	5.25±0.70	5.18±0.70	4.525±0.104	4.616±0.032	3.305±0.192
	VF	2.78±0.54	3.57±0.58	2.69±0.48			
Physical activity	IE	4.00±1.41	3.20±0.87	3.17±0.90	0.111±0.946	7.952*±0.005	1.804±0.406
	VF	1.33±0.27	2.00±0.24	1.88±0.48			
Physical health	IE	2.82±0.67	3.08±0.45	3.81±0.94	1.629±0.443	5.220**±0.022	3.421±0.181
	VF	1.84±0.29	2.33±0.41	1.68±0.36			

Variables are presented as the means ± standard error.
FHSQ: forest healing standard questionnaire, IE: indoor education, VF: visit forest.
*p<0.05, **p<0.01.

Table 6. Effects of the multiple-visit anti-aging standard forest healing program on sGDS scores

sGDS	Group	Scores at baseline	Scores at 12-week	Scores at 20-week	Effect of multiple visits (V)	Effect of group (G)	G×V
Score	IE	4.50±1.25	7.10±1.47	6.89±1.51	3.584±0.167	5.107*±0.024	2.263±0.323
	VF	3.50±0.51	4.15±0.68	3.45±0.49			

Variables are presented as the means ± standard error.
sGDS: geriatric depression scale, short form, IE: indoor education, VF: visit forest.
*p<0.05.

sGDS

The effect of the multiple-visit ASFHP between the two groups on sGDS was shown in **Table 6** and **Supplementary Fig. 1**. sGDS scores were significantly affected by the group (Wald's χ^2: 5.107, p=0.024). The scores in the multiple-visit ASFHP VF group (3.50 [0.51] to 3.45 [0.49]) showed a positive effect on emotion compared to the IE group (4.50 [1.25] to 6.89 [1.51]).

DISCUSSION

This study was conducted at community dementia relief and targeted individuals over 70 years of age who were not diagnosed with dementia but with concerns about cognitive decline. Several studies have investigated the effectiveness of an ASFHP as a nonpharmacological treatment for cognitive decline and reported positive effects on mood, immune system, stress levels, and physical health.[7,10,11,19] In a meta-analysis, forest-based intervention showed a significant effect on overall mental health.[20] In a

https://doi.org/10.12779/dnd.2024.23.1.44

previous study, similar ASFHP conducted on MCI patients showed positive effects on psychological, physiological, and physical health.[11] In addition, it was reported that the forest healing program affects the autonomic nervous system, such as heart rate variability or electroencephalography, and alleviates depression symptoms and controls physical risk factors.[21,22] The alleviation of depressive symptoms observed in our study is thought to be due to relieving the participant's psychological burden through the various experiences provided by the physical forest environment. In the physiologic aspect, forest therapy was linked with an increase in neurotransmitters such as serotonin and a decrease in stress hormones such as cortisol.[23,24] Walking in the forest environment is a physical activity and is expected to improve overall physical health, including cardiovascular functions.[24-26] In our study, the VF group showed significant positive effects on physical health than the IE group. These results could be explained by the fact that ASFHP conducted in the forest affected physiologic and physical health by engaging in more than usual outdoor activities under the supervision of an instructor. Previous research also demonstrated that guided forest therapy had more positive effects on emotional change and social interaction.[27] The ASFHP was developed by the FOWI as a program that strengthens cognitive, emotional, and physical activities under the supervision of qualified forest therapy instructors rather than visiting a mountain like mountain climbing, hiking, or forest bathing. While the ASFHP is a standardized program, it was not clear whether people who have difficulty accessing forest welfare facilities for various reasons could participate in the program from other locations and achieve the same results.

In this study, the ASFHP showed significant effects on various (CIST total score/memory, K-RBANS total score/immediate recall/visuospatial-construction/language, and FHSQ total score/cognitive function) tests following multiple visits (**Tables 3**-**5**). This means that when the ASFHP is repeated for 20 weeks, regardless of the location, memory, visuospatial, and language functions are positively affected. Differences between the FV group and the IE group were found in the CIST orientation, K-RBANS delayed recall, sGDS, FHSQ emotional state, physical activity, and physical health, with the FV group showing more significant effects than the IE group (**Tables 3**-**6**). A positive effect was seen on orientation, delayed recall, emotional stability, physical activity, and health when the ASFHP was implemented by physically visiting a forest facility. As shown in **Table 1**, the IE group underwent the same program that included physical activity and meditation; however, there was meaningful emotional and physical effects in the FV group compared with the IE group c.

Managing risk factors is essential to prevent cognitive decline. Psychological anxiety, physical activity, and social interaction have been identified as modifiable risk factors for cognitive function.[28] In addition, in the FINGER study, multidomain interventions, including nutritional counseling, cognitive training, metabolic and vascular risk factor management, as well as physical activity, were performed on an at-risk elderly population to improve or maintain cognitive function.[3,4] The ASFHP, which includes physical, emotional, and social interaction could help control the risk factors, and is; therefore, an alternative nonpharmacological treatment for cognitive decline. Previous studies have also reported the effects of forest therapy on emotional and physical health, including cognitive function.[11,29] The difference between ASFHP and the recreational use of forest or forest bathing is that ASFHP includes qualified forest therapy instructors who conduct and supervise the program. This could be one of the reasons ASFHP showed positive results similar to the FINGER study.

In our opinion, the important aspects of nonpharmacological treatment for cognitive decline are adherence and guidance from qualified instructors. A multidomain dementia prevention

study using digital therapeutics also showed differences in cognitive function and brain cortical thickness in a facility-based group under supervision. Similarly, in our study, the program was conducted under the supervision of a qualified forest therapy instructor.[30,31] In terms of adherence, seven people dropped out of this study, resulting in a dropout rate of 15.9%. Although this dropout rate included the IE group, the largest percentage was from the FV group, which reflects the challenges of visiting a forest facility due to a wide range of reasons including time and geography.

This study had several limitations. The 20-week ASFHP had to be conducted at a community dementia relief center or forest facility, there were difficulties in recruiting participants for practical reasons. Because the sample size affects the meaningfulness of the study, research with a larger number of participants is needed in the future. Because this study was not hospital-based, the participants were not randomized for practical reasons. Also, since the dementia relief centers were designated as an IE group or a VF group, the influence of the participants' socioeconomic status, living environment, and quality of life, which were not investigated in this study, cannot be ruled out. In addition, because the subjects were limited to older people over 70 years old who had not been diagnosed with dementia at the hospital, most of the participants had normal cognitive function according to the CIST test at the dementia relief center. When adjusted for age and education, all participants in the IE group were normal (14/14). In the VF group, 4 out of 19 participants were below the cut-off value, but the difference was not critical, and the overall mean CIST score between IE and VF groups was not statistically significant. Therefore, there are limitations in applying the results of this study to all types of cognitive decline, including dementia.

Despite these limitations, this study demonstrated that conducting the ASFHP by visiting the abundant and familiar forest resources in Korea could improve psychological stability, physical activity, and health and the effects were more significant compared to conducting the program indoors. Therefore, it could be said that conducting ASFHP by visiting a forest facility with a qualified instructor had an advantage compared to conducting the program indoors.

SUPPLEMENTARY MATERIALS

Supplementary Table 1
Detailed schedule of 20-week anti-aging standard forest healing program

Supplementary Fig. 1
Graph of score changes in CIST and sGDS between IE and VF groups.

Supplementary Fig. 2
Graph of score changes in K-RBANS between IE and VF groups.

Supplementary Fig. 3
Graph of score changes in FHSQ between IE and VF groups.

https://doi.org/10.12779/dnd.2024.23.1.44

REFERENCES

1. Kim KW, Kim OS. Super aging in South Korea unstoppable but mitigatable: a sub-national scale population projection for best policy planning. Spat Demogr 2020;8:155-173. PUBMED | CROSSREF
2. Statistics Korea. Population and Housing Census. Daejeon: Statistics Korea, 2023.
3. Ngandu T, Lehtisalo J, Solomon A, Levälahti E, Ahtiluoto S, Antikainen R, et al. A 2 year multidomain intervention of diet, exercise, cognitive training, and vascular risk monitoring versus control to prevent cognitive decline in at-risk elderly people (FINGER): a randomised controlled trial. Lancet 2015;385:2255-2263. PUBMED | CROSSREF
4. Kivipelto M, Solomon A, Ahtiluoto S, Ngandu T, Lehtisalo J, Antikainen R, et al. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER): study design and progress. Alzheimers Dement 2013;9:657-665. PUBMED | CROSSREF
5. Liu M, Ma J, Fu CY, Yeo J, Xiao SS, Xiao WX, et al. Dysfunction of emotion regulation in mild cognitive impairment individuals combined with depressive disorder: a neural mechanism study. Front Aging Neurosci 2022;14:884741. PUBMED | CROSSREF
6. Park JY, Choi SA, Kim JJ, Park YJ, Kim CK, Cho GJ, et al. Effect of tablet-based cognitive intervention on cognition in patients with mild cognitive impairment: a pilot study. Dement Neurocogn Disord 2023;22:130-138. PUBMED | CROSSREF
7. Park BJ, Shin WS, Shin CS, Yeon PS, Chung CY, Lee SH, et al. Effects of forest therapy on psychological improvement in middle-aged women in Korea. J Prev Med Public Health 2022;55:492-497. PUBMED | CROSSREF
8. Korea Forest Welfare Institute. Forest Therapy. Daejeon: Korea Forest Welfare Institute, 2023.
9. Korea Forest Welfare Institute. Customized Forest Welfare Services for Each Stage of Human Life. Daejeon: Korea Forest Welfare Institute, 2023.
10. Kim H, Lee G, Beak K, Kim C, Song I, Kang D. Physiological and psychological effects of a forest healing program on elderly people with mild dementia. J Korean Ins For Recreat 2022;26:75-88.
11. Baek JE, Jung JH, Shin HJ, Kim SH, Sung SY, Park SJ, et al. Effects of forest healing anti-aging program on psychological, physiological, and physical health of older people with mild cognitive impairment. Int J Environ Res Public Health 2022;19:4863. PUBMED | CROSSREF
12. Korea Forest Welfare Institute. Forest Recreation Welfare Activity Survey Results (2022). Daejeon: Korea Forest Welfare Institute, 2023.
13. Ministry of Health and Welfare. Cognitive Impairment Screening Test (CIST) Manual. Seoul: National Institute of Dementia, 2023.
14. Park JO, Koo BH, Kim JY, Bai DS, Chang MS, Kim OL. The Korean Repeatable Battery for the Assessment of Neuropsychological Status-update: psychiatric and neurosurgery patient sample validity. J Korean Neurosurg Soc 2021;64:125-135. PUBMED | CROSSREF
15. Randolph C, Tierney MC, Mohr E, Chase TN. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): preliminary clinical validity. J Clin Exp Neuropsychol 1998;20:310-319. PUBMED | CROSSREF
16. Bae JN, Cho MJ. Development of the Korean version of the geriatric depression scale and its short form among elderly psychiatric patients. J Psychosom Res 2004;57:297-305. PUBMED | CROSSREF
17. Lee SC, Kim WH, Chang SM, Kim BS, Lee DW, Bae JN, et al. The use of the Korean version of short form geriatric depression scale (SGDS-K) in the community dwelling elderly in Korea. J Korean Geriatr Psychiatry 2013;17:37-43.
18. Park KW. Development of a Forest Healing Standard Questionnaire for Dementia and Cognitive Dysfunction and Panel Study to verify the Effectiveness. Daejeon: Korea Forest Welfare Institute, 2022.
19. Heckmann JG, Kiem M, Immich G. Forest therapy as a nature-based intervention: an option for neurological rehabilitation? Complement Med Res. Forthcoming 2023. PUBMED | CROSSREF
20. Kang MJ, Kim HS, Kim JY. Effects of forest-based interventions on mental health: a meta-analysis of randomized controlled trials. Int J Environ Res Public Health 2022;19:4884. PUBMED | CROSSREF
21. Yi J, Kim SG, Khil T, Shin M, You JH, Jeon S, et al. Psycho-electrophysiological benefits of forest therapies focused on qigong and walking with elderly individuals. Int J Environ Res Public Health 2021;18:3004. PUBMED | CROSSREF
22. Lim YS, Kim J, Khil T, Yi J, Kim DJ. Effects of the forest healing program on depression, cognition, and the autonomic nervous system in the elderly with cognitive decline. J People Plants Environ 2021;24:107-117. CROSSREF

23. Park BJ, Shin CS, Shin WS, Chung CY, Lee SH, Kim DJ, et al. Effects of forest therapy on health promotion among middle-aged women: focusing on physiological indicators. Int J Environ Res Public Health 2020;17:4348. PUBMED | CROSSREF

24. Ochiai H, Ikei H, Song C, Kobayashi M, Miura T, Kagawa T, et al. Physiological and psychological effects of a forest therapy program on middle-aged females. Int J Environ Res Public Health 2015;12:15222-15232. PUBMED | CROSSREF

25. Piva G, Caruso L, Gómez AC, Calzolari M, Visintin EP, Davoli P, et al. Effects of forest walking on physical and mental health in elderly populations: a systematic review. Rev Environ Health. Forthcoming 2022. PUBMED | CROSSREF

26. Nguyen PY, Astell-Burt T, Rahimi-Ardabili H, Feng X. Effect of nature prescriptions on cardiometabolic and mental health, and physical activity: a systematic review. Lancet Planet Health 2023;7:e313-e328. PUBMED | CROSSREF

27. Kim JG, Shin WS. Forest therapy alone or with a guide: is there a difference between self-guided forest therapy and guided forest therapy programs? Int J Environ Res Public Health 2021;18:6957. PUBMED | CROSSREF

28. Livingston G, Huntley J, Sommerlad A, Ames D, Ballard C, Banerjee S, et al. Dementia prevention, intervention, and care: 2020 report of the lancet commission. Lancet 2020;396:413-446. PUBMED | CROSSREF

29. Chun H, Cho I, Choi YY, Park S, Kim G, Cho S. Effects of a forest therapy program on physical health, mental health, and health behaviors. Forests 2023;14:2236. CROSSREF

30. Moon SY, Kim S, Choi SH, Hong CH, Park YK, Na HR, et al. Impact of multidomain lifestyle intervention on cerebral cortical thickness and serum brain-derived neurotrophic factor: the SUPERBRAIN exploratory sub-study. Neurotherapeutics 2022;19:1514-1525. PUBMED | CROSSREF

31. Moon SY, Hong CH, Jeong JH, Park YK, Na HR, Song HS, et al. Facility-based and home-based multidomain interventions including cognitive training, exercise, diet, vascular risk management, and motivation for older adults: a randomized controlled feasibility trial. Aging (Albany NY) 2021;13:15898-15916. PUBMED | CROSSREF