

The effect of forest-based trauma stress management program on job stress, PTSD, resilience, mental health, and salivary cortisol for firefighters

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산림기반 외상스트레스 관리 프로그램이 소방관의 직무스트레스, 외상 후 스트레스, 회복탄력성, 정신건강과 타액 코르티졸에 미치는 효과

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Abstract The purpose of this study was to evaluate the effect of forest-based trauma stress management programs on firefighters' job stress, post-traumatic stress disorder (PTSD), resilience, mental health and salivary cortisol and use them as evidence for disseminating customized intervention programs. This program was a forest-based trauma stress management program for five days and was conducted from June 4 to June 8, 2018, for 20 firefighters. Four psychological questionnaires (job stress, PTSD, resilience and mental health) were applied, and physiological measures were assessed (salivary cortisol) before and after the program. There were significant differences in job stress ($t = -2.411$, $p = 0.026$), PTSD ($t = -3.294$, $p = 0.004$), resilience ($t = -7.242$, $p < 0.001$) and mental health ($t = -2.168$, $p = 0.043$) before and after the program in the experimental group, but there was no significant difference in salivary cortisol ($t = -.962$, $p = 0.348$). The results indicated a statistically significant decrease in job stress and PTSD and an increase in resilience and mental health. These results can be used for disseminating custom-tailored intervention programs for firefighters.

요약 본 연구의 목적은 소방관에게 산림기반 외상스트레스 관리프로그램을 적용하여 직무스트레스, PTSD, 회복탄력성, 정신건강과 타액 코르티졸에 미치는 효과를 확인하여, 소방관에게 맞춤형 중재프로그램 보급을 위한 기초자료로 활용하고자 한다. 본 프로그램은 5일간의 산림기반 외상스트레스 관리프로그램으로 20명의 소방관을 대상으로 2018년 6월 4일부터 6월 8일까지 진행되었다. 4개의 심리적 측정 질문지(직무스트레스, 외상 후 스트레스, 회복탄력성, 정신건강)와 1개의 생리적 측정(타액 코르티졸)이 프로그램 전과 후에 측정되었다. 실험군의 프로그램 전과 후에 직무스트레스($t = -2.411$, $p = 0.026$), 외상 후 스트레스($t = -3.294$, $p = 0.004$), 회복탄력성($t = -7.242$, $p < 0.001$) 및 정신건강($t = -2.168$, $p = 0.043$)에 유의한 차이가 있었으나, 타액 코르티졸에는 유의한 차이가 없었다($t = -.962$, $p = 0.348$). 산림기반 외상스트레스 관리 프로그램이 소방관의 직무스트레스와 PTSD를 감소시켰으며, 회복탄력성과 정신건강을 향상시키는 것으로 확인되었으므로, 소방관을 위한 맞춤형 중재프로그램 보급에 활용하기를 기대한다.

Keywords : Firefighters, Forest-Based Trauma Stress Management Program, Job Stress, Mental Health, PTSD, Resilience, Salivary Cortisol

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1. Introduction

Serious accidents, including natural disasters, occur worldwide, and firefighters save people's lives from forest fires, floods, and building collapses. These public officials have been professionally trained to perform rescue and emergency tasks such as disaster response, firefighting, life-saving activities, first aid for the injured, and transfer to hospitals by promptly dispatching to emergency situations at the site of disasters. It is a job that maintains public order and promotes people's welfare [1]. Due to the nature of their work, they are required to be on standby 24 hours a day and to be dispatched to rescue victims within a short time [2]. Complex job stress is accompanied by the work environment directly related to situations in which life is at stake. Firefighters are often exposed to high heat and toxic chemicals during firefighting. They are also quickly dispatched to the scene of accidents such as fall, severe noise, and collapse of buildings and rescue critically injured victims with physical injury and trauma [3].

Job stress refers to the psychological burden felt by an individual as the individual and the job environment do not match in the process of completing a task at work [4].

Moreover, the firefighters work in two rotation shifts with three groups. These shifts result in accumulation of sleep deprivation and fatigue, which can lead to frequent accidents. They are exposed to higher job stress situations compared to those in other occupations [5].

This job-related stress has a negative effect on their lives with families, and they are also experiencing serious psychological stress [6].

Firefighters are also at increased risk of post-traumatic stress disorder (PTSD) because they are repeatedly exposed to traumatic events, such as witnessing accidents and deaths [7, 8]. PTSD is defined as having extreme fears and

helplessness, and so on, by experiencing or witnessing actual or near death, serious injury, or an event that threatens personal well-being [9]. The prevalence of PTSD among firefighters is 6.5% to 37% [8,10-15], which is ten times higher than that of the general public, indicating that they are more vulnerable to PTSD than any other group in society [16].

In fact, in 2019, a complete enumeration survey of psychological health of firefighters conducted by the National Fire Agency found the following results: 5.6% of firefighters were experiencing PTSD, 25.3% of them had sleep disorders, 29.9% had drinking problems, and 4.6% had depression. Of those with suicidal thoughts, 54.7% had PTSD, 81.1% had sleep disorders, 62.3% had drinking problems, and 67.9% had depression [17].

Moreover, it is reported that stress-related mental health problems have a correlation with an individual's cognitive judgment of a crisis situation, which can appear differently depending on whether each individual perceives it as a coordinate challenge or an overwhelming threat [18].

Accordingly, Walsh [19] emphasized the role of resilience, which allows one to endure and respond to continuous stress as resilience, and the ability to recover from crises and adversity, and to live a more flexible life after overcoming.

Resilience is defined as the ability to successfully adapt to stress, that is, the ability to cope with stress [20].

Therefore, it was confirmed that people with high resilience showed less trauma symptoms related to major events than those with low resilience [21].

People with a high degree of resilience recover from negative emotions even in stressful situations and have more positive emotions [22] and recover from stress quickly [23].

In addition, Song confirmed in previous studies [24], that resilience is a significant

influencing factor in firefighters' PTSD expression, and reported that resilience based on emotional flexibility can affect the prevention and stress reduction of PTSD.

However, it is reported as job stress and resilience as the main factors affecting the mental health of firefighters [25], in order to improve the mental health of firefighters, development of measures to strengthen resilience is urgently needed to reduce job stress and alleviate PTSD expression.

As a way to reduce stress and PTSD for firefighters, research was conducted through various ways such as collective art therapy [26], cognitive behavior therapy [27], post-traumatic stress management programs [28], integrated management programs [29], and mindfulness-based programs [30].

About 70% of Korea is mountainous and the country has many forest resources, so the demand for forest healing activities is on the rise [31].

As a place for health promotion and disease healing, the forest may consist of comprehensive interventions that make the most of natural settings and physical activities of patients, and promote emotional and psychological stability [32].

Forest healing has been clinically proven as an activity for stress relief [33], it was confirmed that the integrated forest experience intervention for cancer patients at home was effective in reducing depression and increasing resilience of the patients [34].

In addition, it has been reported that forest healing significantly improves the mental health of adults by reducing the levels of depression, anxiety, and anger along with stress [35], and reduces stress hormones such as cortisol in physiological aspects [36].

Only one study [37] found that a forest-based program improved their post-traumatic stress symptoms or mood.

To fill this gap, the current study has applied a forest-based trauma-stress-management program to firefighters assess its impact on job stress, PTSD, resilience, mental health, and salivary cortisol; the results provide evidence that such programs can be used to disseminate customized interventions.

Table 1. Domains of forest-based trauma stress management program.

Domains	Program
Counseling	<ul style="list-style-type: none"> · Orientation · Individual and group counseling
Self-reflection	<ul style="list-style-type: none"> · Forest Healing: Self-reflection and healing through Wisdom Forest 1 and 2 · Night solo: Time to meet yourself · Positive Psychology ("Finding myself"): A group program to inspire professional pride in being a firefighters
Resilience	<ul style="list-style-type: none"> · Relaxation training: daily relaxation training through modified autogenic training (modified AT) · Making tea for yourself: relaxation through tea therapy · Stress relief education (Smart Firefighting) · Eye Movement Desensitization and Reprocessing (EMDR)-based calming technique · Learning about healthy food and beverage through the Tea Cocktail program · My life as a firefighter (speaking from the heart): meeting with seniors · Future Template: Simulate coping with stressful situations related to burnout or trauma · Sharing your thoughts and feelings: all are welcome! A time of comfort and encouragement
Physical health promotion	<ul style="list-style-type: none"> · Foot baths, water treatment, heat treatment, walking, and having meals together
Evaluation area	<ul style="list-style-type: none"> · Physiological variables, psychosocial variables, program satisfaction

2. Materials and Methods

2.1 Research subject and setting

The subjects were enlisted by sending a message regarding participant recruitment to three regional fire departments randomly requested through the National Fire Agency. A total of 23 participants who volunteered were selected, and the final sample was 20, excluding

three due to incomplete information. The intervention was provided in the National Hoengseong Soopchewon located in Gangwon province.

The subjects in this study are as follows,

- Those who are included:
 - A male or female firefighter 20 years of age or older
 - Person who has worked in the current position for more than 3 years
 - Persons who voluntarily want to participate in the program
 - Persons who can stay in the same place for more than five days
 - Persons who have never received medical treatment related to mental health

- Subjects to be excluded
 - Persons diagnosed with mental health disorders
 - Persons taking other drugs related to the disease

2.2 Program and procedure

The program was a forest-based trauma stress management program for the period of five days. It was composed of a forest healing program using environmental factors of forest resources and lectures related to psychology with four domains: (1) counseling, (2) self-reflection, (3) resilience, and (4) physical health promotion (Table 1). The detailed program is presented in Table 2.

Table 2. Forest-based trauma stress management program.

Time	Monday(June 4)	Tuesday(June 5)	Wednesday(June 6)	Thursday(June 7)	Friday(June 8)
7-8 am	Breakfast				
8-9 am		Morning walk	Morning walk	Morning walk	Morning walk
9-10 am		Relaxation training	Relaxation training	Relaxation training	Relaxation training
10-11 am		⁽²⁾ Day Solo 'Wisdom Forest 1'		⁽⁵⁾ Making tea yourself	Future template: sharing your thoughts "Yeah, all are welcome!" Complete a survey questionnaire, stress-related test 2 (salivary cortisol)
11 m -12 noon	Arrive at Soopchewon, Complete a survey questionnaire, and stress-relates test 1 (salivary cortisol)				
12 noon -1 pm	Lunch, room assignment/unpacking	Lunch		Lunch	Lunch/Group photo
1-2 pm	Orientation /introducing yourself	⁽³⁾ Day Solo 'Wisdom Forest 2'	⁽⁴⁾ Group counseling	⁽⁶⁾ "My life as a firefighter"	EMDR based calming technique
2-3 pm				⁽⁷⁾ EMDR based calming technique	
3-4 pm	⁽¹⁾ Positive Psychology "Finding myself"				
4-5 pm	Relaxation training	Water/heat therapy (healing forest)		Smart (Stress Management is art)	Return home
5-6 pm	Dinner				
6-7 pm	Wrap-up	Dinner	Dinner	Dinner	
7-8 pm	Evening walk	Individual counseling /evening walk	Night Solo	⁽⁸⁾ Tea Cocktail using beverages	
8-9 pm			Individual counseling/evening walk	Evening walk	
9-10 pm					

Notes: EMDR = Eye Movement Desensitization and Reprocessing.

2.3 Measures

2.3.1 Job stress

Job stress was measured using an instrument developed by Kim [38], composed of a total of 50 items (13 items for psychological factors related to work, eight items for organizational systems, ten items for uncertainty, seven items for working environment-related stress, six items for interpersonal conflict, and six items for excessive workload).

The question of this tool includes, "I have difficulty continuing sleep due to my job," which is a four-point Likert scale, and the higher the score from "very not so" (1 point) to "very yes" (4 points), the higher the job stress situation. In terms of the reliability of the scale, Cronbach's alpha = 0.925 in Kim [38], and 0.983 in the current study.

2.3.2 Resilience (self-resilience)

Resilience was measured by items that Klohnen [39] classified as self-resilience from California Personality Inventory (CPI) items and adapted by Park [40]. This scale was rated from "not at all" (1 point) to "always" (5 points), and negatively worded items were calculated inversely. The questions in this tool consist of questions including "I often feel that I have made a wrong choice of occupation."

This study consisted of 29 items in four sub-areas, including nine items of confidence, eight items of interpersonal efficiency, ten items of optimism, and two items of anger control, and a higher score means higher resilience. In Park [40], Cronbach's alpha = 0.88, and was 0.95 in the current study.

2.3.3 Post-traumatic Stress Disorder (PTSD)

PTSD was measured using the Korean version of the Impact of Event Scale-Revised (IES-RK), which Eun et al. [41] adapted and standardized with verification of its validity from the Impact

of Event Scale-Revised (IES-R). IES-R was developed by Weiss and Marmar [42] based on Horowitz et al.'s Impact of Event Scale (IES) [43] to measure the impact and adaptation processes after traumatic experiences. This scale is a self-reported scale of trauma-related symptoms consisting of 22 items rated on a five-point Likert scale. The items are hyperarousal (6 items), avoidance (6 items), invasiveness (5 items), sleep disturbance, emotional paralysis, and dissociative symptoms (5 items). The questions in this tool consist of questions that include "the things that remind you of the event bring back your feelings about the event."

In the form of self-evaluating how often symptoms appeared during the past week, each item was rated from "not at all" (0 points) to "very much so" (4 points), and a higher score (lowest 0 to highest 88) indicates a higher level of post-traumatic stress. Cronbach's alpha was 0.98 in Weiss and Marmar [42], 0.83 in Eun et al. [41], and 0.97 in the current study.

2.3.4 Psychopathology (Symptom Checklist 90-Revised, SCL-90-R)

A simplified psychodiagnostic test was measured using a multi-dimensional self-reported symptom inventory, which was adapted for use in Korea by Kim et al. [44] from the Symptom Checklist-90 Revision (SCL-90-R) (Derogatis et al.) [45]. SCL-90-R consists of 90 items with ten sub-factors reflecting psychological symptoms, including 12 items of somatization, ten items of compulsion, nine items of interpersonal sensitivity, 13 items of depression, ten items of anxiety, six items of hostility, seven items of phobias, six items of paranoia, ten items of psychosis, and nine items of other problems, consisting of 10 sub-factors. The questions in this tool consist of questions including "I want to die." Each question

asked the degree of symptoms experienced during the past seven days, including today, on a

five-point Likert scale, ranging from “not at all” (0 points) to “very severe” (4 points). The Global Severity Index, a score obtained by converting the total score into a T score, was used, and a higher score indicates worse mental health. Cronbach’s alpha of the Korean version of SCL-90-R ranged from 0.67 to 0.89 reported from Won’s study of 607 patients, including 420 people without psychoneurosis and 187 outpatients with psychoneurosis [46]. Cronbach’s alpha was 0.98 in the current study.

2.3.5 Salivary cortisol

Salivary cortisol, which shows a reliable increase under stress, was measured as an index of endocrine activity [47].

Saliva samples were collected using a saliva collection aid (No.61/524,096; SalivaBio LLC, California, US) between 11:00 and 12:00 on the day before forest therapy and between 11:00 and 12:00 after forest therapy. Saliva samples collected at the field site were immediately placed in a freezer and sent to a laboratory (Macrophi Inc., Takamatsu, Japan) for analysis.

2.4 Data collection and ethical considerations

The data were collected from June 4 to June 8, 2018, from firefighters before and after the program after being approved by the Institutional Review Board on Bioethical Issues (WKIRB-201805-SB-038). To protect the privacy of subjects, the purpose and procedure of the study were explained before data collection, and data were collected after receiving a written consent for participation. The written consent indicated no benefits and losses from participation, guarantee of privacy and confidentiality, the possibility of withdrawing from the research by voluntary volition and no related disadvantages from withdrawal, and that the data will not be used for purposes other than the research purpose.

2.5 Statistical analysis

Data were analyzed with SPSS software (version 24.0 SPSS, Inc., Chicago, IL, US). The general characteristics of participants were analyzed as frequency and percentage, mean and standard deviation. A paired sample t-test was used to compare the differences between before and after the program. The reliability of the measurement tool was tested using Cronbach’s alpha.

3. Results

3.1 General characteristics of the participants

Of the subjects, 17 were male and three were female. The average age was 39.30 years old, and the average years of working was 113.9 months. A total of 65% of the participants were married, 65% were not religious, and 85% had a college degree or higher. A total of 50% reported firefighting as their duty and 70% did not smoke (Table 3).

Table 3. General characteristics of the participants.

Characteristics	Category	n or M±SD	(%)
Gender	Male	17	85
	Female	3	15
Age (year)		39.30 ± 9.958	
Employment period (months)		113.95 ± 123.136	
Marital status	No	7	35
	Yes	13	65
Religion	Yes	7	35
	No	13	65
Education	High school graduate	3	15
	College graduate	14	70
	Postgraduate degree or higher	3	15
Duty	Firefighting	10	50
	Rescue	1	5
	First aid	6	30
	Administration	3	15
Smoking	Yes	6	30
	No	14	70

Table 4. Paired samples t-test on pre-and post-test trauma stress management program on job stress, PTSD, resilience, and mental health for the experimental group.

Variables	Pre-test	Post-test	Difference of pre-post test	t	p
	M ± SD	M ± SD	M ± SD		
Job stress	2.462 ± 0.450	2.121 ± 0.733	-0.336 ± 0.623	-2.411	0.026
Resilience	3.739 ± 0.590	4.033 ± 0.643	-1.834 ± 1.133	-7.242	0.000
PTSD	2.565 ± 0.797	2.067 ± 0.962	-0.530 ± 0.719	-3.294	0.004
Mental health	47.77 ± 8.656	44.19 ± 8.885	-3.580 ± 7.385	-2.168	0.043

PTSD: post-traumatic stress disorder.

Table 5. Paired samples t-test on pre-and post-test trauma stress management program on salivary cortisol for the experimental group.

Variables	Pre-test	Post-test	Difference of pre-post test	t	p
	M ± SD	M ± SD	M ± SD		
Salivary cortisol	0.173 ± 0.098	0.204 ± 0.107	-0.031 ± 0.009	-0.962	0.348

3.2 Paired samples t-test on pre- and post-test trauma test trauma stress management program on job stress, PTSD, resilience, and mental health.

The level of job stress of the experimental group who participated in the forest-based trauma stress management program decreased from 2.462 to 2.121, and the difference before and after the program was statistically significant ($t = -2.411$, $p = 0.026$). The results of this test revealed that the program was effective in reducing the stress of the firefighters. The level of resilience of the experimental group increased from 3.739 to 4.033, and the difference before and after the program was statistically significant ($t = -7.242$, $p < 0.001$). The results of this test revealed that the program was effective in increasing resilience for the firefighters. In addition, the level of PTSD of the experimental group was reduced from 2.565 to 2.067, and there was a significant difference before and after the program ($t = -3.294$, $p = 0.004$). These results were found to be effective in reducing PTSD for the firefighters. The total mental health score of the experimental group decreased from 47.77 to 44.19, and there was a significant difference before and after the program ($t = -2.168$, $p = 0.043$). Hence, these results confirmed

that the program was effective in improving the mental health of firefighters (Table 4).

3.3 Paired samples t-test on pre-and post-test trauma stress management program on salivary cortisol.

The salivary cortisol level in the experimental group that participated in the forest-based trauma stress management program changed from 0.173 ± 0.098 to 0.204 ± 0.107 , but the difference before and after the program was not statistically significant ($t = -.962$, $p = 0.348$). These results were found to have no effect on reducing salivary cortisol for firefighters (Table 5).

4. Discussion

This study examined the effects of forest-based trauma stress management programs on job stress, PTSD, resilience, mental health, and salivary cortisol for firefighters.

Based on previous studies [48], the forest-healing program measured the following items. First, various physical and physiological indicators were used to measure the prevalence of circulatory diseases, blood pressure, heart rate variation, heart rate, cortisol, cardiovascular

disease-related factors, and inflammation-related factors. Second, the following social and psychological indicators were used to measure mental and behavioral disorders: depression, stress, anxiety, self-efficacy, quality of life, mood, positive and negative emotion, and psychological acceptance. Third, physical and physiological indicators of malignant neoplasms were used to measure immune-related variables. Fourth, the study measured the pain and depression scores of patients with other diseases who were suffering from pain.

In previous studies, the target subjects for program interventions have generally been patients suffering from depression, alcohol dependency, hypertension, non-insulin-dependent diabetes, cancer and lung cancer (including among community-resident patients), coronary artery disease, psychiatric problems, stroke, cardiac insufficiency, and gastrointestinal cancer. It was therefore difficult to carry out a direct comparison, as very few interventions involved firefighters. Since this application of a forest-program intervention to firefighters is relatively new, the results of the present study can be reproduced and expanded by developing and mediating forest programs in connection with various stress-management programs [48].

In Korea, firefighters have access to facilities and systems, which allow them to carry out physical training at all times in the workplace. For this reason, the authors have worked to develop intervention tools that do not involve physical training to improve levels of PTSD among Korean firefighters. These tools have been applied to firefighters in Korea to confirm the positive effects of a forest-based stress-management program.

During the program, all participants were asked to stay in accommodation in a recreational forest within a Korean national park for five days. During the program, the following factors were controlled for: social influences, external

variables, and physiological influences, including physiological activities and meals. Although it was impossible to control every cognitive or psychological influence, the authors tried to control as many as possible.

The level of job stress of firefighters who participated in the forest-based trauma stress management program for five days was significantly reduced. These results were consistent with the previous study [49] that the program significantly reduced the job stress of social welfare officers and mental health workers. In addition, it was similar to the result [50] that job stress decreased in male subjects after forest therapy was administered. Therefore, the forest-based trauma stress management program was found to reduce the job stress of firefighters. As a result of this, the forest healing program provides psychological and emotional stability [51], it provided psychological stability to subjects with chronic stress and served as an opportunity to confirm [52] improvement of overall emotions.

This study found that the PTSD of firefighters was significantly reduced after undergoing the program, similar to a study [37] showing that the PTSD significantly decreased after the program. Therefore, it was confirmed that the program could reduce the PTSD of firefighters.

In terms of resilience, the level of resilience of firefighters increased after the program, which is similar to the study result [34] that applied forest therapy to cancer patients and showed improvement in their resilience.

However, these results had limitations in directly comparing firefighters because there were a few previous studies on the effect of resilience through forest-based programs. Resilience is the ability to overcome difficulties and adapt to the environment and grow mentally, which is very dynamic and is influenced by the interaction of environmental factors [53]. In the program of this study, the use of the forest

environment is thought to have served as a catalyst for expressing positive factors inside humans and recovering to the best functional state by providing opportunities to interact with nature.

Since firefighting officials continue to experience small trauma, they need sufficient time and a comfortable external environment for self-inspection for the reprocessing process of the shock of the incident. It is judged that the forest-based program provided sufficient time to self-aware of unrecognized mental and emotional trauma and helped the firefighters regain from trauma, redefine and strengthen their value in a comfortable environment provided by nature.

Therefore, it was revealed that the forest-based trauma stress management program increases the resilience of firefighters.

This study found that the total score of mental health of firefighters improved after applying for the program. The results are similar to a previous study that compared walking in urban forests and activities in the urban area among Japanese male college students and its effect on improving the psychological symptoms of somatization, obsessive-compulsive disorder, anxiety, and hostility [54]. Therefore, the forest-based trauma stress management program was found to have the effect of improving the mental health of firefighters. However, these results showed that among previous studies that made use of forest-based programs, only one study was found to use the same mental health instrument as the current study [54]. These studies used only four sub-categories of the scale, thereby limiting direct comparison.

This study found no significant difference in the salivary cortisol of firefighters after the program was implemented. This is similar to the results of a laboratory study that used 12 original photos taken at various recreational places (cypress healing forest) [55] with no significant

change in salivary cortisol levels. However, the results are contrary to studies [56] that reported salivary cortisol decreased significantly after the forest therapy program was administered to middle-aged women. A previous study [57] reported that cortisol was significantly higher among firefighters working in the field compared to those working in the office. The cortisol level in the blood increased by 1.9 times and 2.3 times, respectively, immediately after field activity rather than after 8 hours of work [43]. It is necessary to consider that the cortisol level was different for the firefighters in the field because the work environment was more dangerous and physically demanding than the office workers. The effects of the program may have been different because of the various psychological burdens that individual officers faced, limiting steady control. The study participants were in charge of firefighting, rescue, first aid, and administration. They worked in shifts having irregular working hours and commuted by car or public transportation from a long distance. In future programs, the psychological and physical stability of the subjects should be taken into consideration.

Mental health problems of firefighters lead to injuries at work, conflicts with family members and co-workers, absenteeism and turnover, and so on, affecting their job performance [28], which is directly related to social and economic losses [58]. It is crucial to provide interventions to help them overcome shock after traumatic experiences and lead to a positive change [59], and this study confirmed the effects.

Therefore, the practical meaning of this study is that resilience is the basis for reducing job stress and PTSD expression of firefighters and it is necessary to improve mental health by promoting rapid recovery and positive emotions from negative effects of stress events [24].

5. Conclusions

We confirmed that the forest-based trauma stress management program for five days reduced job stress and PTSD of firefighters and improved their resilience and mental health. It is expected that these results could be utilized for disseminating custom-tailored intervention programs for firefighters.

The limitations of this study are as follows. There was a practical difficulty in randomized sampling because the subjects belonged to a special job category called firefighters. Since the various study conditions were region-based and all members of the target group were firefighters, it was not possible to obtain a control group from the same small and specialized group. Comparative studies that use both experimental and control groups are therefore needed. In the future, based on the results of this study, we hope to conduct experimental research that includes a control group.

In addition, the present study analyzed outcomes immediately after the intervention, making it impossible to assess the long-term effects of the intervention, how long the effects were retained after the participants return to their normal lives, or the changes brought about by the intervention. Experimental studies with long-term follow-up periods are needed to investigate the longer-term effects of this intervention, based on our findings.

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