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ARTICLE

Psychological and Physiological Health Benefits of a Structured Forest Therapy Program for Children and Adolescents with Mental Health Disorders

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ABSTRACT

Mental health conditions in children and adolescents can be improved by slow mindful nature connection known as forest therapy or bathing. Forest therapy has recently received growing attention as an enabler of relaxation and preventive health care with demonstrated clinical efficacy. However, it is not well-known that forest therapy also decreases mental health issues among individuals with mental health disorders. This study explored the psychological and physiological health benefits of structured forest therapy programs for children and adolescents with mental health disorders. A one-group pre-test-posttest design was employed for our study participants. Twelve participants (aged 9–14 years) engaged in two one-hour guided standard sequence forest therapy experiences. A Mindful Attention Awareness Scale (MAAS), Connectedness to Nature Scale (CNS), Profile of Mood States (POMS), place meanings (e.g., functional, emotional, and cognitive attachment to the forest) questionnaire, and physiological health assessment were administered to the participants. Our results showed that negative mood states were significantly reduced and that a positive mood state was significantly improved after the structured forest therapy programs. Also, mindfulness, nature connection, place meanings, and physiological health were significantly boosted after the interventions. The results demonstrate substantial psychological and physiological health and well-being outcomes of structured forest therapy for similar individuals.

KEYWORDS

Forest therapy; mental health disorders; mindfulness; mood states; place meanings; physiological health

Introduction

Almost 5 million U. S. children have a form of serious mental illness that is significantly interfering with everyday life [1], and at least 1 in 5 youth (aged 9–17) has a diagnosable mental health disorder leading to some degree of impediment [2]. Some children and adolescents experience anxiety disorders, attention-deficit/hyperactivity disorders, disruptive behavior disorders, pervasive developmental disorders, and affective (mood) behaviors [1]. Symptoms in youth with mental health disorders vary by individual, but common general symptoms include substance abuse, inability to cope, changes in sleeping, complaints of physical concerns, confronting authority, significant increase in time alone, and hyperactivity as a few examples of symptoms [1]. These mental health conditions are generally treated using a psychopharmacologic approach [2], but this present study examines youth with diagnosed mental health conditions

using a nonpharmacologic approach of completing slow mindful nature connection.

Slow mindful immersion experiences in natural settings, which are known as forest therapy or bathing ("Shinrin-yoku" in Japanese) include time spent in natural or forest environments to improve health and well-being. Forest therapy has received growing attention as an enabler of quality improvements across multiple health and well-being domains, such as physical, psychological, and physiological. Forest therapy utilizes some aspects of mindfulness practices. Mindfulness is the intentional practice of being attentive to and aware of current experiences or present reality, in a non-judgmental, open-minded, and accepting way [3,4]. A core characteristic of mindfulness is constant open-minded awareness of and attention to present experiences, which optimize many psychological and emotional benefits, including self-regulation and well-being [3,4]. Nature can be used to enhance mindful practices in various ways, such as using meditation to experience your surroundings or using meditative awareness in nature [5].

Connectedness to nature may result from completing mindfulness activities in a natural environment. Choe et al. [6] examined whether the impacts of Mindfulness-Based Stress Reduction (MBSR) are enhanced when combined with the benefits of connection to a natural environment. Findings of the study show that university students and staff who participated in the intervention in a natural outdoor environment had improved nature connectedness, rumination, reflective attitudes, and stress reduction throughout the intervention [6]. Mayer et al. [7] found that college students' nature exposure, particularly through slow and mindful walking in nature, improved nature connection, positive affect, attentional capacity, and ability to reflect on life problems. Furthermore, Lim et al. [8] utilized a structured forest therapy that provided focus or suggestion of activity engagement, including sensory connection and 'sit spot' (siting alone in a comfortable natural area), during a nature immersion period, which is different from taking in the atmosphere of the forest without the suggestion ("Shinrin-yoku"). Lim et al. [8] reported that both guided and unguided nature immersion increased nature connection and mood in students at an international university and community residents in Singapore.

Mood has been shown to be affected by forest therapy as reported in various previous studies. For example, Bielinis et al. [9] examined the mental benefits of forest therapy for mental patients with affective and psychotic disorders by assessing the Profile of Mood States (POMS) scale with six mental health states (tension-anxiety, depression, anger-hostility, vigor, fatigue, confusion). The researchers reported that participants with affective disorders had increased mood states after forest therapy and that participants with psychotic disorders also benefitted from forest therapy as related to confusion and vigor. Yu et al. [10] documented that the negative tension-anxiety mood of older adults was significantly lower after a short forest therapy program, whereas their positive vigor mood was higher after the program. Another study by Kim et al. [11] found that the levels of positive changes in the six mental health states of campus forest therapy participants were significantly higher, compared to the levels of the mental states in the control group. One additional study conducted by Ochiai et al. [12] found that negative mood states (e.g., tension-anxiety, anger-hostility, and confusion) among middle-aged females were significantly lower after forest therapy. Forest therapy not only fosters nature connectedness and mood states, but it can lead to the development of various meanings ascribed to natural places by individuals.

Place meanings encompass various people-environment relationships, including functional, affective, cognitive, social [13,14]. Such multiple meanings instilling a sense of well-being can be developed either when specific goals or needs are met during an individual's connection with the natural environments or when more ongoing transactional interaction between people and natural environments occurs [15]. Forest therapy participants expressing higher levels of place meanings tended to seek various on-site psychological benefits, such as nature enjoyment and mental health by directly engaging in water-based immersion and mindful walking activities in forested environments [16]. Also, the forest therapy participants continued to prefer improved mental health conditions after the nature immersion experiences [16]. Similarly, forest visitors with higher levels of place meanings had higher inclinations for the on-site benefits and were more likely to achieve the benefits [17].

Previous studies have found that forest therapy enhances physiological health states. For example, walking through a forest or viewing the landscape can reduce systolic blood pressure, diastolic blood pressure, and pulse rate compared to walking in the city [18,19]. The pulse rate of pre-hypertensive adults [20] and hypertensive middle-aged men in Japan [21] was reduced after forest walking. Systolic blood pressure in middle-aged women in Taiwan who engaged in a two-day forest therapy session was significantly reduced [22]. In addition, the heart rate in students and community residents in Singapore was significantly lower after structured forest therapy sessions implemented by a forest therapy guide [8].

Overall, previous studies have shown beneficial health and well-being outcomes of forest therapy for various populations. However, it is still not established whether structured forest therapy enhances wide-ranging psychological and physiological well-being benefits. In particular, no previous study employing a structured forest therapy program has not examined the specific health and well-being constructs, such as mindfulness, nature connectedness, mood states, place meanings, and physiological health outcomes among children and adolescents with mental health problems. Hence, the purpose of this study is to explore whether a structured forest therapy practice influences mindfulness, nature connectedness, mood states, and place meanings, and physiological health responses among children and adolescents with mental health disorders who engaged in two sets of a structured forest therapy program.

Materials and Methods

Data collection and sampling

Ethical approval was obtained not only from the Human Research Ethics committee at a Midwestern university, but children and adolescents and their parents in a Midwestern city (IRB number: 19-NK-720). Utilizing convenience sampling, this study recruited small groups of children and adolescents (N = 12) of ages 9–14 with mental and co-occurring behavioral health issues, such as anxiety, stress, trauma, attention-deficit/hyperactivity disorder, disruptive mood dysregulation disorder, and oppositional defiant disorder. The participants were in grades 3–8 and most (80%) were male.

Two sets of structured forest bathing sessions were provided during a two-day interval to the participants by a certified forest therapy guide on natural dirt trails of a city-level forest park in a Midwestern U.S. region during the morning hours (9:15 am to 10:15 am) of July 2019. The trails were easily accessible and had a dirt parking lot, interpretive signs with the trail layout, abundant wildlife species, unique natural elements (e.g., bluffs, vistas, natural springs adjacent to trails), and safe gentle terrains, which were suitable for forest bathing opportunities.

Each forest bathing walk consisted of the five structured phases [23,24] taken on the less than half a mile trail for about an hour: (1) introduction to forest bathing walks, (2) gentle warm-up connective sensory activities utilizing all human sensory modes, such as hearing, smelling, and touching, (3) slow gentle walks, with each walk creating embodied connections with the present moment and place, which involves a specific intention to connect with nature, mindful movement through nature, active communication with nature, and additional deep engagement in connective sensory activities, (4) building a relationship with nature through wander or sit spot time, and (5) a tea ceremony. Time to share experiences with participants after each of the steps 2 to 5 was included in the timeframe. The standard sequence of the forest therapy walk provides focus or suggestion of activity engagement during the nature immersion [23,24].

Construct Measures

To measure the psychological health benefits of the structured forest therapy session, four scales and a physiological health assessment were administered to the participants three times: (1) before the first forest therapy walk, (2) after the first forest bathing walk, and (3) after the second forest therapy walk.

Mindfulness

The Mindfulness Attention Awareness Scale-Children (MAAS-C) [25] with 14 items adapted for children from the original MAAS for adolescents and adults [3,26] was utilized to assess the presence of a mindful state and a unique quality of self-consciousness and self-awareness. Items depict mindless experiences (e.g., "I find it hard to stay focused on what's happening in the present"). Items were measured to rate how frequently participants currently have each experience on 6-point scales (1 = almost always, 6 = almost never) and yielded Cronbach's α values ranging from 0.94 to 0.97.

Connectedness to nature

Fourteen items adapted for children and youth from the Connectedness to Nature Scale (CNS) [27] originally developed for adults (e.g., "I feel connected with nature") were rated to assess participants' current affective, experiential connection to nature. Items were assessed on 5-point scales (1 = strongly disagree, 5 = strongly agree) and had Cronbach's α values ranging from 0.83 to 0.93.

Mood states

The Profile of Mood States (POMS) scale commonly used for all ages, children to adults [28,29] were utilized to assess participants' transient, distinct mood states related to cognitive functioning. At least five items (e.g., uneasy, restless), each representing six dimensions of emotions (i.e., tension-anxiety, depression, anger-hostility, vigor, fatigue, confusion) assessed the extent to which participants experience each current mood state. Items for the dimensions were rated on 5-point scales (1 = not at all, 5 = extremely) and had Cronbach's α values ranging from 0.72 to 0.96.

Place meanings

Six people-place relationship dimensions (i.e., place dependence, place identity, place affection, nature bonding, social bonding, community identity) were commonly used for participants of all ages, including children [30] to adults [13,14]. Four to seven items for each dimension (e.g., place dependence—"This place is best for what I like to do"; place identity—"I am very attached to this place") were measured for this study. Participants were asked about the natural environment where they engaged in the forest bathing on 5-point scales (1 = strongly disagree, 5 = strongly agree). Items for the dimensions had Cronbach's α values ranging from 0.73 to 0.95.

Physiological states

Blood pressure (systolic, diastolic) and pulse were measured, utilizing a wrist blood pressure monitor (Omron 7 Series—BP652, Kyoto, Japan) on the left wrist of all participants in a seated position. Their wrists were large enough for our wrist pressure units to consistently work on children and adults as recommended by Bald et al. [31]. These procedures were performed between 9:00 and 9:15 am on the day before forest therapy (Pre-Forest Therapy Walk 1) and between 10:15 and 10:30 am (Post-Forest Therapy Walk 1). Also, the procedures were completed between 10:15 and 10:30 am after forest therapy (Post Forest Therapy Walk 2).

Data Analysis

Data were analyzed using IBM SPSS Statistics 28 for Windows (SPSS Inc, Chicago, IL, USA). Descriptive statistics comprised means, standard deviation, frequency, and percentage to present socio-demographic information and outcome variables. Cronbach's α values were also examined. One-way repeated measures analysis of variance (ANOVA) was

TABLE 1

Results of one-way repeated measures ANOVA for mindfulness

	Pre-FT walk 1			Post-FT walk 1			Post-FT walk 2					
Variable	***M***	***SD***	***α***	***M***	***SD***	***α***	***M***	***SD***	***α***	***F***	***p***	η_p^2
Mindfulness[1]	3.80[a]	1.21	0.96	4.29[a]	0.98	0.94	4.89[b]	1.03	0.97	9.117	0.007**	0.453

Notes: [1]Measured using a six-point Likert scale format (1 = Almost always, 2 = Very frequently, 3 = Somewhat frequently, 4 = Somewhat infrequently, 5 = Very infrequently, 6 = Almost never). Based on one-way repeated measures ANOVA with Bonferroni's post hoc method, means with different superscripts indicate significant difference. As our data on 'mindfulness' violated the assumption of sphericity, the overall significant difference beweeen the means is based on the values in the Greenhouse-Geisser correction. $^{**}p < 0.01$.

TABLE 2

Results of one-way repeated measures ANOVA for connectedness to nature

	Pre-FT walk 1			Post-FT walk 1			Post-FT walk 2					
Variable	***M***	***SD***	***α***	***M***	***SD***	***α***	***M***	***SD***	***α***	***F***	***p***	η_p^2
Connectedness to nature[1]	2.36[a]	0.78	0.92	2.70[a]	0.92	0.93	4.08[b]	0.39	0.83	31.605	<0.001***	0.742

Notes: [1]Measured using a five-point Likert scale format (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree). Based on one-way repeated measures ANOVA with Bonferroni's post hoc method, means with different superscripts indicate significant difference. As our data on 'connectedness to nature' met the assumption of sphericity, the overall significant difference between the means are based on the Sphericity Assumed values. $^{***}p < 0.001$.

performed to determine participants' psychological and physiological effects between pre-, middle- and post-tests. To determine specific differences in mean scores of the psychological and physiological states across the three assessment points, Bonferroni's post hoc method was conducted. If our data on the states met the assumption of sphericity, we reported Sphericity Assumed values to examine the overall significant difference between the means for the states measured at the different points. If our data violated the assumption, we reported values in the Greenhouse-Geisser correction.

Results

Mindfulness

Results of one-way repeated measures ANOVA between pre-, middle-, and post-test MAAS scores are presented in Table 1. Mindfulness significantly increased after two sessions of the forest bathing program ($F = 9.117$, $p = 0.007$, $\eta_p^2 = 0.453$). The effect size for the improved mindfulness appeared to be large.

Connectedness to nature

Results of one-way repeated measures ANOVA between pre-, middle-, and post-test CNS scores are presented in Table 2. Nature connection substantially increased after two sessions of the forest therapy program ($F = 31.605$, $p < 0.001$, $\eta_p^2 = 0.742$). A large effect size for improved nature connection occurred.

Profile of mood states (POMS)

Results of one-way repeated measures ANOVA between pre-, middle-, and post-test POMS scores revealed substantial positive changes in all five POMS dimensions (Table 3): tension-anxiety ($F = 42.839$, $p < 0.001$, $\eta_p^2 = 0.796$), depression ($F = 22.806$, $p < 0.001$, $\eta_p^2 = 0.675$), anger-hostility ($F = 9.251$, $p = 0.001$, $\eta_p^2 = 0.457$), vigor ($F = 60.705$, $p < 0.001$, $\eta_p^2 = 0.847$), fatigue ($F = 5.365$, $p = 0.030$, $\eta_p^2 = 0.328$), and confusion ($F = 22.943$, $p < 0.001$, $\eta_p^2 = 0.676$). The levels of tension-anxiety, depression, anger-hostility, fatigue, and confusion significantly decreased, while the level of vigor significantly increased. The effect sizes for the positive changes in the mood states, particularly vigor, tension-anxiety, confusion, depression, and anger-hostility appeared to be large.

Place meanings

As results of one-way repeated measures ANOVA between pre-, middle-, and post-test scores of place meanings are presented in Table 4, significant positive changes occurred in all six dimensions of place meanings: place dependence ($F = 28.071$, $p < 0.001$, $\eta_p^2 = 0.718$), place identity ($F = 21.126$, $p < 0.001$, $\eta_p^2 = 0.658$), place affection ($F = 7.277$, $p = 0.004$, $\eta_p^2 = 0.398$), nature bonding ($F = 36.050$, $p < 0.001$, $\eta_p^2 = 0.766$), social bonding ($F = 10.122$, $p < 0.001$, $\eta_p^2 = 0.479$), and community identity ($F = 6.387$, $p = 0.006$, $\eta_p^2 = 0.367$). The large effect sizes for the significant improvement over the interventions occurred in the people-place dimensions, particularly nature bonding, place dependence, place identity, and social bonding.

Physiological states

As results of one-way repeated measures ANOVA between pre-, middle-, and post-test scores of physiological health are shown in Table 5, a significant decrease in blood pressure occurred: systolic blood pressure ($F = 15.521$, $p < 0.001$, $\eta_p^2 = 0.721$) and diastolic blood pressure ($F = 7.768$, $p < 0.007$, $\eta_p^2 = 0.564$) when comparing pre-forest therapy walk 1 and post-forest therapy walk 2. Also, there was a significant increase in pulse rate ($F = 15.521$, $p < 0.001$, $\eta_p^2 = 0.721$) and pulse rate ($F = 9.14$, $p < 0.004$, $\eta_p^2 = 0.604$) when comparing pre-forest therapy walk 1 and post-forest

TABLE 3

Results of one-way repeated measures ANOVA for profile of mood states (POMS)

	Pre-FT walk 1			Post-FT walk 1			Post-FT walk 2					
POMS dimensions[1]	***M***	***SD***	**α**	***M***	***SD***	**α**	***M***	***SD***	**α**	***F***	***p***	η_p^2
Tension-anxiety	2.60^{a}	0.71	0.75	1.63^{b}	0.36	0.72	1.10^{c}	0.21	0.77	42.839	<0.001***	0.796
Depression	2.51^{a}	0.80	0.84	1.51^{b}	0.67	0.85	1.18^{c}	0.36	0.96	22.806	<0.001***	0.675
Anger-hostility	1.93^{a}	0.90	0.89	1.25^{ab}	0.37	0.83	1.07^{b}	0.18	0.75	9.251	0.001**	0.457
Vigor	2.03	0.55	0.73	2.93	0.64	0.77	3.89	0.61	0.77	60.705	<0.001***	0.847
Fatigue	2.40^{a}	0.74	0.87	1.55^{b}	0.55	0.79	2.05^{ab}	1.03	0.81	5.365	0.030*	0.328
Confusion	2.25	0.81	0.82	1.33	0.37	0.84	1.07	0.18	0.75	22.943	<0.001***	0.676

Notes: [1]Measured using a five-point Likert scale format (1 = Not at all, 2 = A little, 3 = Moderately, 4 = Quite a bit, 5 = Extremely). Based on one-way repeated measures ANOVA with Bonferroni's post hoc method, means with different superscripts indicate significant difference. As our data on 'fatigue' and 'confusion' violated the assumption of sphericity, the overall significant difference between the means for each of the two mood states is based on the values in the Greenhouse-Geisser correction. Our data on the other mood states met the assumption. Thus, the Sphericity Assumed values were utilized to report the overall significant difference between the means for each remaining mood state. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 4

Results of one-way repeated measures ANOVA for place meanings

	Pre-FT walk 1			Post-FT walk 1			Post-FT walk 2					
Place meanings dimensions[1]	***M***	***SD***	**α**	***M***	***SD***	**α**	***M***	***SD***	**α**	***F***	***p***	η_p^2
Place dependence	1.90^{a}	0.64	0.89	2.25^{b}	0.57	0.80	3.21^{c}	0.70	0.92	28.071	<0.001***	0.718
Place identity	1.90^{a}	0.92	0.91	2.11^{b}	0.64	0.75	2.96^{c}	0.58	0.88	21.126	<0.001***	0.658
Place affection	1.62^{a}	1.03	0.93	2.06^{a}	0.78	0.79	2.83^{b}	0.61	0.76	7.277	0.004**	0.398
Nature bonding	1.73^{a}	0.85	0.88	2.44^{a}	0.72	0.80	3.71^{b}	0.45	0.76	36.050	<0.001***	0.766
Social bonding	1.85^{a}	1.01	0.95	2.21^{a}	0.95	0.90	3.13^{b}	0.55	0.79	10.122	<0.001***	0.479
Community identity	1.83^{a}	1.08	0.88	2.22^{ab}	1.00	0.86	2.65^{b}	0.53	0.73	6.387	0.006**	0.367

Notes: [1]Measured using a five-point Likert scale format (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = strongly agree). Based on one-way repeated measures ANOVA with Bonferroni's post hoc method, means with different superscripts indicate significant difference. As our data on 'nature bonding' violated the assumption of sphericity, the overall significant difference between the means for 'nature bonding' is based on the values in the Greenhouse-Geisser correction. The other dimensions of place meanings met the assumption. Thus, the Sphericity Assumed values were utilized to indicate the overall significant difference between the means for each remaining dimension. **$p < 0.01$, ***$p < 0.001$.

TABLE 5

Results of one-way repeated measures ANOVA for physiological states

Physiological health variables	Pre-FT walk 1		Post-FT walk 1		Post-FT walk 2				
	M	***SD***	***M***	***SD***	***M***	***SD***	***F***	***p***	η_p^2
Systolic blood pressure	137.29^{a}	9.86	129.29^{a}	10.4	108.86^{b}	8.5	15.521	<0.001***	0.721
Diastolic blood pressure	81.71^{a}	15.22	75.86^{a}	9.34	63.57^{b}	9.36	7.768	0.007**	0.564
Pulse rate	86.57^{a}	13.43	88.71^{a}	16.83	103.86^{b}	14.80	9.14	0.004**	0.604

Notes: [1]Based on one-way repeated measures ANOVA with Bonferroni's post hoc method, means with different superscripts indicate significant difference. As our data on physiological states met the assumption of sphericity, the overall significant difference between the means for each physiological state is based on the Sphericity Assumed values. **$p < 0.01$, ***$p < 0.001$.

therapy walk 2. The large effect sizes for the significant improvement over the interventions occurred in the health assessment dimensions, particularly systolic blood pressure.

Discussion

This study explored the psychological and physiological effects of a structured forest bathing program in natural trails for children and adolescents with various mental disorders. Our results revealed that a structured forest bathing program had significant positive changes in mindfulness, nature connection, mood states, place meanings, and physiological health outcomes, which indicates that the forest bathing program effectively improves the psychological and physiological health and well-being of children and adolescents with mental health disorders.

Our study found that a structured forest bathing program with slow mindful and sensory connection

invitations in natural settings improved mindfulness, which supports the previous finding that exposure to nature enhances mindfulness [5]. Our structured program in a natural environment promoted the ability of the participants to stay focused on and notice what is happening in the present [3], which promoted the richness and vitality of present experiences [32]. Our result here indicates that a place suitable for mindfulness would be natural/forested environments. Furthermore, our result can be explained by the Attention Restoration Theory. The theory posits that nature exposure can help the restorative process [33,34], not only because such natural environments are often physically far away from an individual's stressful everyday life, but because nature stimulates soft fascination (i.e., effortless attention drawn to intriguing objects in natural settings). For instance, nature's soft fascination can assist people in becoming intentionally or unintentionally attentive to their environment when in nature, which allows calmness, rest, and contemplation [5]. As such, nature's characteristics as a recovery environment may enhance mindfulness.

Our study demonstrated that a structured forest therapy program improved nature connection, which is consistent with previous findings that nature exposure leads to greater nature connections [7,8,35]. In addition, our study with participants in two forest therapy interventions indicated that the higher the participation in a structured forest therapy program, the higher the sense of connection with nature. Similarly, positive experiences with nature increase the connection with nature by encouraging spending more time in natural environments [36]. Ongoing positive experiences in and interactions with nature can increase individual inclusion with nature [37].

Our finding suggests that structured programs to foster nature relatedness involving healing and comfort in forests may offer a promising way forward as a potential public health initiative. People with a higher sense of nature connection not only report greater pro-environmental behavior [38] but have a better sense of well-being including satisfaction, happiness, and positive affect [27,39]. Especially, nature connection is positively associated with the well-being of children [40]. Childhood often involves developing values and beliefs [41], which may foster adult nature connection and environmental stewardship [42,43]. Therefore, it is essential to develop a nature connection in childhood, which can be facilitated by structured forest bathing programs.

Our structured forest bathing program reduced negative mood states (i.e., tension-anxiety, depression, anger-hostility, fatigue, confusion) and improved positive emotions (i.e., vigor). Results here support previous findings about the improved mood states of clients with health issues, including mental hospital patients with affective and psychotic disorders [9] and middle-aged and older adults [10] that engaged in forest therapy programs. Positive changes in the mood states of children and adolescents with mental disorders go beyond "feeling good." Mood state inspires what is attended to in the environment and, consequently, can profoundly influence subsequent cognition and behavior [44]. These beneficial outcomes include learning, task performance, helping behavior, social interaction, and health [45]. Therefore, a structured forest bathing program can have a positive effect on the mental health of children and adolescents with a mental illness.

Our study measured various place meanings, including place dependence, place identity, place affection, nature bonding, social bonding, and community identity, among participants of structured forest bathing programs, which was relatively new to slow mindful nature connection research. Our structured forest bathing program improved the multiple aspects of meanings ascribed to natural environments by the participants. For example, our participants are more likely to depend on natural environments for recreational goals that may have been achieved by their engagement in the structured program in natural settings, as shown by Kil et al. [46] that found a significant association between attainment of recreation experiences sought and emotional attachment to natural settings. Our results support previous similar findings with different types of users, such as forest bathers [16], forest visitors [17,47], trail hikers [48], and park visitors [49]. For instance, Kil et al. [16] confirmed that forest therapy participants with higher levels of attachment to natural environments preferred higher levels of on-site recreation experiences, such as nature enjoyment, physical and mental health, group bonding, and solitude.

Our results of analyzing physiological health outcomes revealed a significant decrease in both systolic and diastolic blood pressure over the two structured forest therapy sessions. These results are consistent with the belief that structured forest therapy can be beneficial when experienced over time [22]. However, there was a significant increase in pulse rate that was found when comparing the structured pre-forest therapy walk 1 and post-forest therapy walk 2, which is different from findings of other studies reporting a significant decrease in the pulse rate [20,21] and a non-significant change in pulse rate [50]. This increase in pulse rate may have been attributed to the physical walking associated with participation in the structured forest therapy walk. Our results partially indicate the effectiveness of the structured forest therapy sessions for reducing physiological stress in children and adolescents with mental health disorders.

Our overall results demonstrated that structured forest therapy programs that utilize slow mindful and sensory communication with nature foster positive changes in mindfulness, nature connection, mood states, place meanings, and physiological states. Results here validate previous findings that nature exposure increases nature connection, and that nature connection is related to mindfulness, emotion, and place meanings. For example, Howell et al. [51] showed a significant association between nature connection, mindfulness, and well-being. Huynh [52] reported not only a negative relationship between nature connection and depression, but a mediating role of mindfulness on the association between nature connection and mood states (e.g., depression, stress). Therefore, our results could be explained as an interaction rather than an individual effect of the structured forest therapy intervention.

Our study has limitations. First, this research had no control group, diminishing its internal validity. Thus, a randomized controlled trial should be designed to improve

this type of study. Second, our participants were limited to children and adolescents with mental disorders, and the sample size was small. Further studies need to generalize the findings with large samples of all ages and abilities, including veterans and family members. Third, the short-term effects of the structured forest therapy program were explored here, but its long-term effects could also be examined. Finally, future research could investigate not only the intervention's various psychological benefits, but its physiological health outcomes, such as heart rate variability, blood pressure, and pulse rate among other populations of all ages and abilities.

Conclusions

Our study demonstrated that a structured forest therapy program fosters various psychological and physiological health and well-being outcomes for children and adolescents with mental health disorders. More specifically, significant improvements in mindfulness, nature connection, mood states, place meanings, and physiological health occurred. These results provide empirical evidence on the multiple psychological and physiological health and well-being benefits of a structured forest therapy program for similar individuals. Healthcare providers could provide the opportunity for health challenged individuals to frequently engage in such structured interventions.

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