# Shinrin-Yoku: Striving to Alleviate Stress in High School-Aged Students

**Lana Piretti**

*Received February 21, 2025*
*Accepted June 02, 2025*
*Electronic access June 15, 2025*

Currently, many American high school students report debilitating levels of stress. Although there are numerous treatments such as prescription medicine and therapy for formal diagnoses, those who suffer from feelings of stress seek alternative treatment options. One potential option is a Japanese forest bathing practice known as Shinrin-Yoku that involves walking through a forested area and immersing oneself in a natural environment. Few studies utilize American people or high school students as their sample. For this study, thirty-nine high school students engaged in a guided, thirty-minute walk. The researcher collected quantitative data through a modified State Trait Anxiety Inventory survey using a pretest-posttest design to measure the effects of the walk on students feelings such as stress, calmness, and relaxation. The researcher used questions from the Forestry England Forest Wellbeing Journal to encourage participants to focus on nature. Participants showed a statistically significant reduction in State Trait Anxiety Inventory scores after the walk. This study provides statistical evidence that, for American high schools with access to a forested area, the practice of Shinrin-Yoku may mitigate feelings of stress in students. The findings suggest the implementation of forest bathing programs in American high schools.
**Keywords:** Stress, Shinrin-Yoku, Forest bathing, SEL (social emotional learning), American teenagers, High schools

## Introduction

### Stress in Teens

The Centers for Disease Control (CDC) says that two in five American teens report suffering from stress[1]. Furthermore, in 2024 the CDC declared a mental health crisis in the United States (U.S.). In a time where nearly everyone spends more time online than outside, mental health issues and stress are more prevalent than ever. This applies to many people, including high school students. Additional stressors such as academics, social life, and extracurriculars further exacerbate mental health issues for teens[2].

The American Psychological Association defines stress as a psychological or physiological response to internal or external stressors[3]. This response may influence how people feel or behave. It is important to note that feelings of stress are relative to an individuals perspective, while physiological measurements such as blood pressure or heart rate provide definite insights into a persons stress level and response. Furthermore, relaxation is highly important in mitigating the effects of stress[4]. Mayo Clinic underscores the concept that relaxation helps alleviate the negative impact of stress.

As American teens suffer from increasing stress, finding stress management or relaxation strategies will help maintain mental health[2]. Currently, American high schoolers use strategies such as journaling, meditation, and exercise[5]. In fact, researchers found that meditation can decrease stress and improve mood[6]. Although these provide partial benefits including mental clarity and lowered cortisol levels, meditation requires increased focus. In addition, researchers found that people can alleviate stress through reconnecting with nature, which benefits one's physical and mental health[7]. Furthermore, Shinrin-Yoku requires less focus and practice than journaling or meditation and less physical exertion than exercise.

### Forest Bathing vs. Forest Therapy

In addition to exclusions, previous studies lack differentiation between forest bathing and forest therapy. Researchers use the terms forest bathing, or Shinrin-Yoku, to refer to a self-driven practice and the term forest therapy, or Shinrin-Rhyoho, when referring to a therapist-guided walk[8]. While participants use the same principles of engaging with nature for both practices, accessibility increases greatly with forest bathing as a therapist does not need to be present.

Previous studies used forest bathing and forest therapy on Japanese undergraduates. One study, performed in a suburban Japanese university, involved the implementation of a forest bathing program focused on physical activity and long-term benefits[9]. In a different study, Japanese professors and doctors in psychology investigated a program using guided therapeutic activities during forest bathing focused on immediate psychological benefits and stress reduction[10]. Hence, studies seeking to implement forest bathing in schools should utilize

forest bathing rather than forest therapy, as schools may not wish to employ trained therapists to guide students in forest bathing. Furthermore, forest bathing poses a more realistic and cost-effective option where teachers educate students on the practice of Shinrin-Yoku, providing students with opportunities to engage in self-guided forest bathing.

### Proposed Solution

Shinrin-Yoku, a Japanese practice, referred to in North America as forest bathing, centers around connecting with nature. Shinrin-Yoku involves taking in the forest atmosphere by walking in a tree-covered area without distractions, while focusing on engaging with nature to achieve a free mind[11]. Importantly, this practice differs from hiking, as it requires minimal physical exertion. Thus, it allows practitioners to focus solely on their mental state.

Shinrin-Yoku has been practiced for many years in Japan. In fact, Tomohide Akiyama of the Japanese Ministry of Agriculture, Forestry, and Fisheries first coined the term Shinrin-Yoku in 1982. However, research institutions, primarily in Japan, conducted most studies in the last ten years. Interestingly, this timeline correlates with a rise in stress among Japanese adolescents[12]. Concurrently, American high school students continue to report increasing stress levels each year[13]. Thus, Shinrin-Yoku may help alleviate stress in American teenagers.

Synthesizing this information led to the research question: Can a thirty-minute session of the Japanese forest bathing practice, Shinrin-Yoku, decrease stress levels in high school students? This study addressed a gap in the study of Shinrin-Yoku on American teenagers, specifically researching a group of high school students within a thirty-minute timeframe. Among only two prior American studies, neither define their sample group as high school students, consist of a singular forest bathing session, or include a thirty minute session. This study investigated the efficacy of forest bathing in relieving stress in students. The hypothesis for this study was that one thirty-minute session of Shinrin-Yoku would decrease stress in a group of high school students. If proven correct, this study hypothesized that American high schools may benefit from implementing Shinrin-Yoku to alleviate stress in students.

## Literature Review

### Reconnecting with Nature

Differing from older generations, Generation Z, or people born between 1997 and 2012[14], accessed screens from a very young age. In 2025, all teenagers (ages thirteen to nineteen) are considered members of Generation Z. Thus, the terms Generation Z and teenagers are used interchangeably for this section.

Dr. Jonathan Haidt, professor of Ethical Leadership at New York University and author of The Anxious Generation, explains that children need free play, which he defines as when frequent and vigorous play includes playing alone or with parents, siblings, or friends, oftentimes outside[15]. As screens became integral to daily life for most people, parents and children developed a constant desire for screen time. Thus, children spent decreased time outside which resulted in a generation with more connection to a screen than to parents. As the use of cell phones rapidly rises, disconnection from nature continually increases[16]. Haidt explains that the anxious generation emerged due to decreased time outside, increased screen time, and increased access to social media.

Furthermore, as high school students experience social, academic, and familial pressures, they turn to screens for rapid comfort[17]. However, screens only further exacerbate stress because of social pressure, negativity, and fragmented focus inflicted by social media[15]. Thus, schools, students, and parents must establish realistic solutions to reduce stress and anxiety in students. Reconnecting with nature may help many students reduce screen usage, consequently decreasing stress[18]. If people can reconnect with nature, this may offer significant insights for helping the anxious generation.

### Background on Shinrin-Yoku

In Japan, years of research exist on the established practice of Shinrin-Yoku. Dr. Qing Li, an associate professor at Tokyos Nippon Medical School, led the first official study on Shinrin-Yoku which investigated the effects of forest bathing on human natural killer activity and expression of anti-cancer proteins[19]. The science-based nature of this study makes the results irrelevant to the current study. Since his groundbreaking study in 2007, Li conducted over thirty studies investigating the effects of Shinrin-Yoku on physiological, psychological, and mental well-being. In 2019, Dr. Li, president of the Japanese Society of Forest Therapy, published Into the Forest: How Trees Can Help You Find Health and Happiness. The book outlined how to engage in Shinrin-Yoku, explaining its benefits to the mental, physiological, and psychological health of Japanese populations.

Forest bathing, or Shinrin-Yoku, refers to nature connection using a low-intensity walk through a tree-covered area, with sensory engagement in ones surroundings[20]. Shinrin-Yokus proven benefits to psychological and physiological health highlight its value as a widely used practice[21]. As Shinrin-Yoku research continues, experts such as Li and colleagues at the Japanese Society of Forest Therapy predict the discovery of further benefits.

## Cultural Differences

Despite Japans proven benefits of Shinrin-Yoku, limited research examines whether these benefits extend to other nations. This limits the review of existing literature from comparing stress and mental problems among teens of each nation. Thus, the following section seeks to understand whether Japanese studies may apply to and help predict the effects of forest bathing for American teenagers. Admittedly, a cultural gap exists between American and Japanese teens[22]. Furthermore, perspectives differ on perceived priorities, political beliefs, and social norms among American and Japanese teens[22]. However, no research exists on specific differences between teenagers of Japan and America in the realm of stress and mental health.

Research found that perceived stress levels may be similar among North American and Japanese young people. In 2023, researchers from the Universities of Montreal and Tokyo performed a study investigating cultural differences in perceptions of daily stress between Canadian and Japanese undergraduates. The study found that Canadian undergraduates viewed stressful non-interpersonal situations as more frequent, while Japanese undergraduates viewed stressful interpersonal situations as more frequent[23]. These findings indicate that Canadian students felt stronger academic and social stressors, while Japanese students felt more stressed in social interactions.

In addition to Lee and colleagues findings, central values in North American and Japanese culture may present differences in how people process and respond to stress. Specifically, America has a deeply rooted individualistic culture centered around unique traits but also personal gain, which may create greater feelings of stress and isolation than less individualistic societies[24]. Conversely, Japanese culture is considered collectivist, focusing on the group rather than the individual[25]. Cambridge University Press. 2024).). While this creates a sense of selflessness, community, and unity, it also inflicts a lack of autonomy and leads to high levels of conformity. This societal value may lead individuals to feel stress in trying to meet expectations.

## Shinrin-Yoku in America

Furthermore, reported stress and anxiety among U.S. teens increased by forty percent from 2010 to 2020, with both nations continuing to observe increased mental health issues[1]. Thus, the researcher can utilize prior studies on Japanese adolescents for hypotheses, predictions, and references. While Shinrin-Yoku is largely unknown in America, extensive Japanese research exists. However, a number of studies are not translated to English, thus posing a limitation in the review of existing literature. Furthermore, many sources from this literature review analyze Japanese research, under the assumption that American participants may show similar results. As previously explained, minimal research exists on Shinrin-Yoku in America. Prior American studies[26,27] did not study high school- aged subjects in a time frame under one hour, and they did not study the effects of a single forest bathing session. Additionally, prior studies assessed mood states and overall mental well-being, rather than specifically studying stress.

Only two previous studies included American participants and occurred in America. Researcher Namyum Kil of the Department of Recreation Management and Recreational Therapy at the University of Wisconsin-La Crosse performed a study that utilized twelve participants ages nine to fourteen who repeatedly participated in structured forest therapy sessions[27]. The results of this study provide evidence that forest bathing increases connection with nature while decreasing negative feelings and increasing positive feelings. This study measured results using the Mindful Attention Awareness Scale (MAAS), Connectedness to Nature Scale (CNS), and Profile of Mood States (POMS).

Additionally, Jennifer Keller and colleagues from Antioch Universitys Department of Environmental Studies investigated the effect of forest bathing on adolescent mental well-being[26]. This study utilized twenty-four participants aged sixteen to eighteen who practiced forest bathing three times over three weeks. The results of this study reflect that forest bathing increases the mental well-being of adolescents, using the WarwickEdinburgh Mental Wellbeing Scale (WEMWBS). Interestingly, however, researchers did not use the term Shinrin-Yoku in this research paper.

## Research Instruments

The current study employed a pretest-posttest research design. According to research design scholars Leedy and Ormrod[28], with this design, a single group undergoes a pre-experimental assessment, then an experimental treatment, and lastly an assessment following treatment. This design helps determine that a change has occurred, however, it cannot rule out other possible explanations for the change since there is no control group under this design. Thus, this research may demonstrate a correlation between Shinrin Yoku and feelings of stress rather than a causal relationship.

Among prior studies investigating Shinrin-Yoku, the employment of a pretest-posttest design is a common theme. In 2019, Akemi Furuyashiki and colleagues of the Hiroshima University Institute of Biomedical and Health Sciences aimed to investigate the impact of forest bathing on the psychological well-being of working-age adults with and without depressive tendencies[29]. A group of 155 individuals completed the POMS survey directly before and after a day-long forest bathing session. Similarly, in 2018, Ahmad Hassan and colleagues administered three different surveys to sixty university students, before and after, they engaged in fifteen-minute walks in either a bamboo forest or city environment[30]. Additionally, both studies highlighted that participants did not carry any belongings; all bags and cell phones remained in a secure location as participants immersed them-

selves in the forest. While both studies investigated the effects of Shinrin-Yoku on individuals and involved the administration of surveys, they differed in the demographics of each sample group, size of the sample group, and survey administered. Synthesizing similarities and differences among existing literature helps future researchers understand the importance of data collection through a pretest-posttest design, as the pretest serves as a control group.

Instruments to measure the effects of Shinrin-Yoku vary greatly among prior studies based on the research question or goal. Considering the new nature of research on this practice, professionals continue to seek the surveys, tests, and analyses which provide the most useful data and answer research questions most effectively. For example, Dr. Hiroko Ochiai of the Tokyo Medical Center administered the Profile of Mood States (POMS) and measured the pulse rates of seventeen middle-aged women using a five-hour structured program. Following the program, participants recorded significantly lower pulse rates and improved positive feelings such as comfort and relaxation[31]. Conversely, Kotera and colleagues administered the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS), Self-Compassion Scale (SCS), and University of California Los Angeles Loneliness Scale (UCLA-LS) to twenty-five Japanese undergraduates[32]. However, participants recorded improved scores only on the SCS. Kotera suggested this may be because the WEMWBS does not differentiate between physical, mental, emotional, spiritual, and social well-being, thus decreasing its validity as a measurement tool.

Studies that do not employ a pretest-posttest design must supplement their control group, oftentimes by using a different environment. For example, Dr. Chorong Song of Chiba University administered the POMS and State Trait Anxiety Inventory (STAI) to sixty young women with a mean age of twenty-one, comparing the effects of forest bathing versus walking in a city area[33]. This study found that the POMS scores improved greatly after forest bathing, while staying the same or decreasing after walking in a city area. Additionally, this study summed the total STAI score rather than assessing the difference in responses to each question on the twenty-item survey. Using this method, the researcher found that the mean STAI score significantly decreased in the forest environment, implying that participants felt less anxious in the forest than in the city.

Furthermore, whether studies utilize a physical control group or a pretest-posttest design, current methods for analyzing STAI data lack nuance. For example, in studies that employ the STAI with a pretest-posttest design, researchers compared participants' responses to surveys and questionnaires before versus after forest bathing[30]. However, Hassan and colleagues still summed the total scores of the STAI responses. Researchers such as Song et al. (2019) and Hassan et al. (2018) neglected to measure for statistical differences in responses to each question, which would better allow researchers to conclude the influence of Shinrin-Yoku on exact feelings such as anxiety, relaxation, or any other feelings on the twenty-item questionnaire.

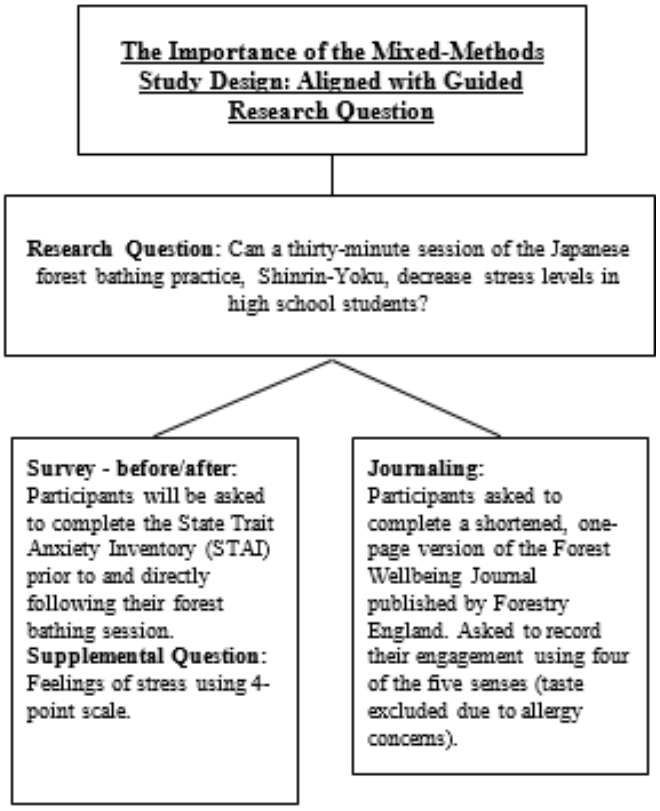


**Fig. 1** Flow Chart Outlining Research Method

## Methodology

### Overview

This study assessed whether or not a thirty-minute session of Shinrin-Yoku decreased stress in high school students, utilizing participants from a suburban town defined by the town clerk as a rustic farming history in New England[34]. The researcher hypothesized that the Shinrin-Yoku session would lead to reductions in feelings of stress and increased feelings of relaxation, as measured by the modified STAI survey. The null hypothesis states no difference from before to after. The researcher, an AP Research student, piloted the modified survey on five peers also enrolled in AP Research. Figure 1 visualizes the alignment among the research question and data collection methods.

### Ethical Considerations

The researcher mitigated numerous ethical concerns using an Institutional Review Board (IRB) form. The IRB approved

this research after reviewing a form the researcher completed (Appendix A), which detailed the process of this study. The researcher met with the school principal and psychologists numerous times to ensure that all procedures, surveys, and instructions followed the ethical standards of the IRB. The researcher explained how they gathered participants, maintained anonymity of participants, and utilized the survey instruments to collect data. Due to ethical concerns from administration, school psychologists required the research question to be placed on the parental consent form (Appendix B) which posed a limitation regarding knowledge of the general purpose of the study, if parents read the form closely. Additionally, only the science teachers could identify each participant. This step kept the names of participants anonymous to both the researcher and the expert advisor, allowing them to see only an identification number. In summary, this form addressed ethical considerations and verified that participants were protected.

## Exclusions

While a wealth of literature provides evidence on the benefits of Shinrin-Yoku, variations in methodology raise limitations and gaps in existing research. For example, numerous studies excluded persons suffering from a diagnosed mental disorder from their participant sample[29,30,35]. While this may aid in excluding outliers from the data, this prevents research from striving to aid the demographic most in need of ways to better their mental health. Similarly, Dr. Kyung-Sook Bang, of Seoul National Universitys College of Nursing, excluded people suffering from conditions such as asthma and heart disease[9]. While both present examples of logical exclusions for the sake of consistency in data, as researchers work to increase knowledge on Shinrin-Yoku, they must address a variety of demographics without such exclusions.

The current study may address this gap by including participants with mental health conditions. While developing the current study, the Institutional Review Board (IRB) prohibited the researcher from pre-screening high school student volunteers. The researcher was not allowed to question underlying mental health conditions such as attention-deficit/hyperactivity disorder (ADHD), anxiety, or depression. Thus, this study may address the gap of including participants with mental health conditions. However, this cannot be declared with certainty.

## Participants and Location

For this study, the researcher collected data from thirty-nine volunteer high school student participants (N=39) in grades 9 through 12 who attended a field trip to a popular local trail (Appendix C) used for walking, cycling, and running. While the high school property has a forested area, going off-site was more appropriate for the study as the area on school grounds was not large enough to spend thirty minutes under tree cover. Twenty-nine members of this sample were students enrolled in AP Environmental Science, AP Chemistry, College Prep & Honors Environmental Science, or members of Green Earth Club.

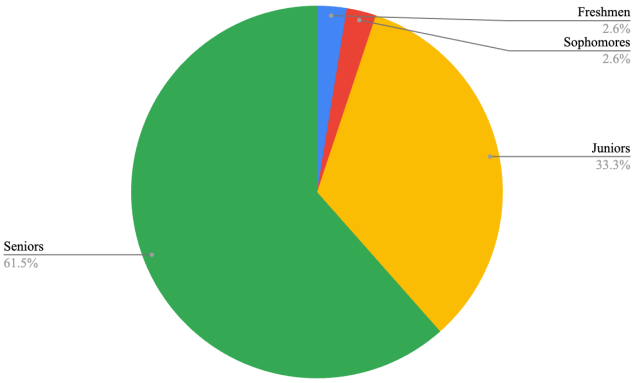


**Fig. 2** Grade Distribution Pie Chart

The remaining ten participants learned about the trip through the school announcements. Of the sample size, fourteen participants identified as male and twenty-seven as female; however, this study did not assess if a difference occurred in results among genders, which poses a gap for future study. In an attempt to obtain an accurate representation of this particular high school, the researcher invited students from all grades to participate. However, the vast majority of participants were juniors and seniors aged sixteen to eighteen. Figure 2 represents the grade distribution of participants.

## Procedure

Prior to the study, the researcher took steps to ensure its success and validity. Firstly, subjects submitted signed parental consent forms. They also received an email from the researcher advising them to wear proper footwear and dress appropriately for the cold weather, as the study took place in mid-November. To begin the study, teachers distributed folders labeled with numbers one through fifty to each participant. Teachers recorded the names of each participant in a table with their identification number to preserve anonymity to the researcher (Appendix D). Next, the researcher read a script (Appendix E) giving a brief summary of the parameters and asking participants to leave their cell phones and belongings on the bus to prevent distractions. Participants then completed the Before survey individually (Appendix F). Once all participants completed this survey, chaperones collected and placed them in a separate folder for the duration of the field trip. Figure 3 shows the modified STAI, which participants completed.

Upon arrival at the trail, the researcher gave participants in-

Before

State Trait Anxiety Inventory

Read each statement and select the appropriate response to indicate how you feel right now, that is, at this very moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best. Please complete this survey individually. Do your best to understand the language of each statement and respond accordingly.

| 1 - Not at all | 2 - A little | 3 - Somewhat | 4 - Very much so |
|---|---|---|---|
| Please rate your current stress level | 1 | 2 | 3 | 4 |
| I feel calm | 1 | 2 | 3 | 4 |
| I feel secure | 1 | 2 | 3 | 4 |
| I feel tense | 1 | 2 | 3 | 4 |
| I feel strained | 1 | 2 | 3 | 4 |
| I feel at ease | 1 | 2 | 3 | 4 |
| I feel upset | 1 | 2 | 3 | 4 |
| I feel satisfied | 1 | 2 | 3 | 4 |
| I feel frightened | 1 | 2 | 3 | 4 |
| I feel uncomfortable | 1 | 2 | 3 | 4 |
| I feel self confident | 1 | 2 | 3 | 4 |
| I feel nervous | 1 | 2 | 3 | 4 |
| I feel jittery | 1 | 2 | 3 | 4 |
| I feel indecisive | 1 | 2 | 3 | 4 |
| I am relaxed | 1 | 2 | 3 | 4 |
| I feel content | 1 | 2 | 3 | 4 |
| I am worried | 1 | 2 | 3 | 4 |
| I feel confused | 1 | 2 | 3 | 4 |
| I feel steady | 1 | 2 | 3 | 4 |
| I feel pleasant | 1 | 2 | 3 | 4 |

**Fig. 3** Modified State Trait Anxiety

structions on the completion of the journal and advised them to complete questions only when prompted. The researchers megaphone failed, leading participants to remain relatively quiet throughout the walk to hear the prompts. Every five minutes, the researcher read aloud a question from the Forest Bathing Journal. Participants then had two minutes to answer the question. The researcher repeated this procedure for five questions throughout the duration of the walk. Upon their return to the beginning of the trail, students were asked to complete the After survey individually (Appendix G). Once their survey was returned to a chaperone, the researcher informed participants that they had completed their participation.

## Data Collection

The researcher collected quantitative data using the modified STAI to answer the question: Can a thirty-minute session of Shinrin-Yoku decrease stress levels in high school students? To modify the STAI, the researcher removed one item asking students how much they were presently worrying about possible misfortunes, due to concerns from school psychologists relating to triggering anxiety in participants. The replacement item asked students to rate their current stress level using the four-point scale; a rating of four meaning Very much so and a rating of one meaning Not at all. This study assessed the efficacy of a thirty-minute session of Shinrin-Yoku in decreasing stress levels in high school students. Hence, the researcher included a question explicitly to assess stress among participants.

The pretest-posttest design allowed the researcher to examine the direct impact that Shinrin-Yoku had on feelings such as stress, worriedness, relaxation, and calmness among students. The researcher utilized the data collected to investigate whether a difference occurred in participants responses to each question before and after Shinrin-Yoku. Following data collection, the researcher collaborated with an expert advisor, the high school statistics teacher, for help with calculations, analysis, and interpretation of the data. The researcher employed a Google Spreadsheet to calculate results (Appendix H).

Additionally, the researcher composed a one-page journal (Appendix I) using five questions from the Forestry England Forest Wellbeing Journal (Appendix J) to encourage students to practice mindfulness and channel their attention to existing in the moment. The journals were not used to collect data, but to increase engagement in the practice. While other studies discussed asking participants to complete journals, there were no copies of the journals included in the appendices of these studies. Therefore, the researcher opted to utilize questions from Forestry England, one of very few published forest bathing journals available.

## Statistical Methods

To analyze the results of this study, the researcher performed a paired two-sample t-test for each item, comparing students mean responses before and after engaging in a researcher-guided thirty-minute forest bathing session. For example, item one on the STAI asked students to rate their perceived stress level. The t-test allowed for comparison to identify the difference in perceived stress level before and after. Thus, this test is appropriate for the data set as there are two samples. Descriptive statistics were used to assess the key characteristics of this dataset.

Researchers use the t-test to determine if a significant difference exists between the means of two groups[36]. For this study, the researcher measured for a significant difference among results before and after forest bathing. The researcher selected a

$$t = \frac{\bar{x}_{\text{diff}} - 0}{s_{\bar{x}}}$$

**Fig. 4** Equations of Statistical Analysis

significance level of $p < .05$ for statistical testing, a commonly accepted threshold. Therefore, a p-value of less than .05 indicates 95% confidence that forest bathing contributed to changes occurring in participant responses before and after forest bathing. Figure 4 shows the equation the researcher used to calculate t-values. Based upon t-values, the Google Spreadsheet used a t-distribution table to calculate p-values using a 95% confidence threshold (Appendix K; (T-Table. (n.d.). T Table.).).

## Results and Analysis

Item one of the modified STAI survey asked students to rate their current stress level. For the survey prior to forest bathing, the mean stress level was 2.4615. In the after survey, this mean decreased to 1.2632. This results in a mean difference of over one whole point ($\mu$ = 1.1842). Analysis revealed that participants stress levels significantly decreased post-intervention ($t = 8.76$, $p < .000001$) (Appendix L). Thus, the null hypothesis can be rejected. For reference, with a confidence level of 95%, the benchmark for outliers is two standard deviations. Thus, the decrease in stress levels among participants before and after Shinrin-Yoku was statistically significant.

Similarly, survey item fifteen, I am relaxed, had significant results. Responses to the Before survey had a mean of 2.6923 points, while responses to the After survey had a mean of 3.6923 points, suggesting that overall relaxation increased one whole point among participants. This results in a mean difference of slightly less than one whole point ($\mu$ = -0.9744). Furthermore, analysis revealed significant increases in relaxation following forest bathing ($t = -6.9684$, $p < .000001$) (Appendix M). Thus, the null hypothesis can again be rejected.

Overall, the results for each survey question had t-values greater than two ($t > 2$), suggesting a statistically significant difference in participant responses before and after forest bathing. Additionally, all p-values were significantly smaller than .05 ($p < .05$), which provides sufficient evidence to reject the null hypothesis that no difference would be observed before and after forest bathing. Figure 5 presents the t-tests and p-values calculated for each question.

Admittedly, this sample group consisted of volunteers. However, since the group was large and diverse enough ($N > 30$), the paired two-sample t-test maintained validity and reliability. For questions one, two, three, fourteen, sixteen, and seventeen, the researcher analyzed data from thirty-eight responses ($N = 38$), as one participant circled a number only for before or after, making it impossible to observe the change from before to after. Because the sample group stayed greater than thirty, this did not impact the results of the data.

| | Average Before | Average After | t-value | p-value |
|---|---|---|---|---|
| Rate current stress level | 2.462 | 1.263 | 8.757 | p < .001 |
| I feel calm | 2.658 | 3.692 | -8.075 | p < .001 |
| I feel secure | 2.795 | 3.324 | -4.568 | p < .001 |
| I feel tense | 2.103 | 1.410 | 4.263 | p < .001 |
| I feel strained | 1.846 | 1.256 | 4.724 | p < .001 |
| I feel at ease | 2.385 | 3.359 | -5.444 | p < .001 |
| I feel upset | 1.333 | 1.077 | 2.517 | 0.0163 |
| I feel satisfied | 2.256 | 3.410 | -6.330 | p < .001 |
| I feel frightened | 1.282 | 1.077 | 2.458 | 0.019 |
| I feel uncomfortable | 1.641 | 1.179 | 3.666 | p < .001 |
| I feel self confident | 2.667 | 3.026 | -2.890 | 0.006 |
| I feel nervous | 1.923 | 1.231 | 5.444 | p < .001 |
| I feel jittery | 2.026 | 1.487 | 3.822 | p < .001 |
| I feel indecisive | 2.132 | 1.487 | 4.787 | p < .001 |
| I am relaxed | 2.692 | 3.692 | -6.968 | p < .001 |
| I feel content | 2.447 | 3.359 | -5.281 | p < .001 |
| I am worried | 1.763 | 1.256 | 3.340 | 0.002 |
| I feel confused | 1.462 | 1.154 | 3.132 | 0.003 |
| I feel steady | 2.590 | 3.205 | -4.049 | p < .001 |
| I feel pleasant | 2.667 | 3.564 | -5.211 | p < .001 |

**Fig. 5** Table Summarizing Forest Bathing Results (rounded to three decimal places; p values under .001

## Discussion and Implications

This study demonstrates that a thirty-minute Shinrin-Yoku session may be able to reduce stress in American high school students. Thus, the results support the researchers hypothesis. Data analysis on each item of the STAI reflected significant differences in before and after survey responses. The results conclude, with 95% confidence based on the p-value of $p < .05$, that a thirty-minute forest bathing session may contribute to stress reduction and increase feelings of calmness, security, self-confidence, and relaxation. At the same time, results reflect that a thirty-minute forest bathing session may decrease feelings such as tension, strain, jitters, and indecision.

The findings of this study align with the results of prior research on Japanese adolescents and adults who engaged in forest bathing sessions ranging from fifteen minutes to eight hours[9,29,30]. Bang and colleagues (2017) study synthesizing 28 papers found that the long-term implications of Shinrin-Yoku show significant benefits to physical and psychological health, emotional state, and feelings toward obstacles or difficult tasks. The present study establishes itself in the existing literature by suggesting that American high school students may experience the same benefits. Furthermore, Hassan and colleagues (2018) and Furuyashiki and colleagues (2019) both found that Shinrin-Yoku may be beneficial in reducing negative feelings such as anxiety. The present study aligns with prior literature by providing further evidence of potential benefits.

It is important to note, however, that causal conclusions can-

not be drawn from the results of this study. While it provides evidence that stress reduction may occur, future research must take further steps to observe a relationship based on causation rather than correlation. One step future research must take is the use of a control group. For example, Song et al. (2019) compared Japanese people in a forest setting and an urban setting. Comparing an experimental and control group would allow future studies to separate the effects of forest bathing from other factors such as the novelty of participating in a field trip, expectancy effects, and a break from traditional school routine. Additionally, future studies should seek to use a validated scale, such as the original STAI, or another scale that specifically addresses the research question.

The researcher acknowledges that limitations arose throughout the study. Firstly, loud noises such as the school bus being reversed may have interrupted students engagement in the practice. Additionally, as discussed in the methodology, the school megaphone was broken on the day of the trip, so the researcher used a projecting, almost yelling, voice at times to gain participants attention. Additionally, there was between 100 and 300 feet of forest between the trail and the road on either side. Therefore, participants heard noise from vehicles throughout the duration of the walk. These disruptions may have interfered with participant engagement.

The researcher and chaperones noted high levels of student engagement. At times, however, chaperones and the researcher reminded participants to quiet down or maintain a slower walking pace. The researcher and chaperones observed no cell phones, with the exception of the chaperone who took photographs (Appendices N-Y). People heavily utilized the trail on the study day, and some approached the researcher or participants to ask about the study. The researcher and chaperones explained that an active research study was being conducted and asked the people to leave. These limitations may have disrupted participants focus on taking in the forest atmosphere.

The sample group of volunteer participants poses another limitation. While the findings remain significant, future studies should note that volunteers may not achieve the same results as randomly selected individuals. While the researcher offered no incentives or rewards for participants, future research should seek to study all students in a school, grade, or particular class. Studying a more random group will provide insight to the efficacy of forest bathing as a general practice.

Admittedly, numerous factors that aided in the success of this study are unavailable for every place. A moderate climate with sufficient tree cover may not be widely available in places with extreme climatic conditions. Examples include cities and regions with terrain primarily desert or grassland. Differing environmental conditions may decrease the availability of this practice, thus eliminating the ease and cost-effectiveness which this study presents.

The novelty factor poses another limitation future studies should seek to address. New practices tend to be exciting, and people want to engage. Over time, this excitement tends to deplete. Numerous studies assessed repetition of Shinrin-Yoku (Bang et al. 2017, Jin et al. 2020, Keller et al. 2023). In each of these studies, data suggested increased benefits as participants engaged in multiple sessions. However, participants did not repeat programs for long durations of time, such as an entire school year. Keller and colleagues 2023 study in Southampton, New York, found that engaging in forest bathing three times over three weeks significantly increased mental well-being. While an increase occurred after each session, the most dramatic increase occurred following the first one. Despite these findings, prior studies have not investigated Shinrin-Yokus effects over longer periods, such as one year. Thus, the novelty factor requires further research.

This study provides evidence that Shinrin-Yoku may benefit high school students mental health. However, further research is necessary to make causal conclusions due to the lack of a control group. As American teens report debilitating stress levels, namely because of academics (Lee, 2024), schools may consider implementing Shinrin-Yoku pilot programs to assess efficacy when the practice is repeated or used on a non-volunteer group. Admittedly, this may not apply to schools lacking certain resources, such as a wooded area on campus or nearby, and a climate safe and comfortable to spend thirty minutes walking outside.

Due to limited resources, the researcher could not measure physiological changes in participants based on their survey results. However, results of aforementioned studies allow the researcher to infer that blood pressure and heart rate would decrease, further supporting the findings of this study, as both factors decrease when stress decreases (Mayo, 2024). The two most commonly measured physiological factors within Shinrin-Yoku research include blood pressure and heart rate. Future studies may seek to investigate any disparities or differences between American and Japanese teens who engage in the practice of Shinrin-Yoku.

Along with the significant findings of this study, numerous opportunities for further research arose. Firstly, studies investigating the long-term effectiveness of Shinrin-Yoku may highlight further impacts of forest bathing on schools. Future research should also eliminate the volunteer factor by selecting entire classes or grades to engage in Shinrin-Yoku, in order to assess the efficacy for a wider demographic. Additionally, researchers should study the impact of forest bathing on academic performance, class engagement, and school attendance. In consideration of geography and climate, future research should also investigate if forest bathing results vary across different seasons. Lastly, future studies should assess the optimal group size to achieve the greatest benefits from forest bathing.

## Conclusion

The results of this study are significant to the future of Shinrin-Yoku studies in America. This study provides evidence that American high schools may consider implementing forest bathing to help existing mental health initiatives. Pilot programs are one way for districts to integrate the practice, while assessing if it is beneficial to their students based on geography and demographics with an easy quick implementation process. Future research should also assess if repetition of the practice influences observed benefits, and investigate optimal frequency. Despite gaps and limitations, this study creates valuable opportunities for future research and concludes that Shinrin-Yoku offers a new way to help high school students decrease stress and improve mental health.

## References


1 Centers for Disease Control and Prevention, *Protecting the Nations Mental Health*, https://www.cdc.gov/mental-health/about/what-cdc-is-doing.html, 2024, Mental Health.

2 G. P. Stromjer, M. Csima, R. Ivncsik, B. Varga, K. Takcs and T. Stromjer-Rcz, *Children*, 2023, **10**, 1548.

3 APA Dictionary of Psychology, *APA Dictionary of Psychology*, https://dictionary.apa.org/, 2018.

4 Mayo Clinic Staff, *Relaxation Techniques: Try These Steps to Lower Stress*, https://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/relaxation-technique/art-2004536, 2024.

5 P. Reynolds, *Managing Stress in High School*, https://summer.harvard.edu/blog/managing-stress-in-high-school/, 2022.

6 M. C. Pascoe, M. de Manincor, J. Tseberja, M. Hallgren, P. A. Baldwin and A. G. Parker, *Comprehensive Psychoneuroendocrinology (Online)*, 2021, **6**, 100037.

7 K. Weir, *Nurtured by Nature*, https://www.apa.org/monitor/2020/04/nurtured-nature, 2020.

8 B. Aya and D. P. Glfer, *Effects of Forest Bath (Shinrin-Yoku) and Forest Therapy (Shinrin-Rhyoho) on Womens Health*, https://dergipark.org.tr/en/download/article-file/2291036, 2023.

9 K. S. Bang, I. Lee, S. Kim, C. S. Lim, H. K. Joh, B. J. Park and M. K. Song, *International Journal of Environmental Research and Public Health*, 2017, **14**, 728.

10 G. K. Jin, T. G. Khil, Y. Lim, K. Park, M. Shin and W. S. Shin, *International Journal of Environmental Research and Public Health*, 2020, **17**, 3409.

11 S. Fitzgerald, *Forest Bathing: What It Is and Where to Do It*, https://www.nationalgeographic.com/travel/article/forest-bathing-nature-walk-health, 2019.

12 S. Iimura, *Current Psychology*, 2018, **37**, 803–808.

13 S. Wilson and N. M. Dumornay, *The Journal of Adolescent Health*, 2022, **70**, 354–355.

14 M. Dimock, *Defining Generations: Where Millennials End and Generation Z Begins*, https://www.pewresearch.org/short-reads/2019/01/17/where-millennials-end-and-generation-z-begins/, 2019.

15 J. Haidt, *The Anxious Generation: How the Great Rewiring of Childhood is Causing an Epidemic of Mental Illness*, Penguin Press, 2024.

16 M. Richardson, Z. Hussain and M. D. Griffiths, *Journal of Behavioral Addictions*, 2018, **7**, 109–116.

17 M. H. Centers, *Health Matters: Excessive Screen Time Linked to Anxiety, Depression, ADHD, and Obesity in Children*, 2018, https://mchcinc.org/excessive-screen-time-health-issues/.

18 H. Wang, C. Abbey, T. Kennedy, E. Feng, R. Li, F. Liu, A. Zhu, S. Shen, P. Wadhavkar, S. Rozelle and M. K. Singh, *Risk Management and Healthcare Policy*, 2023, **16**, 369–381.

19 Q. Li, K. Morimoto, A. Nakadai, H. Inagaki, M. Katsumata, T. Shimizu, Y. Hirata, K. Hirata, H. Suzuki, Y. Miyazaki *et al.*, *International Journal of Immunopathology and Pharmacology*, 2007, **20**, 3–8.

20 B. Shirvell, *Dip Your Toes Into Forest Bathing*, 2024, https://hub.jhu.edu/2024/06/04/forest-bathing-nature-kids/.

21 Y. Wen, Q. Yan, Y. Pan, X. Gu and Y. Liu, *Environmental Health and Preventive Medicine*, 2019, **24**, 70.

22 B. B. Brown, B. Benson, R. Larson and T. S. Saraswati, *The World's Youth: Adolescence in Eight Regions of the Globe*, Cambridge University Press, 2002.

23 H. Lee, T. Masuda, K. Ishii, Y. Yasuda and Y. Ohtsubo, *Personality & Social Psychology Bulletin*, 2023, **49**, 571–584.

24 A. Zakaras, *Alex Zakaras on the Roots of American Individualism*, 2022, https://press.princeton.edu/ideas/alex-zakaras-on-the-roots-of-american-individualist.

25 *Cultural Stereotype and Its Hazards: Japanese Collectivism as a Case*, ed. Y. Takano, Cambridge University Press, 2024, pp. 1–16.

26 J. Keller, J. Kayira, L. Chawla and J. L. Rhoades, *International Journal of Environmental Research and Public Health*, 2023, **21**, 8.

27 N. Kil, J. G. Kim, E. Thornton and A. Jeranek, *International Journal of Mental Health Promotion*, 2023, **25**, 1117–1125.

28 P. D. Leedy and J. E. Ormrod, *Practical Research: Planning and Design*, Pearson, 12th edn, 2019.

29 A. Furuyashiki, K. Tabuchi, K. Norikoshi, T. Kobayashi and S. Oriyama, *Environmental Health and Preventive Medicine*, 2019, **24**, 46.

30 A. Hassan, J. Tao, G. Li, M. Jiang, L. Aii, J. Zhihui, L. Zongfang and C. Qibing, *Evidence-Based Complementary and Alternative Medicine : eCAM*, 2018, **2018**, 9653857.

31 H. Ochiai, H. Ikei, C. Song, M. Kobayashi, T. Miura, T. Kagawa, Q. Li, S. Kumeda, M. Imai and Y. Miyazaki, *International Journal of Environmental Research and Public Health*, 2015, **12**, 15222–15232.

32 Y. Kotera and D. Fido, *International Journal of Mental Health and Addiction*, 2022, **20**, 2652–2664.

33 C. Song, H. Ikei, T. Kagawa and Y. Miyazaki, *International Journal of Environmental Research and Public Health*, 2019, **16**, 229.

34 *Town of Ellington Home Page*, https://www.ellington-ct.gov/, Accessed: 2025-06-06.

35 X. Wang, Y. Shi, B. Zhang and Y. Chiang, *International Journal of Environmental Research and Public Health*, 2019, **16**, 3263.

36 D. Siegle, *T-Test Educational Research Basics by Del Siegle*, https://researchbasics.education.uconn.edu/t-test/, 2015, Accessed: 2025-06-06.