

Use of Forest Therapy (Shinrin-yoku) in Stress Reduction: Evidence & Application

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Abstract: *Forest therapy (also known as forest bathing, Shinrin-yoku) is increasingly studied as a non-pharmacological intervention for stress reduction. This review surveys recent empirical and meta-analytic studies (≈25) to assess effects on psychological and physiological stress markers, evaluate mechanisms, and identify best practices and limitations. Evidence shows consistent short-term benefits on anxiety, depression, mood, cortisol, blood pressure, heart rate variability. However, heterogeneity of study designs, limited long-term data, and variable definitions of “forest therapy” reduce certainty. We propose guidelines for application and avenues for future research.*

Keywords: forest therapy, stress reduction, psychological wellbeing, physiological markers, future research

1. Introduction

- Define stress: psychological (perceived stress, anxiety, depression), physiological (cortisol, BP, HRV, etc.). Define forest therapy / Shinrin-yoku: spending time in forested/natural environments, with senses engaged, often structured (walking, sitting, breathing).
- Rationale: urbanization, mental health burden → attractive low-cost, low risk intervention.
- Aim: examine evidence, strength of effect, mechanisms, and application.

2. Overview

Forest Therapy (Shinrin-yoku) —the practice of immersing oneself mindfully in forest environments—has emerged as a compelling, evidence-based approach to reducing stress and improving mental well-being. Originating in Japan in the 1980s, it integrates gentle physical activity, sensory engagement, and mindfulness within natural forest settings. Over the past decade, more than two dozen studies and several meta-analyses have demonstrated that forest therapy produces significant reductions in psychological stress (including anxiety, depression, anger, and fatigue) and physiological stress responses (such as elevated cortisol, blood pressure, and heart rate). The mechanisms are multifactorial: immersion in nature enhances parasympathetic nervous system activity, lowers sympathetic arousal, restores cognitive attention, and fosters emotional balance.

The growing body of research positions forest therapy as a non-pharmacological, low-cost, and accessible intervention for individuals experiencing chronic stress, workplace burnout, or mood disturbances. Structured programs—combining guided walks, meditation, and breathing exercises—are shown to be particularly effective. Despite its promise, the field still faces challenges, including limited long-term follow-up data, small sample sizes, and variability in study design. Nonetheless, the convergence of findings across diverse populations and regions underscores forest therapy’s potential as a public health strategy to combat the psychological burdens of modern urban life. Continued research into optimal “doses” of nature exposure, cultural

adaptations, and integration into healthcare systems will be key to fully realizing its benefits for global mental health.

3. Methods of This Review

Sourced studies from PubMed, Scopus, Web of Science etc., up to 2025.

Inclusion: studies using forest therapy / bathing with a stress outcome (psychological/or physiological) in humans.

Both experimental (RCT, quasi-experimental, pre-post) and meta-analyses / systematic reviews included.

Over the past decade, research on **forest therapy (Shinrin-yoku)** has expanded rapidly, with at least 25 peer-reviewed studies and meta-analyses confirming its benefits for **stress reduction** across diverse populations. The strongest and most consistent findings relate to **psychological stress markers**—such as anxiety, depression, anger, and perceived stress—which show significant decreases following participation in forest therapy sessions compared with either pre-intervention baselines or urban control environments.

Antonelli et al. (1) conducted a meta-analysis of 22 studies and found that forest exposure significantly reduced salivary cortisol, a key biomarker of stress. Likewise, Kotera et al. (2) in a large meta-analysis published in the *International Journal of Mental Health and Addiction* involving over 2,000 participants reported moderate-to-large improvements in anxiety and mood following forest therapy. More recent systematic reviews and meta-analyses (3-5) confirm these outcomes and suggest that **structured, guided forest therapy programs**, rather than unstructured nature walks, yield greater psychological benefits—particularly among individuals experiencing higher baseline stress or depressive tendencies.

Physiologically, forest therapy has been shown to lower **blood pressure, heart rate, and cortisol**, while enhancing **heart rate variability (HRV)**, indicating activation of the parasympathetic (“rest-and-digest”) nervous system. Lee et al. (6) reported significant reductions in both systolic and diastolic blood pressure in their meta-analysis of cardiovascular outcomes. Controlled studies in Japan and Korea (7-9) further demonstrated improvements in HRV,

immune markers such as natural killer cell activity, and emotional stability among office workers, middle-aged women, and older adults after short-term immersion in forest environments.

However, while these effects are robust in the short term, **long-term data remain limited**. Most studies examine acute responses lasting hours to days, with few assessing whether benefits persist weeks or months later. Methodological heterogeneity—differences in intervention duration, forest type, environmental characteristics, and participant demographics—also complicates comparisons. Despite these limitations, the convergence of evidence across physiological, psychological, and behavioral domains strongly supports forest therapy as a **scientifically grounded, low-risk intervention for stress reduction**. The magnitude of benefit appears greatest in structured programs lasting at least 20–30 minutes per session, repeated over several days, and conducted in natural, biodiverse forest settings.

4. Mechanisms Proposed

From these studies, several mechanisms emerge:

- 1) **Physiological modulation**
Reduction in cortisol (salivary/serum) after forest exposure. [PubMed+2SAGE Journals+2](#)
Lower blood pressure, lower pulse rate, higher heart rate variability (indicative of increased parasympathetic / reduced sympathetic activity). [BioMed Central+3SpringerLink+3PubMed+3](#)
- 2) **Psychological / emotional improvements**
Reductions in anxiety, tension, depression, anger, fatigue. [SpringerLink+2BioMed Central+2](#)
Improvements in mood states (vigor, calm, liveliness) and quality of life. [PubMed+1](#)
- 3) **Cognitive restoration**
Attention Restoration Theory: forest environments allow effortless attention, reducing mental fatigue. Studies sometimes measure attention, but more indirect. [SpringerLink](#)
- 4) **Environmental and sensory inputs**
Engaging multiple senses (smell, sight, hearing, touch) may help distract, provide aesthetic pleasure, reduce rumination.
Natural compounds (“phytoncides”) suggested in some research (but less directly tied to stress outcomes in human trials).
- 5) **Dose / exposure parameters matter**
Longer sessions (≥ 20 min), multi-session programs tend to have more robust effects. [PMC+1](#)
Type of activity (walking, sitting/viewing, meditation) also influences outcome. [MDPI+1](#)

Magnitude and Duration of Effects

- **Magnitude:** Effect sizes for psychological outcomes (anxiety, depression) often medium-to-large in forest therapy vs urban or baseline. For physiological markers (cortisol, BP), effects are smaller but consistent.
- **Duration:** Most studies measure only immediate pre-post effects (hours to days). Few measure sustained (weeks or months) effects. Maintenance of benefit is less well documented.

5. Limitations, Gaps & Quality Issues

- Overrepresentation of East Asia (Japan, Korea, China) → cultural/geographical bias. Fewer studies from other regions.
- Heterogeneity in definitions: what constitutes “forest therapy” vs simple exposure vs walking vs meditation in forest.
- Sample sizes often small; many studies are non-randomized or quasi-experimental.
- Risk of bias: many studies have issues with blinding (very hard), allocation, control groups.
- Physiological measures often acute; long-term biomarkers or health outcomes (eg, clinical stress disorders) less studied.
- Confounding variables: season, temperature, participants’ prior exposure to nature, baseline stress, motivation, expectations.

6. Applications & Best Practices

Based on the evidence, the following practical recommendations emerge:

- **Program design:** include structured sessions (walking, sitting, meditation) rather than simple forest exposure. Multi-session interventions appear more effective.
- **Duration:** sessions of ≥ 20 minutes seem to yield more consistent benefits. One-day retreats also beneficial; even shorter exposures help but with smaller effects.
- **Population targeting:** people with higher baseline stress or depressive tendencies benefit more; older people, middle-aged women show positive response. Workplace interventions are promising.
- **Setting:** forest environments, but even green/wooded urban parks may be helpful. Comparisons between urban vs forest show forest superior.
- **Measuring outcomes:** combine psychological scales (anxiety, depression, mood, perceived stress) with physiological markers (cortisol, BP, HRV). Pre-post and control group designs preferable.
- **Follow-ups:** include assessments days/weeks after therapy to understand duration of benefit; possibly booster sessions.

7. Implications for Clinical / Public Health

Forest therapy could be used as an adjunct to standard treatments for stress, anxiety, depression.

Workplace wellness programs might integrate forest therapy retreats or regular forest walks.

Urban design / green infrastructure policy: increasing accessible natural green spaces could have preventive effects on population stress.

Cost-effectiveness seems promising though formal cost analyses are few.

8. Future Directions

- Need for RCTs with larger, diverse samples outside East Asia (e. g., tropical, temperate, urban vs rural).
- Longitudinal studies to assess durability of effects (weeks, months).
- Dose-response analyses: how much, how often, which kinds of activity are optimal.
- Mechanistic studies: disentangle roles of sensory input, phytoncides, air quality, microbiome exposure etc.
- Studies examining which subpopulations (age, gender, baseline mental health) benefit most.
- Consider virtual or simulated forest exposure (VR, indoor green) as more accessible alternatives.

9. Conclusion

Forest therapy / Shinrin-yoku has robust evidence for short-term reduction in stress: both psychological (anxiety, depression, mood) and physiological (cortisol, blood pressure, HRV) outcomes. However, heterogeneity in methods, limited long-term data, and geographic bias suggest caution. For maximal utility, forest therapy interventions should be structured, of adequate duration, and measured with rigorous methods. With further research, forest therapy holds promise as a scalable, low-cost tool in public health and clinical contexts to mitigate stress.

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