

## The Impact of Forest Bathing (Shinrin-Yoku) on Adolescent Mental Health: A Systematic Review of Existing Evidence

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### ABSTRACT

**Introduction:** Shinrin-yoku, or forest bathing, is a natural therapy method that involves direct interaction with the forest environment and is associated with various mental health benefits. This study aims to systematically evaluate the impact of forest bathing on adolescent mental health by analyzing the available scientific evidence.

**Objective:** This study aims to systematically analyze the impact of forest bathing (shinrin-yoku) on adolescent mental health.

**Method:** A systematic search was conducted in the PubMed, ProQuest, JSTOR, and Garuda databases from 2017 to 2024, focusing on adolescent populations experiencing mental health disorders such as anxiety, depression, and low self-esteem, without restrictions on gender, religion, or race.

**Result:** Seven studies involving a total of 245 participants were analyzed. Forest bathing (Shinrin-yoku) consistently demonstrated significant benefits in reducing symptoms of depression and anxiety while enhancing overall mental well-being. The intervention cycles ranged from one day to five months, with session durations varying between 40 minutes and four hours. These sessions included structured activities in forest environments, such as walking, meditation, and inhaling forest air, either dynamically or statically.

**Conclusion:** Forest bathing (Shinrin-yoku) is effective in improving adolescent mental health by reducing anxiety and depression while enhancing psychological well-being. The clinical implications for nursing practice include integrating forest bathing as a non-pharmacological intervention in holistic care, particularly in community and school settings, to support stress management and prevent mental health issues among adolescents.

**Keywords:** adolescent, forest bathing (shinrin-yoku), mental health

## Introduction

In today's fast-paced and digitally connected world, adolescent mental health has emerged as an increasingly urgent global concern. Maintaining good mental health is essential for fostering healthy behaviors, decision-making, and emotional regulation during adolescence (Setiawan et al., 2023). Hurlock, in *A Life Span Approach*, emphasizes that adolescence is a critical developmental stage marked by identity formation, cognitive maturation, and emotional instability (Hurlock, 2008).

Jiang et al. (2021) highlight that academic pressure, heightened social expectations, and excessive use of technology significantly contribute to increased levels of stress, anxiety, and depression among adolescents. A recent report by the World Health Organization, as discussed by Cuijpers et al. (2023), reveals that more than one billion individuals globally—over one in eight people—experience mental disorders. Depression affects an estimated 280 million people, while anxiety impacts around 301 million, with additional burdens from disorders such as ADHD, schizophrenia, bipolar disorder, and behavioral conditions.

According to Rahmawaty et al. (2022), adolescence is often characterized by intense emotional fluctuations, frequently triggered by school-related demands and household responsibilities. While mood changes are common during this period, they do not necessarily indicate underlying psychological disorders (Setiawan et al., 2023). Nevertheless, if left unaddressed, persistent mental health challenges during adolescence can increase the risk of maladaptive behaviors, including substance use and social withdrawal. Lindholdt et al. (2022) found that adolescents with elevated stress levels are more prone to sleep disturbances and negative self-image, which are closely associated with the onset of depressive symptoms in later life.

Given the growing mental health burden among adolescents, there is a critical need to explore alternative, non-pharmacological strategies to complement conventional treatments. In particular, the modern urban lifestyle—marked by reduced contact with nature—limits adolescents' exposure to natural environments that have been shown to provide psychological restoration and stress relief.

One such nature-based intervention is forest therapy, which evolved from the Japanese practice of *Shinrin-yoku* or “forest bathing.” Li (2022) describes forest therapy as an evidence-based preventive approach aimed at enhancing mental and physical well-being through immersive experiences in forest environments. According to Ochiai et al. (2015), forest bathing has been shown to lower blood pressure, reduce heart rate, and suppress sympathetic nervous activity while increasing parasympathetic responses and natural killer (NK) cell activity—indicators of reduced stress and enhanced immune function. These physiological benefits may persist for up to seven days following forest exposure.

Forest bathing encourages mindfulness and sensory engagement with nature—smelling forest aromas, listening to ambient sounds, and breathing clean air—which together foster psychological relaxation. While research has largely focused on adults, Hu et al. (2023) emphasize that the potential mental health benefits of *Shinrin-yoku* for adolescents remain underexplored. Given the increasing academic pressures, hormonal changes, and social media influences faced by this demographic, further investigation is necessary.

This study, therefore, aims to examine the effects of *Shinrin-yoku* on adolescent mental health. Specifically, it seeks to determine how forest bathing can reduce stress and anxiety while enhancing overall psychological well-being. The findings are expected to inform the development of evidence-based, nature-oriented interventions for adolescent mental health support. In addition, the study aims to bridge current knowledge gaps and offer recommendations for educational institutions and families to incorporate nature exposure

into daily routines. Promoting outdoor activities through strategies like forest bathing may contribute not only to emotional stability and cognitive development but also to improved long-term quality of life for adolescents facing the challenges of modern life.

**Objective**

This study aims to systematically analyze the impact of forest bathing (shinrin-yoku) on adolescent mental health.

**Method**

***Study design***

This systematic literature review adheres to the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. The research protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO).

***Search strategy***

The search strategy covered the period from January 1<sup>st</sup>, 2017, to December 31<sup>st</sup>, 2024, and spanned various databases, including Pubmed, ProQuest, GARUDA, and JSTOR. The search strategy was limited to the last one decade to ensure that researchers encompass the most recent and relevant information on a specific topic. Research and developments in a field of science can change and evolve over time, making it essential to consider the most up-to-date literature for a comprehensive understanding. Additionally, restricting the search timeframe to the last one decade aims to enable researchers to manage the number of studies they need to evaluate and synthesize.

**Tabel 1. MeSH term on search strategy phase**

Source	Link	Keywords	Num
Pubmed	<a href="https://rb.gy/jic196">https://rb.gy/jic196</a>	Forest bathing [MeSH Terms]	7
ProQuest	<a href="https://rb.gy/kmvqpj">https://rb.gy/kmvqpj</a>	mainsubject (forest bathing)	59
GARUDA	<a href="https://rb.gy/i3lujc">https://rb.gy/i3lujc</a>	forest bathing	300
JSTOR	<a href="https://rb.gy/fsa0wa">https://rb.gy/fsa0wa</a>	(forest bathing)	350
<b>Total</b>			<b>716</b>

The search employed the Medical Subject Headings (MeSH) system and relevant keywords in advanced search engines, as presented in Table 1. These searches were conducted independently by two of this article’s co-authors (DLPA and DN), who accessed the previously referenced electronic databases.

***Inclusion criteria***

The participants included in this study are individuals experiencing mental health disorders in adolescence, including anxiety, depression, low self-esteem, and other related conditions. There were no restrictions based on sex, religion, or race.

***Intervention***

Forest bathing, or Shinrin-yoku, is a Japanese practice that emphasizes deep immersion in forest environments to enhance physical and mental well-being. This therapeutic approach encourages individuals to fully engage their senses while surrounded by nature, fostering a heightened state of mindfulness. Exposure to natural environments has been linked to increased levels of phytonutrients—natural compounds released by trees—that contribute to

improved immune function. Additionally, forest bathing strengthens one's connection with nature, which has been shown to enhance psychological resilience and overall life satisfaction. Research has explored the physiological and psychological mechanisms underlying these benefits, highlighting the role of biophilia, the innate human affinity for nature, in promoting health. By encouraging slow, mindful walking, deep breathing, and keen observation of the surrounding environment, forest bathing facilitates relaxation and mental clarity, ultimately supporting holistic well-being.

### *Control*

Eligible controls were required to receive standard care or usual care , or placebo

### *Outcomes*

We include studies that measure mental health intensity using various instruments, The Beck Depression Inventory (BDI) and Generalized Anxiety Disorder 7-item Scale (GAD-7) measure depression and anxiety. Stress can be assessed using the Perceived Stress Scale (PSS). Blood pressure, heart rate, and cortisol levels provide physiological indicators of stress. Observational tools help evaluate behavior and environmental interactions. Quality of life is measured using scales like WHOQOL and EQ-5D. The Connectedness to Nature Scale (CNS) assesses a person's relationship with nature.

### *Study design*

We include randomized controlled trials (RCT), Kualitatif and Mix method to assess the effect of forests bathing. Article based on single case study, literature review, systematic review and opinion articles will be excluded. only studies written in English will be included.

### ***Exclusion criteria***

Studies were not published in English language. Individuals under the age of 12 years and families with chronic illnesses in individuals over 65 years old were excluded from the study. Articles focusing on single case studies, case report, editorial, Letter to Editor, correspondence, narrative review, scoping review, literature reviews, systematic reviews, proceeding abstract, book chapter and opinion articles were excluded from consideration in this analysis.

### ***Study selection and data extraction***

Three authors (DF, DLPA, DP) independently reviewed all titles and abstracts according to the previously outlined design. In cases where consensus could not be reached between the two reviewers, the senior researcher (AF) made the final decision regarding the inclusion of the disputed articles. Three other authors (SU, AEP, NH) independently extracted data from each study included in the dataset. The selected studies for inclusion included information on authorship, year, country, study design, sample size, interventions, instruments, results, and findings.

### ***Assessment of quality***

Three researchers (DF, SU, AEP) independently assessed the quality of the studies included. Discrepancies in assessments were discussed, and if further clarification or resolution was needed, the senior researcher (AF) was consulted. This meticulous process ensures that the quality evaluation is conducted rigorously and in accordance with scientific standards.

## CASP

We used the Critical Appraisal Skills Programme (CASP) to assess the quality of primary and secondary outcomes based on the following domains: study design, risk of bias, inconsistency, indirectness, imprecision, and other consider.

## Result

### Study selection

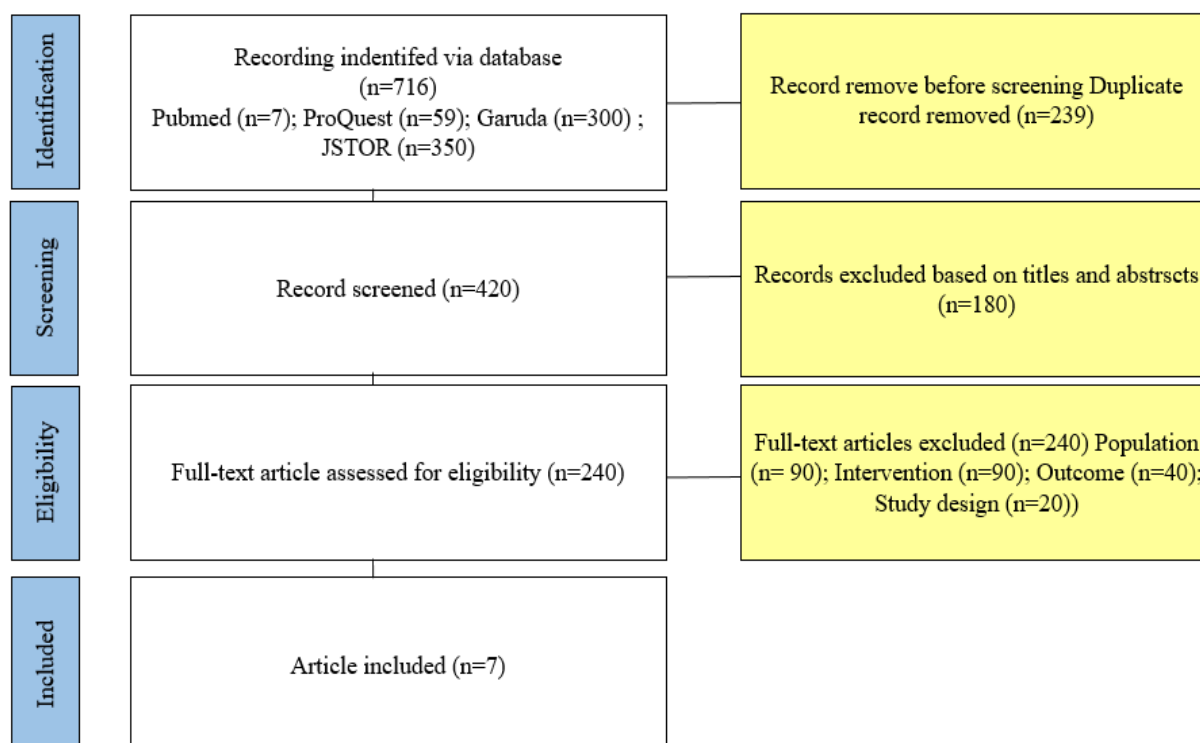


Figure 1. Screening Process Flowchart by PRISMA

In this study, a total of 716 articles were identified through various databases: PubMed (n=7), ProQuest (n=59), Garuda (n=300), and JSTOR (n=350). After the initial screening process, 239 articles were removed due to duplication, leaving 420 articles for the screening stage. Three researchers (DF, DPLA, DP) evaluated the titles and abstracts, resulting in the exclusion of 180 articles that did not meet the selection criteria. Subsequently, the remaining 240 articles were subjected to an in-depth analysis at the full-text assessment stage to evaluate their eligibility based on the established criteria. From this analysis, 233 articles were eliminated for not meeting the research criteria: 90 articles were irrelevant to the population characteristics, 90 articles were not relevant in terms of intervention, 40 articles did not align with the expected outcomes, and 20 articles did not meet the desired study design. As a result of this selection process, only 7 articles met all criteria and were included in the subsequent analysis. Detailed information can be found in Figure 1.

Study characteristics

Tabel 2. Characteristics of Studies

Author	Intervention and Fasilitator	Number of session	Duration	Method or Media
Li et al., (2024) Japan	The practice of Shinrin-yoku (forest bathing) was conducted by forest therapists	Over two days, two sessions were conducted (one session in a forest area and one session in an urban area)	2 hours	Participants traveled to the forest park (Akasawa Shizen Kyuyourin) and to an urban area as a control.
Mazzarino et al.( 2024) Brazil	The practice of Shinrin-yoku (forest bathing) was conducted by the researchers and the research team from the University of Vale do Taquari	From July to November 2022, first-semester students participated in one session per month, while fourth-semester students participated in three consecutive sessions	40 minutes	The sessions were held at the university's forest facility for 40 minutes, where students were instructed to maintain a minimum distance of three meters from each other, refrain from using electronic devices, and remain in a state of calm
Wen et al. (2023) China	The practice of Shinrin-yoku (forest bathing) was conducted by the researchers.	Preparation was carried out over the course of 1 week, and the intervention	The intervention included 1 hour of hiking in the forest and 20 minutes of observing the forest and urban environments.	Hiking The intervention included 1 hour of hiking in the forest, followed by 20 minutes of observing the forest environment, as well as watching
Keller et al. (2024) USA	The practice of forest bathing was conducted by ANFT (Association of Nature and Forest Therapy).	The intervention was conducted for 3 consecutive weeks, with 3 sessions in total.	1,5-3 hours	Photovoice was used, where participants took photos during the sessions and wrote captions reflecting their experiences.

Kotera & Fido (2022) Japan	Shinrin-yoku (forest bathing) was conducted by the researchers	The intervention lasted for 3 days: Day 1: 3 hours (including walking in the area) Day 2: 5 hours (water activities such as paddleboarding) Day 3: 5 hours (earth activities such as harvesting vegetables)	13 hours	The retreat included activities such as meditation, yoga, and nature observation.
Markwell & Gladwin (2020) Inggris	Shinrin-yoku (Forest Bathing) was conducted by the researchers.	It was conducted once a week for 4 consecutive weeks, with a total of 4 sessions.	4 hours	The forest videos were created by the researchers.
Guan et al. (2017) China	Shinrin-yoku (Forest Bathing) was conducted by the researchers.	10 May 2017	60 minutes	Forest bathing, where participants walk, observe, and enjoy the atmosphere of the forest

Table 3. Data extraction of intervention

Author, year, country	Design (Sample size)	Intervention (Case)	Instrument (outcomes)	Findings
Li et al., (2024) Japan	RCT was conducted with 31 participants who were randomly assigned to either group A or group B.	Forest bathing (shirin-yoku) (depression/depressive)	SDS for mental health	This study demonstrates that forest bathing (shinrin-yoku) has a significant positive impact on hormonal balance (serotonin, oxytocin, and IGF-1), reduces depression scores (SDS and POMS), improves sleep quality, and alleviates fatigue symptoms in women with depressive tendencies. These findings suggest the potential of forest bathing as a preventive measure against depression. Further clinical studies are needed to confirm the therapeutic benefits of this practice in managing depression.
Mazzario et al. (2024) Brazil	RCT A total of 81 students were divided into two groups, consisting of 70 females and 11 males.	Forest bathing (shirin-yoku) (mental health)	BRUMS for mental health	This study demonstrates that forest bathing significantly enhances the well-being of medical students by reducing negative moods. No significant differences were found between yoga practitioners and non-practitioners, but there was an imbalance in confusion levels between male and female students. First-semester students exhibited greater mood variability compared to fourth-semester students, who showed higher confusion levels. Further research with a more homogeneous sample and consideration of external factors is needed to ensure more accurate and generalizable results.



Wen et al. (2023) China	RCT A total of 12 participants, consisting of 6 females and 6 males, were assigned to the dynamic group, while 20 participants were assigned to the static group	Forest bathing dynamic <sup>a</sup> Forest bathing static <sup>b</sup> (physiological and psychological health)	BPOMS and PI for mental health	Forest bathing enhances physical and mental health by regulating the autonomic nervous system, increasing parasympathetic activity while reducing sympathetic activity. Static forest bathing benefits physiological health more, whereas dynamic forest bathing improves mental well-being. Gender differences exist, with greater psychological benefits for men and physiological benefits for women. These findings support incorporating forest bathing into healthcare strategies and urban planning. Further research is needed to optimize its benefits and deepen understanding of its mechanisms.
Keller et al. (2024) USA	Mixed methode 24 participants	Forest bathing (shirin-yoku) (mental well being )	WEMWBS for mental health and kuisiometer for mental health	In conclusion, forest bathing can be an effective tool for improving adolescent mental well-being, reducing anxiety and depression. As Anne Frank believed, nature provides comfort, which can be integrated into Social and Emotional Learning (SEL) programs. Requiring no special equipment, forest bathing offers a simple and beneficial way to help teenagers feel more calm, mindful, and connected.
Kotera & Fido (2022) Japan	Kualitatif The study included 25 participants, comprising 15 males and 10 females.	Shinrin-yoku (mental health)	PSS, PANAS, WEMWBS for mental health	A three-day shinrin-yoku retreat can provide lasting self-compassion benefits for Japanese university students facing mental health challenges. Despite some limitations, the findings highlight its potential as a cost-effective supplement to existing treatments. Future research should explore the optimal duration for clinically significant improvements.

Markwell & Gladwin (2020) Inggris	Mixed methode The study included 22 participants, consisting of 4 males and 18 females.	Shinrin-yoku (reduces stress and increases people's positive affect and well-being)	PSS, PANAS, WEMWBS for mental health	Recent findings suggest that shinrin-yoku reduces stress and enhances positive affect and well-being more effectively than digital applications. While its benefits were observed in Western cultures, not all measures showed significant effects. Engaging the five senses emerged as a key theme, warranting further research to better understand the underlying mechanisms.
Guan et al. (2017) China	RCT The participants were divided into three groups, with each group consisting of 20 to 30 participants.	Forest bathing (perceived nxiety )	Questionnaire on Anxiety for mental health	Our study found that urban forests reduce student anxiety differently. birch and oak forests eased academic, personal, and anxiety, while maple improved learning interest. birch relieved work stress, especially for heavier student, while oak benefited bathing enhanced learning interest and was most effective for heavier young adults

## Discussion

This systematic review confirms that forest bathing (Shinrin-yoku) has a positive effect on adolescent mental health, notably in enhancing well-being, reducing symptoms of depression and anxiety, and improving positive mood. Both dynamic and static forms of forest bathing have demonstrated psychological benefits, although static practices appear to produce more significant physiological responses (Wen et al., 2023).

Multiple studies consistently report that forest bathing significantly alleviates depressive and anxiety symptoms, especially among vulnerable populations such as university students and adolescents with preexisting mental health tendencies (Mazzarino et al., 2024; Langer et al., 2023). Zhou et al. (2019) emphasize that forests offer natural therapeutic environments for reducing anxiety, although the urban–rural distinction remains under-researched (Hansen et al., 2017). Urban forests, while accessible, may have different outcomes compared to rural or natural forest settings, warranting further comparative investigation.

Several studies support the role of forest bathing in stress reduction and psychological restoration. Li et al. (2024) report that exposure to forest environments reduces negative emotional states such as tension, anxiety, and depression. Similarly, Yeon et al. (2021) found that engaging in forest activities, such as walking or meditating among trees, fosters a calming and restorative experience, which contributes to long-term emotional stability. The presence of green, tranquil settings not only reduces stress but also promotes relaxation and improves mood (Janeczko et al., 2020). Guan et al. (2017) further highlight that specific tree species, particularly birch, are associated with enhanced anxiolytic effects.

Expanding on these findings, Doimo et al. (2020) argue that both natural and urban forests offer opportunities to improve public well-being, reduce healthcare costs, and create sustainable community-centered interventions. Such insights are further supported by Janowiak et al. (2021), who advocate for the integration of nature-based solutions in urban planning and health promotion.

Physiological mechanisms underlying forest bathing's effectiveness have also been documented. Kotera and Fido (2022) and Li et al. (2016) demonstrated increased serotonin and oxytocin levels following forest immersion, biomarkers closely associated with improved mental health. These findings are supported by Ochiai et al. (2015), who suggest that the forest environment modulates autonomic nervous system activity, reducing sympathetic responses while enhancing parasympathetic functioning, thus supporting cardiovascular health.

Wen et al. (2023) compared dynamic (active) and static (passive) forest bathing interventions, concluding that dynamic methods were more effective in reducing anxiety in males, while static sessions had greater emotional benefits for females. This suggests the need for gender-responsive approaches in designing forest therapy programs.

The educational relevance of forest bathing is also significant. Keller et al. (2024) demonstrated that integrating forest bathing into social-emotional learning programs improved sleep quality and reduced depressive symptoms among adolescents. However, Li (2022) provides a contrasting perspective, stating that while forest bathing can improve sleep quality, walking in urban environments may not offer similar benefits. Additionally, both activities were found to have limited effects on sleep initiation and maintenance.

Regarding methodological robustness, most studies employed standardized psychological instruments such as the Beck Depression Inventory (BDI), Generalized Anxiety Disorder Scale (GAD-7), and Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Mazzarino et al., 2024; Keller et al., 2024; Markwell & Gladwin, 2020). Physiological indicators, including cortisol levels and neurochemical markers, were measured in studies by Wen et al. (2023) and Guan et al. (2017), adding a biological dimension to psychological outcomes and enhancing the scientific rigor of these findings.

In terms of research design, most studies followed systematic procedures involving randomized or purposive sampling, division into control and intervention groups, pre- and post-intervention assessments, and the application of statistical analyses such as ANOVA or regression (Kotera & Fido, 2022; Mazzarino et al., 2024). These methodological frameworks ensure internal validity and reinforce the reliability of results.

Despite their strengths, several studies have limitations. For instance, Li et al. (2024) reported significant effects on serotonin and oxytocin, yet their small sample size and lack of participant diversity reduce the generalizability of findings. Guan et al. (2017) explored species-specific effects but highlighted inconsistencies in long-term outcomes. Wen et al. (2023) demonstrated gender-based differences in dynamic vs. static practices but faced challenges in controlling external variables. Similarly, Markwell and Gladwin (2020) and Kotera and Fido (2022) supported mental health benefits but had relatively small sample sizes, affecting external validity.

In the context of complementary nursing, forest bathing offers practical applications for improving mental health, particularly in patients with depression or anxiety. The practice has been shown to elevate serotonin and oxytocin levels, reduce fatigue, and enhance sleep quality. Moreover, forest bathing promotes social connectedness and self-awareness, key elements in holistic healing. Nurses can incorporate nature-based interventions into patient

care as low-cost, non-pharmacological strategies that enhance overall well-being (Li et al., 2022; Yeon et al., 2021).

In conclusion, the findings of this review demonstrate that forest bathing holds substantial potential for enhancing adolescent mental health. Although the efficacy of interventions may vary depending on demographic, environmental, and methodological factors, the overarching evidence suggests that Shinrin-yoku is a promising, accessible, and scalable approach to psychological well-being. Future research should focus on long-term impacts, individual differences, and optimizing protocols for specific populations. Moreover, integrating forest bathing into public health, education, and urban planning policies could yield broader societal benefits.

## **Conclusion**

The conclusion of this study affirms that the intervention of forest bathing (shinrin-yoku) has a significant impact on adolescent mental health, with strong evidence indicating a reduction in symptoms of depression and anxiety, as well as an overall improvement in psychological well-being. Through a systematic analysis of eight different studies, it was found that participation in forest bathing activities can facilitate a reduction in stress levels, improve sleep quality, and enhance mood, particularly in individuals experiencing high academic and social pressures.

This practice encourages adolescents to connect with the natural environment, which contributes to the enhancement of their mental and emotional well-being. Additionally, the results of this study indicate that the positive effects of forest bathing are not limited to psychological aspects but also include physiological components, such as a reduction in stress hormone levels and improvements in other mental health indicators. Therefore, it is essential to consider the integration of forest bathing into mental health and educational programs as a sustainable and cost-effective intervention strategy.

Further research is needed to explore the mechanisms underlying these benefits, including the specific roles of various elements of the natural environment and individual characteristics that may influence responses to the intervention. Additionally, broader studies with more diverse samples could provide a more comprehensive understanding of the potential use of forest bathing in the context of global mental health. Therefore, efforts to promote this practice among adolescents could serve as a strategic step in enhancing the mental well-being of the younger generation and creating a more supportive environment for their emotional and psychological growth.

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Not applicable.

## **Authors' contribution**

Each author contributed equally in all the parts of the research. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

## **Conflict of interest**

The researchers stated that there is no conflict of interest related to the implementation and publication of the results of this research. The entire research process, from planning,

data collection, analysis, to report preparation, was carried out independently without any influence or pressure from any third party. A commitment to research ethics is upheld throughout the research process, ensuring transparency, accuracy and honesty in reporting results. Respondents' participation was voluntary with informed consent, and their confidentiality and privacy were maintained in accordance with applicable research ethics standards. With this statement, researchers hope that the research results can be trusted and used as a valid reference for the development of science and health practices related to ethnomedicine and reproductive health.

### **Ethical consideration**

Not applicable.

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