

Review on the Development History and Health Mechanisms of Forest Therapy

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Abstract As a nature-based health promotion method, forest therapy has attracted widespread attention from both academia and society. This paper overviewed the development history of forest therapy, successful domestic and international experiences, as well as existing challenges and potential solutions, aiming to advance the field by exploring the underlying mechanisms and effects of forest therapy and thereby maximize its social value and provide more effective means to promote human health.

Keywords Forest therapy, Development history, Health mechanism, Research review

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In 2019, the National Forestry and Grassland Administration, the Ministry of Civil Affairs, the National Health Commission and the National Administration of Traditional Chinese Medicine jointly issued *Opinions on Promoting the Development of Forest Health Industry*. The document set a target of establishing 300 national forest wellness bases by 2022 and 1,200 by 2035, aiming to provide multi-level, diverse, and high-quality forest wellness services to the public and meet people's growing needs for a better life.

Forest therapy has become one of the ways to achieve harmonious coexistence between humans and nature in the context of Chinese modernization. Simply put, forest therapy is a form of treatment that involves temporarily immersing individuals in a forest environment to improve their physical and mental well-being. Its core idea is to recognize the positive impact of the natural environment on human health and to promote physical and psychological wellness through close contact with nature. Studies have shown that many people in modern society often face stress and anxiety, while the incidence of chronic diseases continues to rise. This makes people interested in finding natural healing power. As a non-pharmaceutical intervention, forest therapy offers a natural and feasible way to improve human health^[1–4].

Over the past few decades, numerous studies have demonstrated the positive effects of forest therapy on human health. The forest environment boasts better air quality, enriched with beneficial components such as negative oxygen ions and volatile organic compounds, which exert positive influences on the respiratory, cardiovascular, and immune systems. Meanwhile, visual and auditory stimuli in the natural environment, such as green vegetation and birdsong, have been shown to help reduce

stress levels, improve mental health, and enhance concentration. In addition, forest therapy offers a natural form of exercise, such as walking and outdoor activities, which contributes to improved cardiovascular health and muscle function^[5].

Although some studies have demonstrated the beneficial effects of forest therapy on human body, a comprehensive understanding of its specific mechanisms and outcomes remains relatively limited. Therefore, further research is still necessary to better understand the impact of forest therapy on human health and to provide a scientific basis for its application in clinical practice and public health policies. Through in-depth study on the potential mechanisms and effects of forest therapy, we can further promote the development of this field, maximize the social value of forests, and provide more effective means for promoting human health.

1 Development history of forest therapy

The world's first forest wellness base was established in the 1840s in the town of Bad Wörishofen, Germany, serving as a prototype for such forest wellness bases. It subsequently spread to countries such as Japan, South Korea, and other parts of Europe and the Americas, where distinct development models emerged based on each society's unique needs. In Germany, forest therapy is an activity that utilizes the forest environment and resources to promote physical and mental well-being, boasting a long history and extensive experience. It also gave rise to a series of forest-based therapies, notably represented by "Kneipp Therapy". By the 1980s, forest therapy in Germany had increasingly emphasized the role of forests in supporting medical treatment, leading to its designation as "forest medical care" and its gradual development into a national policy^[6–8].

Japan introduced the concept of "Forest Medicine" in 2006. The term "Forest Medicine" was first adopted in English in 2007 with the establishment of the Society of Forest Medicine. Internationally, the health benefits of forests on human body are referred to as "forest medicine". This interdisciplinary field examines the healing, wellness, health promotion, and recuperative functions of forests from a medical perspective. As early as the 1980s, Japan introduced forest therapy and was the first to propose its integration into a healthy lifestyle. The country also initiated systematic research to validate the effects of forest therapy. In 2001, Japan established a certification system for forest wellness bases and a qualification examination system for forest therapy instructors. To date, 62 forest wellness bases have been certified, and a relatively comprehensive forest therapy program system has been developed^[9–12].

South Korea began constructing natural recreation forests in 1988. To date, the country has established nearly 400 natural recreation forests, forest bathing sites, and forest wellness bases. In developed nations such as the United States and the Netherlands, the forest health industry similarly demonstrates a growing and vigorous momentum^[10].

However, in China, forest therapy is still in its early stages. In the 1980s, the concept of forest bathing was introduced to the country. In 2010, China's first "Indoor Forest Environment Rehabilitation Center", simulating a primitive forest environment, was unveiled in Shanghai. Subsequently, in 2013, the book *Forest Medicine* was translated and published in China. Since 2014, the Chinese government has released numerous policy documents to vigorously promote the development of the forest health industry. In 2016, the National Forestry Administration issued the "13th Five-Year Plan" for Forestry

Development, which explicitly called for vigorous promotion of forest therapy. Starting that year, pilot programs for forest wellness bases were launched nationwide, marking the official beginning of the forest health industry's development in China.

In 2019, the National Forestry and Grassland Administration, the Ministry of Civil Affairs, the National Health Commission and the National Administration of Traditional Chinese Medicine jointly issued *Opinions on Promoting the Development of Forest Health Industry*. By 2021, annual visits to forest wellness sites in China had reached nearly 500 million. Over the past decade, forest wellness activities have flourished in the country, and over 4,000 various types of forest wellness bases have been established, forming a new business model in the forestry and grassland sector during this new era^[13-14].

2 Forest environmental factors and their health benefits

Forest therapy factors include air negative ions and air particulate matter. The air quality in forests is generally superior to that in urban or industrial areas, owing to the absorption and filtration of air pollutants by forest vegetation. Meanwhile, forests exhibit higher concentrations of negative oxygen ions. These negatively charged oxygen ions are beneficial to the human body, improving immune function and emotional states. Additionally, the relatively high air humidity in forests helps moisturize the respiratory tract and maintain hydration, exerting a positive influence on the respiratory system. Relevant studies indicate that negative air ions in forests contribute to reducing stress hormone levels, enhancing mental health, and boosting immunity.

2.1 Forest environmental factors can improve air quality

Plant volatiles (Volatile Organic Compounds, VOCs) are also important environmental factors in forest therapy. The diversity of vegetation and the chemical composition of plants in forests play a significant role in the effectiveness of forest therapy. Vegetation diversity means that there are different kinds of plants in the forest, and the volatile organic compounds released by them can be beneficial to human body through inhalation or contact with skin. These volatile organic compounds possess biological activities such as antioxidant, anti-inflammatory, and antibacterial properties, which can reduce inflammatory responses, improve mood, and enhance immune function. Additionally, plants in forests absorb carbon dioxide and release oxygen, positively impacting

air quality. Studies have shown that, compared with urban environments, individuals in forest environments can absorb more plant volatiles, which contributes to lowering heart rate, reducing stress, and improving mental health^[15-18].

The human thermal comfort index, calculated based on forest microclimate factors (temperature, humidity, wind speed), is an indicator used to assess thermal comfort in specific environments. Applying this index in the field of forest therapy provides a scientific basis for evaluating and optimizing forest wellness activities. By measuring and assessing the human thermal comfort index, it helps to understand people's comfort levels in forest environments, thereby enabling better design and planning of forest therapy programs. Based on the evaluation results of the index, the forest therapy environment can be further optimized. Microclimate factors refer to temperature, humidity, illumination, and wind speed in forests, which are generally more comfortable compared with urban climates. Applying the human thermal comfort index in the field of forest therapy can play multiple roles, as its numerical values significantly influence the effectiveness of wellness outcomes. In experiments, these values can be used to intuitively assess whether people feel comfortable under such conditions. For example, more suitable environmental conditions can be created to enhance people's comfort by adjusting tree density and distribution, and controlling light exposure and ventilation. Meanwhile, improving comfort levels boosts the therapeutic effects of forest therapy. Human comfort is closely linked to therapeutic outcomes. Enhancing the comfort of the forest therapy environment can increase people's sense of pleasure and relaxation in the forest, thereby improving their physical and mental well-being, achieving better therapeutic results, and better meeting people's pursuit of health and happiness^[19-20].

2.2 Forest environmental factors can reduce noise index and improve sleep

The noise index is an indicator used to measure the noise level in the environment. Acoustic factors in forest environments often include the chirping of birds, the rustling of leaves, and the sound of flowing water. These natural sounds have a positive effect on human relaxation and recovery. Research has found that individuals in forest environments can experience the soothing effects of natural climate and sounds, which help reduce anxiety and stress levels while enhancing concentration and emotional state.

In the field of forest therapy, the noise index can significantly influence therapeutic benefits. Forests typically provide a relatively quiet

environment, free from urban noise and traffic sounds. The low level of the noise index reflects the tranquil atmosphere of forests, which is crucial for relaxation and mental calmness and helps to reduce stress and anxiety. Meanwhile, this serene environment contributes to improved sleep quality. The forest environment, free from urban traffic and industrial noise, can help improve sleep quality, thereby promoting physical and mental health. Noise interferes with the ability to concentrate, while in the quiet setting of a forest, people find it easier to maintain focus and attention. It is particularly beneficial for mental activities such as meditation, relaxation, and reflection. A forest environment with a low noise index contributes to enhanced physical and mental well-being. Studies have shown that prolonged exposure to high noise levels can have negative effects on the human body, including an increased risk of cardiovascular diseases and anxiety. Therefore, enjoying a quiet forest environment helps reduce these health risks. It provides people with a tranquil and comfortable environment for wellness, contributing to improved sleep quality, enhanced concentration, reduced stress and anxiety, and ultimately the promotion of physical and mental health. Consequently, in the planning and design of forest therapy programs, it is essential to consider and prioritize the impact of the acoustic environment on therapeutic benefits^[21-23].

In summary, the application of forest environmental factors in forest therapy has positive effects on both physical health and psychological well-being. Benefiting from the forest microclimate, high air quality, negative air ions, relatively tranquil acoustic environment, and plant volatiles, people can achieve an optimal forest therapy experience. The combined action of these environmental factors promotes mental wellness, enhances immune function, and reduces stress levels, offering an effective natural therapeutic approach.

3 Current research challenges and limitations

3.1 Lack of quantitative evaluation methods

Current studies predominantly rely on the harmonious evaluation of subjective feelings, lacking quantitative indicators and methods to evaluate the impact of forest environmental factors on human experiences. It limits the objectivity and scientific rigor of research findings.

3.2 Disconnection between site design and practical application

Some studies on forest therapy site design focus on theoretical exploration and model construction but lack close integration with

actual site design and implementation, resulting in insufficient practicality and operational applicability.

3.3 Insufficient diversity and comprehensiveness

Current research predominantly focuses on a single forest environmental factors or a single type of wellness activities, lacking comprehensive studies that integrate multiple factors and diverse therapeutic practices. It limits the ability to fully address the complexity and diversity of forest therapy site design.

3.4 Lack of systematic research methodology

Some existing studies lack a systematic research methodology, making it difficult to conduct comparative and comprehensive analyses. The absence of a unified research framework and evaluation indicators limits the comparability and generalizability of research findings.

3.5 Subjectivity in human perception evaluation

Assessment of human experience in forest environments often rely on individual subjective experience and questionnaire surveys, lacking objective and quantitative evaluation methods. There are also some problems such as small sample sizes. Consequently, research outcomes may be influenced by subjective biases, hindering an accurate understanding of the site design for forest therapy.

3.6 Insufficient comprehensive consideration of environmental factors

Existing studies often focus on isolated environmental factors, such as vegetation type, air quality, or natural sounds, while neglecting the complex interactions among these elements. Insufficient comprehensive consideration may result in design solutions that fail to fully leverage the potential benefits of forest environments for human wellness.

3.7 Issues of applicability and sustainability

Some research findings may be limited to specific regions or cultural contexts, lacking studies on their applicability for diverse areas and populations. Additionally, there is insufficient consideration for the sustainability of design solutions, as well as a lack of consideration for the long-term protection and utilization of forest resources.

4 Conclusions

In summary, research on the site design for forest therapy still faces several challenges and limitations. Current issues primarily include a lack of robust methodology, reliance on

subjective evaluation, insufficient integration of environmental factors, absence of long-term effect studies, and concerns regarding applicability and sustainability. Future research needs to more systematically design study protocols, and adopt objective evaluation methods comprehensively considering multiple environmental factors and focusing on long-term effects and sustainability, so as to promote the in-depth development of studies on the site design for forest therapy.

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