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Review

Forest Therapy in Germany, Japan, and China: Proposal, Development Status, and Future Prospects

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Abstract: Forests have provided support for human health and survival since ancient times. With improved public awareness of health issues and the importance of forest ecological functions, forest therapy has gradually gained momentum. Forest therapies have been applied around the world as preventive and alternative therapies to promote human health. As a safe, side-effect-free, low-cost, preventive, and alternative therapy, forest therapy has been scientifically proven to promote physical and mental health in humans. However, the forest therapy service system is still underdeveloped, and forest therapy has not become a mainstream part of clinical medical treatment methods in most countries worldwide. Therefore, in order to better present the development path and current situation of forest therapy in different countries and provide guidance for how other countries can develop similar interventions and clinical sites to base these activities, this study uses Germany, Japan, and China as examples to systematically tease out how forest therapy has developed and the status of forest therapy services in different countries, as well as the health benefits of forest therapy. Furthermore, the key components and traditional cultural and socioeconomic backgrounds related to forest therapy are discussed. Finally, based on published empirical research, we believe that forest therapy can be a solution to public health problems thanks to its multiple, medically proven health benefits. Forest therapy facilitates the return of people to the forest and nature to achieve health and well-being effects. However, there is a need for more research on the mechanisms (such as the immune system, endocrine system, nervous system, etc.) underlying forest therapy's effectiveness, which should include strengthened collaborations between disciplines. In addition, the role of forest therapy services in promoting human health needs to be emphasized.

Keywords: forest therapy; public health; health services; medical evidence; forest therapy service systems

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1. Introduction

On our blue planet, the color *green* has always held special significance for human beings: in almost all cultural systems, *green* represents hope and health. Humans' respect for *green* seems to stem from the reliance of ancient humans on their natural environments and is deeply ingrained in our genes and culture, which have been passed down to us over countless generations [1]. Wilson, a North American biologist, described it as "biophilia", arguing that humans have an internal emotional connection with other creatures, that nature is attractive to humans, and that this feeling is innate [2]. As the source of greenness worldwide, plants form two main continental ecosystems: forests and grasslands. Due to their higher species and structural diversities, forest ecosystems have more diverse functions that humans can access, giving forests higher levels of utilization. In the early days of human evolution, humans lived in forests and searched for food and fresh water from them, and cut down trees from them to build shelters. At the same time, certain features of the human body evolved to make them better adapted to forests, such as the front-facing positioning of the eyes and the space between the thumb and fingers for improved hand-eye coordination, grasping, climbing trees, and jumping in the jungle.

Moreover, the imitation of sounds in forests gradually evolved into music, which had an important influence on the evolution of human culture [1]. Therefore, throughout our history, the survival and evolution of humans and human cultures have been inextricably linked with forests.

With the development of civilizations and progress in human societies, the ecological capacities of forests to sustain human health and well-being have become increasingly important relative to traditional services, such as wood supply and so on [3]. In recent years, forest therapy has gradually emerged globally as an important representation of the health and well-being of forests and has been used in adjuvant therapy activities to enhance human treatments [4,5].

Forest therapy has been defined as 'immune-strengthening, disease-preventing and health-promoting activities utilizing various elements of forest' [6,7]. As a safe, side-effect-free, low-cost, preventive, and alternative therapy, forest therapy has been scientifically proven to promote physical and mental health in humans [8–13]. People receive health benefits from forests through short-term, rational forest therapy activities or even just exposure to forests [14]. When immersed in forests, people will unconsciously feel free and relaxed, and their spirit will be uplifted and energized. Physiological index data have also shown that exposure to forests significantly reduces blood pressure and heart rate, enhances the activity of the parasympathetic nerve, reduces the activity of the sympathetic nerve, and improves the activity of the immune system [15–17].

Against the backdrop of accelerating global urbanization, deepening population aging, and the growing financial burden placed on health care service systems, the role of forest therapy services, driven by evidence-based research, is gaining in popularity among health-promoting activities [18,19]. This non-drug adjuvant therapy activity has gradually become an important means of relieving sub-health, lifestyle diseases, and somatic complaints [20]. Furthermore, exposure to forests is beneficial to the physical and mental health of the public. However, the forest therapy service system is still underdeveloped, and there is a lack of widely recognized industry norms on how to effectively carry out forest therapy activities. Further, due to the limitations of medical systems, public awareness, traditional treatment concepts, and other factors, forest therapy has not become a mainstream part of clinical medical treatment methods in most countries worldwide. These factors limit the service capacity and effectiveness of forest therapy for human health purposes.

At present, forest therapy in different countries presents different development characteristics and paths. Among countries worldwide, Germany has one of the longest traditions of using natural factors to promote human physical and mental health, and relevant practices have matured, which has a strong significance as a reference for other countries to carry out the application of relevant forest therapy. Supported by relevant medical evidence, scientific research in Japan has developed certification procedures for therapy bases and therapists, and other aspects have been improved. In China, research on forest therapy mechanisms is being carried out continuously and supported by relevant national policies, basic research and industrial development have developed rapidly, forming good prospects for the future [6]. Meanwhile, in terms of time series, these three countries are at different developmental stages. In the 19th century, Germany began to pay attention to the role of nature in promoting human health, and in the middle and late 20th century, its practices could be considered mature. Japan began to pay attention to the health benefits of forests in the 1970s and in the late 20th century and early 21st century, supported by medical evidence, gradually formed a systematic model for forest therapy industries [21,22]. It was in the 2010s that China began to pay real attention to the direct effects of forests on human health. Based on the lessons learned during the development experiences of other countries, related service activities are developing rapidly in China [6].

Therefore, in order to better promote in-depth research on the mechanisms of forest therapy and improve the forest therapy service system, this study focused on Germany, Japan, and China as examples. This study systematically examines the developmental processes of forest therapy in each country, focusing on the traditional cultural and socioe-

conomic backgrounds in which forest therapy is based. Finally, this study puts forward future prospects for developing and improving forest therapy. This provides priority research directions for forest ecology, forest medicine, and forest management related to forest therapy. Further, it offers development directions and references for forest therapy service systems (base construction, industry norms, professional qualifications, service methods, etc.).

2. Germany

2.1. History of Forest Therapy in Germany

2.1.1. German Forest Culture

In Germany, well-known methods and concepts for forest management such as close-to-nature management and multi-functional management are utilized. The health benefits gained from landscape recreation and the social well-being provided by forests are held in high esteem by the public, which also reflects the deeply engrained symbiotic relationship between Germans and forests. The first humans to arrive or live in Germany were Neanderthals (about 400,000 to 40,000 years ago), followed by modern *Homo sapiens*. Over long evolutionary processes, these species adapted to live in or near forests as hunter-gatherers due to the easy access to food from forests [23]. In this period, forests and humans in Germany, and even Europe, had demanding but relatively harmonious social relationships.

Subsequently, after several major climatic fluctuations, the modern Germanic people gradually developed a tribal civilization in the struggle for survival under climatic challenges. As civilization developed, lifestyles evolved, and hunter-gatherers gradually became farmers. The sedentary lives enabled by farming required land and shelter, which, in turn, required the destruction of forests for wood and the development of space. Therefore, by the 14th century AD, forest coverage in Germany was only about 25% [18]. Over time, people became increasingly aware of the environmental problems caused by deforestation, and the destruction of forests gradually decreased. Indeed, since the 19th century, the forest area in Germany has not shrunk further. In the 20th century, with the end of the war between Europe and Germany, the Germans carried out large-scale afforestation operations using tree species such as spruce, fir, and pine. After more than half a century's effort, Germany's forest cover had reached about 30% in 2010 and 32% in 2018 [18].

Based on how social development in Germany was closely related to forests, it follows that there is a close relationship between forests and human beings in Germany, and the forests reflect and contribute to the development of German society with their own rise and fall. Naturally, the various relationships between humans and nature have become an important part of German culture.

2.1.2. Germany's Tradition of Integrating Nature into Health Care

In Germany, there is a long history of using nature to promote health. One of the most well-known methods is hydrotherapy. As early as the Roman Empire, Europeans have known of the medicinal properties of hot springs and mineral springs. These spa wellness traditions were ubiquitous across Europe during the Middle Ages and were especially popular in Germany. In the 19th century, with the deepening of the industrial revolution throughout Europe, as a form of industrialization, many areas centered on hot springs became high-end resorts. During this period, hydrotherapy, with Sebastian Kneipp as the main representative and advocate, gradually became a normative health regimen that was accepted and recognized by the public [24]. After establishing the tradition of spa-based therapy, forest-based therapy modes (such as climate therapy, topographic therapy, etc.) gradually became popular in Germany. At the beginning of the 20th century, affected by the Second World War and the subsequent social recovery, water and nature-based therapeutic activities in Germany stagnated for a time. However, a large number of nature-related films, poems, and other literary and artistic works were still being created in the cultural field that reflected the longing of German society for forests and their hope to obtain spiritual healing from them. Nowadays, people rely on nature to carry out leisure activities and holidays

to prevent disease and promote health. This is a healthy habit that has been formed in Germany and is favored by the people.

2.1.3. Proposing Forest Therapy

Germany has a relatively comprehensive medical system. According to statistics, in terms of per capita expenditure on prescription drugs, the annual expenditure per capita in Germany is about 777 USD, and the number of hip surgeries per 100,000 people is 299.3 [18]. This reflects the universality and efficiency of the German health care system but also raises concerns about medical costs. Furthermore, the German health care system is also facing problems linked to its aging population.

In the face of the health problems and the need to further improve the medical system, as non-drug health care methods become more and more prevalent, our understanding of natural therapy practices is increasing and their use better implemented. Forests as alternative medicine have been brought to the public's attention in recent years because it is promising, enjoyable, and low-cost. These therapies are gaining in popularity despite there currently being no rigorous scientific (especially medical) evidence to support their beneficial effects.

2.2. Research Progress and Application of Forest Therapy

2.2.1. Progress in Evidence-Based Research

In Germany, some activities are well developed for promoting human health. In recent years, with the increasing attention to the health benefits of forests and the deepening of research on the relationship between forests and human health, some supporting evidence has been obtained. Kabisch et al., 2021 took 33 elderly people (aged 63.5 $\pm$ 4.2) as their research object and analyzed the effects of short-term visits to three kinds of environments (a long-standing urban park, a newly developed park, and a busy street environment) in the inner city of Leipzig, Germany, on their physiological and psychological states. Their statistics showed that in the long-standing urban park, systolic and diastolic blood pressure indicators were significantly reduced, indicating a protective effect on cardiovascular health, with the natural and restoration experiences being perceived most strongly, reflecting common theories on restoration. In the busy street environment, heart rate variability parameters were significantly reduced, suggesting an adverse effect on cardiovascular health. Their research confirmed that visiting urban green spaces can be a valuable preventive measure that promotes cardiovascular health in older adults [17]. Kühn et al., 2021 conducted another study on the effect of urban green space around residences on the brain structure of the elderly. Their study analyzed the brain structures of 207 elderly people (average age of 70.1 years) using MRI images and then used mapping data to analyze the green space surrounding the area where the subjects lived. The results showed that urban green space areas were significantly positively correlated with the volume of the perigenual/subgenual anterior cingulate cortex (p/sACC) in the brain. Other studies have demonstrated that the volume of p/sACC is reduced in the brains of patients with severe depression. Their research suggested that urban green spaces have an important potential mental health value [25]. Another study on the health and well-being of older adults in Berlin, Germany, also showed that older people with close social networks used urban parks more often than those who were more isolated in their daily lives, reflecting another ecological service from urban green spaces that impacts residents' health [19].

2.2.2. Forest Therapy Services

As mentioned above, Germans have been using nature to promote human health for centuries, especially through naturopathic activities such as hydrotherapy, which are recognized by the law and health care systems. Meanwhile, Germany has always paid attention to the human life health services provided by forests and has a tradition of using forests to promote health, and also focuses on identifying health-related benefits of forests. At present, there are many well-established types of outdoor activities that can

promote physical health (such as recreation, vacation, camping, hiking, etc.). However, forest therapy as an independent therapeutic activity is not well known to the general public or researchers.

In terms of specific practices, Germans recognize the health-promoting effect of forests and also agree that "being in the forest means freedom and healing" [18]. In Germany, however, forest therapy activities carried out by individual subjects in forests have not received extensive medical or legal support. At present, nationwide in Germany, the effects of forest therapy on human health are being researched and established, and relevant specific operating guidelines are also being established and certified. The ultimate goal is to incorporate forest therapy as an auxiliary therapy within the national health care system.

3. Japan

3.1. Development of Forest Therapy in Japan

3.1.1. Japanese Forest Complex

Japan is an island country with a large population and a relatively small land area, but it has many forest types and is rich in forest resources, which account for 66.4% of the country's land area. In Japanese culture, forests have always been valued for their cultural significance and health effects, and forests are regarded as the place where gods reside. The country has always paid attention to the protection and rational use of forests emphasized the connection between humans and nature and has made note of the roles of natural environments in the occurrence and recovery of human disease [1].

3.1.2. Transformation and Development of Japanese Forests

In the early and mid-1970s, with changes in the international timber import and export trade, the import volume of cheap foreign timber increased, and it became increasingly used in the Japanese woodworking industry. In addition, with the development of the Japanese economy, labor costs increased significantly, and the demand for domestic wood continued to decline. For a period of time, how to best use and protect forests became the focus of debate. Subsequently, the awareness of the non-timber value of forests was elevated.

3.1.3. Proposition of Forest Bathing (Shinrin-Yoku) and Promotion of Health Concepts

In this context, in 1982, the Secretary of the Japanese Forest Agency Tomohide Akiyama first proposed the term "forest bathing (Shinrin-yoku)" [21]. After which, the term "forest bathing" saw wide use, defined as: "absorbing the forest atmosphere and feeling the power of the forest through five senses" [12,22]. After that, under the promotion of the Forestry Agency, the beneficial health effects of forests were gradually accepted by people. Basically, the public came to recognize the importance of forests to human health. According to a public opinion survey conducted by the Cabinet Office, the proportion of people who expressed willingness to go to the forest for health and well-being increased from 12.2% in 1992 to 15.5% in 1999 and 26.4% in 2003 [22].

However, over this roughly 20-year period, no direct link between forests and human health was scientifically established. This was because the primary focus of research during this period was on the substances present in forests that contributed to human health. Many initial studies paid attention to the negative air ions in forests and carried out studies on the impact of increasing the concentration of negative air ions in the environment on human health. Watanabe et al., 1997, measured the effect of the negative air ions on the human body by increasing the concentration of negative air ions in a sauna room and showed that in the sauna room with negative ions, the surface temperatures of the forehead, hands, and legs were significantly higher than in the sauna room without negative ions. This resulted in the subjects in the sauna with ions having significantly more sweat and higher pulses than those in the sauna without negative air ions. Studies have confirmed that the presence of negative air ions can amplify the effects of sauna on the human body [26]. Ryushi et al., 1998, studied the effect of negative air ions on the recovery of physiological responses after moderate endurance exercise. Their work showed that exposure to negative air ions during

the recovery period after moderate endurance exercise reduced the diastolic blood pressure and serotonin and dopamine levels [27]. Similarly, other ecological service functions of forests (such as water purification, water conservation, climate regulation, etc.) have been focused on by numerous researchers. For example, Ca et al., 1998, studied the effect of Tama Central Park in Tama New Town, west of Tokyo, Japan, on the summer climate of the nearby area. At noon, the maximum temperature of the grass-covered ground in the park was 40.3 °C, which was 19 °C lower than that of the asphalt pavement and 15 °C lower than the concrete temperatures in a parking lot and a commercial area. At a height of 1.2 m, the air temperature of the grass area in the park was 2 °C lower than that of the surrounding commercial areas and parking lots. A park with an area of about 0.6 km^2 can reduce the air temperature by 1.5 °C at noon and can produce a cooling effect as far as 1 km downwind [28]. Despite the existing research, the health effects of forests in this period have not been effectively demonstrated, which means its functions have not been fully utilized, and the service value generated by forests accounted for a relatively small proportion of the entire forestry industry in Japan during that period.

3.1.4. Establishment of Forest Medical Evidence

Subsequently, with our deepening understanding and recent innovations in research methods, forestry personnel have gradually begun to carry out interdisciplinary cooperative research with medical personnel to establish scientific evidence linking forests and human health. In the first decade of the 21st century, a large amount of evidence-based medical research was published that confirmed the effects of forest environments on human health. Medical studies have shown that short-term (1 day, or 2-nights/3-days) forest bathing can have an impact on the body's stress levels. The concentrations of cortisol in the blood samples and the concentrations of adrenaline and noradrenaline in urine were significantly reduced, and the reduction in stress hormone levels lasted for 7–30 days after the trip [13,29–31]. Meanwhile, adding phytoncide in a hotel room can have the same effect on stress hormones [32]. Li et al. studied natural killer (NK) cells, which are an indicator of human immune system status, during forest bathing and observed significantly enhanced activity and quantity of NK cells, along with increases in the intracellular anticancer protein level. Furthermore, this effect lasted for at least 7 days after the forest bathing activity was completed, and further study showed that the elevated NK activity can persist for more than 30 days. These studies have clearly shown that forest bathing can benefit human immune function. Studies have also speculated that phytoncides released by trees may be partly responsible for the increased NK activity [12,13,30–34]. Li et al., 2008, also examined the relationship between forest cover rate and cancer mortality and revealed significant negative correlations between forest cover rates of all prefectures in Japan and the mortality due to lung, breast, and uterine cancer in women and prostate, kidney, and colon cancer in men [35]. Subsequent studies on the effects of forest bathing on physical and mental health were carried out; the results showed that, compared with urban environments, forest environments can reduce the concentration of cortisol, reduce pulse rate, lower blood pressure, increase parasympathetic nerve activity, and decrease sympathetic nerve activity. In addition, forest bathing significantly increased the score for vigor and decreased the scores for depression, fatigue, anxiety, and confusion [10,30,36]. These studies in Japan, conducted with the medical community, have provided scientific evidence for the relationship between forests and human health.

3.2. Research Progress and Application Status of Forest Therapy

3.2.1. Progress in Evidence-Based Research

In the last decade, certain institutions and researchers in Japan have continued to carry out evidence-based research on the effect of forests on human health. However, their research objects are more diverse, and the methods are more systematic. Through this research, the health-promoting effects (e.g., lowering blood pressure, relieving stress, reducing anxiety levels, improving depression level, enhanced positive emotions, etc.) of

forest therapy on different groups (healthy adult people, middle-aged women, middle-aged men with hypertension, people with depressive tendencies, etc.) have been scientifically demonstrated [8,14,37–41] (see Table 1).

Table 1. Description of study sample populations, stratified by study design in Japan.

Health Effects of Forest Therapy	Population and Sample	Natural Space Exposure Type	Health Outcome	Citation
Immune system	12 healthy male subjects (aged 35–53 years).	Walk for 2 h in the morning and afternoon, respectively, in the forest park.	The day trip to the forest park significantly increased NK activity, and the numbers of CD16(+) and CD56(+) NK cells, perforin, granulysin, and granzyme A/B-expressing NK cells and significantly decreased CD4(+) T cells.	Li et al. [13]
	13 healthy nurses (age 25–43 years).	A 3-day and 2-night trip to a forest.	The forest bathing trip significantly increased NK activity and the numbers of NK, perforin, granulysin, and granzymes A/B-expressing cells and significantly decreased the percentage of T cells. The increased NK activity lasted for more than 7 days after the trip.	Li et al. [31]
Blood pressure and heart rate	155 working-age people (18–59 years) with and without depression tendencies.	One-day forest bathing activities.	After forest bathing, the systolic blood pressure, diastolic blood pressure, and other indicators significantly decreased in all participants.	Furuyashiki et al. [8]
	20 middle-aged hypertensive patients (age 58.0 ± 10.6 years).	Short (17 min) forest walks.	The high-frequency component of HRV was significantly higher when walking in the forest compared to walking in the city, and the heart rate was significantly lower when walking in the forest as well.	Song et al. [14]
	16 healthy middle-aged subjects (57.4 ± 11.6 years)	Walked for 2 h in the morning and afternoon.	The day trip to the forest park significantly reduced blood pressure by reducing sympathetic nerve activity.	Li et al. [30]
Autonomic nerves	22 adult male college students (age 21.2 ± 0.9 years).	A field experiment for 3 days and 2 nights.	Compared with an urban environment, the forest environment significantly increased parasympathetic nerve activity and significantly inhibited sympathetic nerve activity.	Lee et al. [37]
	48 male college students (age 21.1 ± 1.1 years).	Short-term (15 min) forest view.	In the forest landscape, subjects had significantly higher parasympathetic activity and significantly lower sympathetic activity.	Tsunetsugu et al. [38]

Table 1. *Cont.*

Health Effects of Forest Therapy	Population and Sample	Natural Space Exposure Type	Health Outcome	Citation
Stress hormones and psychological effects	13 healthy nurses (age 25–43 years).	A 3-day and 2-night trip to a forest.	The forest bathing trip significantly decreased the concentrations of adrenaline and noradrenaline in urine.	Li et al. [31]
	19 middle-aged male subjects (age 51.2 ± 8.8 years).	One-day forest walking activities.	Forest walking significantly increased the score for vigor and decreased the scores for depression, fatigue, anxiety, and confusion. Urinary adrenaline after forest bathing showed a tendency toward decrease.	Li et al. [36]
	9 middle-aged men (age 56 ± 13.0 years) with hypertension.	Forest therapy was performed for 4 h and 35 min.	Adrenaline and cortisol were significantly lower than baseline levels ($p < 0.05$). After a walk in the forest, subjects reported feeling significantly more relaxed, with significantly lower scores regarding negative mood and total mood disturbance.	Ochiai et al. [40]
	17 middle-aged women (age 62.2 ± 9.4 years).	Multiple timed forest therapy activities over 4 h and 41 min.	Forest therapy significantly reduced salivary cortisol levels and negative emotions and increased positive emotions.	Ochiai et al. [41]

3.2.2. Forest Therapy Services

Driven by these scientific studies, Japan's forest therapy industry has developed rapidly in the last decade. In 2008, the Forest Therapy Society of Japan was established; it is a nonprofit organization (NPO) that specifically aims to monitor the latest relevant research results and actively publicize and promote them to the public. The scope of the Forest Therapy Society includes holding scientific seminars, training forest therapists, administering qualification examinations for forest therapists and forest guides, compiling teaching materials, and certifying forest therapy bases and forest therapy paths, among others [22]. That is, under the promotion of the Forest Therapy Society, forest therapy has developed into a mature industry in Japan.

Based on the evidence available regarding forest medicine, and under the promotion of the Forest Therapy Society, the government, and other institutions, Japan has formed a relatively complete certification system for forest therapy bases and forest therapists. Since 2005, Japan has started planning and certifying forest therapy bases. Between 2005 and 2008, 35 forests were approved as forest therapy bases, and that number increased to 42 by 2010 [22]. By 2020, the number had increased to 65, and a complete certification system for forest therapy bases had been established.

4. China

4.1. Evolution of Forest Therapy in China

4.1.1. Ideological Origin of Forest Therapy

The philosophical discussion on the relationship between humans and nature dates back to ancient times in China. Pre-Qin Taoism is a fundamental source of traditional Chinese ideology, and it contains ecological wisdom about the relationship between human health and nature that gave birth to traditional ecological concepts. Lao Tzu's ideas of "harmony between man and nature" and "Tao follows nature" encourage people to learn from and respect nature. Zhuangzi believed that nature is the mother of all things. All these philosophies suggest that people integrate their minds into nature, achieve spiritual sublimation, and achieve harmony between humans and nature. In traditional Chinese medicine, plants and nature are used as healing materials or backgrounds to promote human health. "The Yellow Emperor' Internal Classic" encourages "nourishing yang in spring and summer, while nourishing yin in autumn and winter" and advocates that nature,

life, and culture are mutually restricted and restrained [6]. As all living things, human beings need to adapt to nature so as to find spiritual harmony and make unceasing progress.

4.1.2. Changes in the Modes of Forest Utilization

Under the influence of traditional Chinese health care ideas, with the improvement of the country's social and economic level and the advancement of science and technology since the 1980s, people have focused on the ecological service functions of forests, such as fixing carbon and releasing oxygen, purifying the air, cleaning water, relieving fatigue, and regulating emotions, and people have gradually come to realize the benefits of substances in the forest (such as phytoncide, negative air ions, etc.) and their health effects. Meanwhile, people have begun to consciously use these substances to improve human health as a number of research papers providing evidence for their benefits have been published in Chinese. During their development over the decades around the turn of the century, the health benefits of forests have mainly been explained from the perspective of forest utilization, while scientific and systematic monitoring and the evaluation of the beneficial substances in forests have not been conducted, resulting in a lack of scientific evidence for the medical relationship between forests and human health. The development during this period can be said to be an extension and further development of the country's existing traditional ecological health care ideas. This perspective has a certain scientific research awareness but has not formed a comprehensive scientific system for forest therapy research.

4.1.3. Proposition of the Concept of Forest Therapy

It was not until the beginning of the 21st century that quantitative studies from the perspective of human comfort examined the microclimate characteristics of forests and green spaces and their impact on human outdoor comfort [42,43]. Some scholars quantitatively monitored the concentrations of specific individual beneficial substances (such as negative air ions) in forests and their temporal and spatial distributions [44,45]. Meanwhile, medical researchers began to study the role of forest activities as adjuvant treatments for certain chronic diseases in humans. For example, Mao et al., 2012 examined healthy college students (aged 20.79 $\pm$ 0.54 years) as subjects as they carried out activities in evergreen broad-leaved forest and urban environments and measured physiological indicators reflecting inflammation, stress response, and oxidative stress before and after the activity (such as malondialdehyde, interleukin-6, serum cortisol, plasma endothelin, etc.) while simultaneously monitoring emotional state using the profile of mood state (POMS) method to comprehensively evaluate the impact of forest environments on health. Their data showed that subjects who conducted forest environment activities exhibited significantly reduced levels of oxidative stress and inflammation, lower scores for negative emotions, and increased scores for active emotions. Studies have shown that, through effective forest activities, the risk of cardiovascular disease can be reduced, the immune system can be bolstered, and bad moods can be improved [46].

On the foundations established by these scientific studies and the improved public health awareness, the Foreign Cooperation Center (FPCC) of the State Forestry and Grassland Administration (SFGA) (formerly the State Forestry Administration, SFA) and the Beijing Municipal Bureau of Landscape and Forestry (BMBLF) began introducing and promoting the concept of forest therapy developed in Japan in 2012 and translated and published the book "Forest Medicine" in Chinese in 2013 [6]. At the National People's Congress and Chinese People's Political Consultative Conference (NPC and CPPCC) in 2013, the then director of the Hunan Provincial Forestry Department, Deng Sanlong, who was then a representative to the NPC, submitted a proposal to the conference entitled "Proposal for Vigorously Promoting Green Supply", which called on the country to vigorously develop the forest therapy industry. Since then, the term "forest therapy" (described as "森林康养" in Chinese) has been used officially in China.

Overall, the emergence of the concept of forest therapy in China is not an entirely new invention of modern people but derived from history and based on China's extensive

traditional ideologies and culture, which adhere to consistent and positive ecological concepts. Driven by scientific research, the introduction of forest therapy has altered people's health awareness, making use of forests, plants, and natural environments as "good medicine" for the auxiliary treatment of common diseases. This has encouraged people to use forests to achieve the effect of "preventing diseases before and curing existing ones" to improve their health.

4.2. Research and Application Status of Forest Therapy

4.2.1. Relevant Research Progress

In the past ten years, people have conducted systematic research into forest ecological service functions related to human physical and mental health. The monitoring factors have become more comprehensive and monitoring methods more advanced. Scientific evidence has shown that the ecological service functions of forests include fixing carbon and releasing oxygen, noise reduction, and regulating comfort [47–50]. A survey of carbon stocks in China's terrestrial ecosystems conducted from 2011 to 2015 estimated that the total carbon pool made up of four ecosystems (forests, shrublands, grasslands, and croplands) was 79.24 ± 2.42 Pg C, and forest biomass has a sequestration potential of 1.9–3.4 Pg C in the next 10–20 years, assuming no removal, mainly due to forest growth [47]. Another study estimated carbon fixation and oxygen release from 2000 to 2015 using the Carnegie Ames Stanford Approach model (CASA) in the Guangdong–Hong Kong–Macao Greater Bay Area. The results showed that 91.03% of carbon sequestration and oxygen release by terrestrial ecosystems in the area was in forest and farmland ecosystems, and the evolution of terrestrial ecosystems (urban land encroachment on farmland and grassland) during 2000–2015 has resulted in the carbon sequestration and oxygen release in the region, decreasing by 53.49 and 518.65 Gg, respectively. Studies have observed forest coverage to have a strong positive correlation with carbon sequestration and oxygen release, indicating that increases in forest cover will benefit carbon sequestration and oxygen release in ecosystems [49]. Zhang et al., 2021, established a monitoring platform in Xixi Wetland to conduct long-term continuous monitoring of the microclimate and compared it with a control point in downtown Hangzhou. The temporal dynamics of the microclimate and thermal comfort index were quantified, which showed that wetland parks effectively alleviate the urban heat island effect and dry island effect in summer. In addition, wetland parks provided ecological services that alleviated the cold island effect at noon in winter. What is more, wetland parks had the strongest effect on improving comfort during the daytime during the hot season and at noon in the cold season. Finally, the study also noted that in hot weather, citizens should take appropriate protective measures when going to visit parks and try to carry out recreational activities in the morning or evening [50]. In terms of the effect of forest environments, their positive effects on various aspects of human health (especially mental health, such as lowering blood pressure and heart rate, relieving anxiety, restoring perception, improving mental state, etc.) have been observed in recent research, as summarized in Table 2 [5,15,16,51–53].

4.2.2. Forest Therapy Services

Based on relevant research, the forestry department in China has taken the lead in developing the concept of forest therapy and practical work in terms of promoting and provisioning ecological services that rely on the high-quality forest environments in national forest parks, nature reserves, scenic spots, and state-owned forest farms and collective forest farms. This department strives to improve the health of people and continuously meet the growing needs of people for improving lives by providing beautiful health care environments, safe forest food, and high-quality health care services. Between 2016 and 2021, the "National Forest Therapy Base" (described as "国家森林康养基地" in Chinese) selected by the Forestry Industry Federation (FIF) has undergone seven phases, and a total of 958 units have been designated as pilot units for the national forest therapy bases. At present, the identification of the "2022 National Forest Therapy Pilot Base" is ongoing.

Table 2. Description of study sample populations organized by study design in China.

Health Effects of Forest Therapy	Population and Sample	Natural Space Exposure Type	Health Outcome	Citations
Immune system	20 chronic obstructive pulmonary disease (COPD) patients (age 61–69 years)	Three-day trips to forest and urban areas.	In the forest group, there were significant decreases in perforin, granzyme B expressions, and the levels of pro-inflammatory cytokines.	Jia et al. [53]
Blood pressure and heart rate	120 university students (age 19–24 years).	Three-day bamboo forest therapy.	Blood pressure and heart rate decreased after three days of bamboo therapy viewing and walking activities. Viewing activity had a more pronounced effect on heart rate reduction in college students, producing significantly lower systolic blood pressures and heart rates in women.	Zeng et al. [5]
	1498 middle-aged people (age 51.66 ± 15.58 years).	Stayed in the park area for 0.5–8 h.	Compared with before entering the forest environment, both the systolic and diastolic blood pressure had decreased significantly by the time subjects left the forest ($p < 0.001$).	Chu et al. [51]
Stress hormones and psychological effects	43 adult college students (age 19–23 years).	Three-day forest bathing activities.	Urban forest parks alleviated anxiety caused by financial state ($p = 0.0028$), exam-pass pressure ($p = 0.0040$), and love-affair relationships ($p = 0.0286$), while rural forest parks only alleviated anxiety from financial state ($p = 0.0222$).	Zhou et al. [15]
	364 young people (age 23 ± 4.6 years).	A speed-controlled slow walk for 15 min.	Short walks on urban roads surrounded by Metasequoia, Sakura, and London plane significantly reduced negative psychological factors, such as tension, fatigue, confusion, and anxiety. In addition, the recovery effect and vitality of participants were higher after walking on roads with Metasequoia trees and Sakura.	Elsadek et al. [16]
	96 college students and social workers (age 24.03 ± 5.29 years).	View seven representative forest environments through virtual reality (VR) videos.	The seven different types of forest environments all produced some degree of stress relief. Among them, the environment with the highest degree of naturalness did not have the strongest stress relief effect, while water features had a positive effect on stress relief.	Wang et al. [52]

With the further enhancement of national ecological awareness and improved recognition of health needs, other departments, in addition to forestry, have begun to pay attention to the health benefits provided by forest therapy and have actively cooperated with the forestry department to jointly promote various channels such as legislation and policy recommendations to promote the development of the forest therapy industry. In March 2019, the SFGA, the Ministry of Civil Affairs (MCA), the National Health Commission (NHC), and the National Administration of Traditional Chinese Medicine (NATC) jointly issued the "Opinions on Promoting the Development of Forest Therapy Industry" [6]. Guided by this, 96 forest therapy bases were selected among the national forest therapy bases (i.e., the first batch) in 2020. At the same time, in Beijing, Hunan, Sichuan, Zhejiang, Shanxi, and other provinces and cities, multiple departments have also jointly realized the construction and promotion of provincial forest therapy bases. Furthermore, Beijing Forestry University and Fujian Agriculture and Forestry University both offer classes and majors in forest therapy.

At present in China, forest therapy combined with other green activities such as forest tourism, forest health preservation, forest leisure, and forest education has become a new healthy life activity and is increasingly sought after by more and more people.

5. Conclusions and Outlook

5.1. Health Benefits of Forest Therapy

In an overview of evidence-based research in three countries, the multiple health benefits of forest therapy in humans, such as immune system, blood pressure and heart rate, autonomic nerves, stress, etc., have been medically proven and are gender-independent [10,13,31,36,40,41,51]. In particular, there is growing evidence on the effects of forest therapy on reducing stress hormones in the body, and studies have shown that guided therapy activities play a key role [54,55], which is of great value in scientifically elucidating the mechanism of forest therapy for reducing stress. However, it is undeniable that the effects of forest therapy on the endocrine and nervous systems need to be further studied. In addition, the mechanism of therapeutic guidance, forest type, trail type, and other factors in the course of adjuvant therapy is still unclear. Encouragingly, a number of researchers have tried to answer this research question by examining humidity, phytoncides, air quality, and other factors, as well as by comparing the different effects of managed and less managed forests and different planting schemes (e.g., bamboo vs. birch vs. maple, etc.) [5,31,56,57]. Although the results are still limited and more studies are needed to directly compare the effects of forest therapy in different environments, these efforts are valuable. There are also differences in the research among different countries. For example, compared with the research in Japan, the detection research on human medical indicators in China is not sufficient. There are few studies on immunity, autonomic nerves, and stress hormones, but more studies on psychology, heart rate, and blood pressure.

5.2. Forest Therapy Services

As mentioned above, forest therapy offers solutions to a number of public health problems, such as lifestyle disorders, stress, mental health problems, cardiovascular problems, etc., due to its documented health benefits [18]. The benefits and efficacy of forest therapy have been recognized by the public as a "bridge" between people and nature, facilitating people to enter the forest and return to nature, thereby improving health and well-being [21,58]. However, in different countries, due to the influence of development time, culture, and other factors, there are differences in the way and content of forest therapy services. For example, in Germany, forest therapy operations have matured, technology has been perfected, and public recognition has become high. Currently, forest therapy is being incorporated into the national medical and health system in Germany. In Japan, with the support of medical evidence, the service personnel training and industrial operation systems have become well developed and mature. In China, multiple government departments have begun to jointly establish policies to guide the gradual promotion and development of the entire ecological health industry, led by forest therapy. Other countries are also making significant efforts to implement forest therapy, presenting unique development characteristics. For example, in South Korea, the Forestry Culture and Recreation Act clarified the concepts of forest therapy and forest therapy program as well as the forest environment suitable for carrying out forest therapy. The form of legislation gives a strong impetus to the implementation of forest therapy.

5.3. Future Outlook

In the future, research focusing on the mechanisms of forest therapy needs to be prioritized. Collaborations between different disciplines need to be strengthened to quantitatively study the health benefits of specific forest environmental factors, such as phytoncide, negative ion particles, etc. [31]. In addition, from the perspective of landscape ecology, the forest and its environment are taken as a whole to focus on the effects of different types of forests on specific health benefits (such as immune system, endocrine system, nervous system, etc.), and verify whether different types of green space can produce similar health and well-being benefits.

Meanwhile, forest therapy service systems need to be improved. First, the concept of forest therapy should be clarified in the form of law, and the rights of protection and

utilization of resources related to forest therapy should be strictly regulated. To address the specific health needs of different groups of people, customized guiding policies need to be formulated, government capital investment must be increased, the construction of relevant forest therapy bases should be supported and standardized, and management certification should be conducted. Furthermore, as the training and certification system for forest therapists has been improved, the government can train forest guides who are familiar with the forest environment so they can guide the public to deeply integrate themselves into the forest and maximize the health benefits of nature. It is also necessary to enrich forest therapy service products and provide high-quality personalized experiences. In addition, there is also a need to integrate forest therapies with tourism and health services and to consider leisure and tourism as a potential way of developing and implementing forest therapy. Finally, on the basis of medical evidence, forest therapy should be incorporated into healthcare systems.

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